Appendix C

Modeling Protocols/Reports

This page left intentionally blank.

Dispersion Modeling Report

1-Hour SO_2 NAAQS Area Designation
D.E. Karn Generating Station
Consumers Energy Company

Prepared for:

Consumers Energy Company
1945 W. Parnall Road
Jackson, Michigan 49201

Prepared by:

Horizon Environmental Corporation
4771 50th Street SE, Suite One
Grand Rapids, Michigan 49512

July 15, 2015

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ATTACHMENTS

1 INTRODUCTION

On behalf of the Consumers Energy Company ("Consumers"), Horizon Environmental Corporation ("Horizon") has conducted ambient air quality dispersion modeling analyses to demonstrate that the area surrounding the D.E. Karn Generating Complex (SRN: B2840) is in attainment with the 1-hour sulfur dioxide ("SO_2") national ambient air quality standard ("NAAQS"). The dispersion modeling analyses were conducted in accordance with the relevant provisions of the draft *SO_2 NAAQS Designations Modeling Technical Assistance Document* (the "Modeling TAD", U.S. EPA, December 2013), the *Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standard* (U.S. EPA, March 20, 2015), and *Guidance for 1-Hour SO_2 Nonattainment Area SIP Submissions* (U.S. EPA, April 23, 2014). Moreover, the dispersion modeling analyses were conducted consistent with a protocol submitted to the Michigan Department of Environmental Quality, Air Quality Division ("AQD") on May 28, 2015 and subsequently approved by the U.S. EPA, Region 5.

This submittal constitutes the technical report summarizing the methodology and results of the dispersion model simulations that Consumers conducted in support of the 1-hour SO_2 NAAQS attainment designation. A description of the D.E. Karn ("Karn") Generating Complex, including a discussion of the SO_2 emissions data that were analyzed in support of the attainment designation, is provided in **Section 2**. The dispersion model, databases, and methodology employed in the analysis, as well as resultant model-predicted impacts, are detailed in **Section 3**.

1.1 REGULATORY FRAMEWORK FOR SO_2 AREA DESIGNATION

On June 2, 2010, the U.S. EPA established for the first time a primary 1-hour SO_2 NAAQS,[1] while at the same time revoking both the existing 24-hour and annual primary SO_2 NAAQS. Attainment with the new standard in an airshed is demonstrated when the 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average SO_2 concentrations does not exceed 75 ppb. To date, attainment designations have been established for 29 areas in 16 states. On March 2, 2015, the U.S. District Court for the Northern District of California entered a Consent Decree ("1-hour SO_2 NAAQS CD") and

[1] The 1-hour standard became effective on August 23, 2010.

issued an enforceable order for the U.S. EPA to complete its area designations according to a specified time schedule.

Based on current SO_2 emission levels, an attainment designation for the area surrounding the Karn Generating Complex must be completed no later than July 2, 2016. The U.S. EPA has requested that the states, including Michigan, submit their designation recommendations by September 18, 2015. Considering the accelerated submittal schedule and limited representative ambient monitoring data, designation recommendations for the area surrounding the Karn Generating Complex will be based on source modeling.

In contrast to a typical 1-hour SO_2 NAAQS compliance demonstration, the Modeling TAD recommends that an area designation request follow an ambient monitoring approach by conducting the modeling analyses as follows:

- Use actual emissions as an input for assessing violations to provide results that reflect current actual air quality;
- Conduct three years of modeling to calculate a simulated design value consistent with the 3-year monitoring period required to develop a design value;
- Place receptors only in locations where a monitor could be reasonably placed; and
- When simulating actual emission rates, use actual stack heights rather than stack heights based on good engineering practice (if different).

Upon the request of the AQD and in order to support them with their area designation recommendations, Consumers conducted air quality dispersion modeling analyses to assess compliance with the 1-hour SO_2 NAAQS in the area surrounding the Karn Generating Complex. Consumers followed the approach recommended in the Modeling TAD, deviating only to the extent that more site-specific guidance was provided by the U.S. EPA Region 5 or the AQD, or an emissions strategy more conservative than one based on actual emissions is sufficient to demonstrate attainment with the standard.

2 FACILITY DESCRIPTION

The Karn Generating Complex is located at 2742 North Weadock Highway, Essexville, Michigan. Emission units operating at the Karn Generating Complex are covered under ROP No. MI-ROP-B2840-2014, and Permit to Install No. 40-15. The location of the Karn Generating Complex in relation to the surrounding area is illustrated in **Figure 1**.

2.1 INVENTORY OF COMBUSTION SOURCES

It should be noted that the Karn Generating Complex is co-located with the JC Weadock Generating Complex ("JCW"), which is comprised of coal-fired utility boiler Units 7 and 8 and ancillary equipment. In November 2014, Consumers entered into a Consent Decree ("Consumers CD") with the Environmental Protection Agency (EPA) and Department of Justice ("DOJ") which requires JCW Units 7 and 8 be retired no later than April 15, 2016. Therefore, consistent with the 1-hour SO_2 NAAQS CD, no SO_2 emission sources associated with JCW were included in this modeling analysis.

The primary steam-generating units for electric generation at the Karn Generating Complex are identified as DEK1, DEK2, DEK3, and DEK4. These combustion units as well as other smaller combustion units operating at the Karn Generating Complex that have the potential to emit SO_2 (i.e., excluding units which are limited to firing natural gas only via enforceable restriction) are summarized as follows:

- One 2,500 MMBtu/hr coal-fired boiler with fuel oil startup ("DEK1");
- One 2,540 MMBtu/hr coal-fired boiler with fuel oil startup ("DEK2");
- One 7,290 MMBtu/hr dual fuel-fired boiler (fuel oil and natural gas) ("DEK3");
- One 8,030 MMBtu/hr dual fuel-fired boiler (fuel oil and natural gas) ("DEK4");
- One <500 Hp diesel-fired AC emergency generator engine;
- One <500 Hp diesel-fired DC emergency generator engine; and
- One <9 MMBtu/hr diesel-fired emergency generator engine.

Considering their heat input capacity, fuel type, and historical and projected operations, the area designation modeling analyses included emissions from DEK1, DEK2, DEK3, and DEK4. The three diesel-fired emergency generator engines are intermittent sources that operate only during emergency situations (or readiness testing). Readiness testing of the diesel-fired emergency generator engines generally occurs for a few minutes on a weekly basis. Actual operation of the three diesel-fired emergency generator engines for the previous two years (including approximately 7 hours of emergency run time in 2014 due to a station power trip) is summarized as follows:

2013

<500 HP AC Emergency Generator Engine – 13 hours
<500 HP DC Emergency Generator Engine – 24 hours
<9 MMBtu/hr Emergency Generator Engine – 4 hours

2014

<500 Hp AC Emergency Generator Engine – 25 hours
<500 Hp DC Emergency Generator Engine – 35 hours
<9 MMBtu/hr Emergency Generator Engine – 11 hours

Consistent with Section 5.4 of the Modeling TAD, modeling of intermittent sources was not conducted as part of the area designation analysis. Consumers also operates two 300 MMBtu/hr auxiliary natural gas-fired boilers that have no backup fuel capability. Consequently, the two boilers do not have the potential to emit significant quantities of SO_2 and were not included in the area designation analysis.

2.2 EMISSIONS CHARACTERIZATION

Pursuant to the Modeling TAD, area designation modeling may be conducted following an "actual emissions" approach or, if sufficient to demonstrate compliance with the 1-hour standard, a more conservative approach based on allowable emissions. Actual emissions data is beneficial for assessing whether an area has been in attainment with the 1-hour SO_2 NAAQS, but may have limited benefit looking forward if a source is in the process of implementing an emissions control strategy. In that event, future actual emissions will likely be much lower than recent historical actual emissions. Similarly, federally-enforceable allowable emission limits for the source are also typically lower after implementation of the control strategy.

2.2.1 Coal-Fired Units (DEK1 and DEK2)

Such is the case with the two coal-fired units, DEK1 and DEK2. On April 30, 2015, the AQD issued Permit to Install No. 40-15, which contains federally-enforceable emission limits and operating restrictions for the two coal-fired units based on the implementation of an enhanced SO_2 emissions control strategy mandated by the Consumers CD. As stipulated by the permit, DEK1 and DEK2 have each been equipped with a spray dry absorber ("SDA"), operation of which commenced on June 6, 2014 for DEK1 and May 20, 2015 for DEK2.

Historically, the only SO_2 emission limits for DEK Units 1-4 consisted of lb/mmBtu emission limits (calendar month average) which originated from Michigan Air Pollution Control Rule 336.1401. For DEK1 and DEK2, the Consumers CD introduces additional 30-day and 365-day rolling average SO_2 lb/mmBtu emission limits for each unit (there are no additional SO_2 limits for DEK3 and DEK4). For purposes of assessing the allowable SO_2 emission rates for DEK1 and DEK2, the 30-day rolling average SO_2 emission limits in the Consumers CD were simulated.

The historic SO_2 lb/mmBtu emission limits (based on Rule 336.1401) and the new 30-day rolling SO_2 emission limits for DEK 1 and 2 and resultant allowable mass emission rates for DEK1 and DEK2, as well as DEK3 and DEK4, are shown in **Table 1**. The effect of the emissions control strategy on the two coal-fired units is to reduce the SO_2 combined potential to emit of the four units from 25,422 pounds per hour to 17,459 pounds per hour (a 31% reduction).

2.2.2 Proposed 1-Hour Critical Emission Values

As shown in **Table 1**, the current permit-allowable emission limits for DEK1 and DEK2 are based on a monthly/30-day averaging period. Though there are currently no federally-enforceable hourly emission limits for the two units, the U.S. EPA's *Guidance for 1-Hour SO_2 Nonattainment Area SIP Submissions* provides a procedure for developing a 1-hour "critical emission value" from a longer-term average emission limit. After consultation with the AQD and the U.S. EPA Region 5, Consumers estimated 1-hour critical emission values for DEK1 and DEK2 following the U.S. EPA guidance.

Conceptually, the U.S. EPA guidance suggests that a determination of the variability in SO_2 emissions over longer-term averaging periods should be based on the final control configuration coupled with the emission limits. In this regard, historic CEMS data for DEK1 and DEK2 are unusable as these units have only limited actual emission data with the required SDA controls in place. However, an alternative approach based on a review of actual emissions data from similarly controlled emission units is provided in the guidance. Following the guidance, the proposed basis for developing a 1-hour critical emission value for each unit is described below.

DEK1 and DEK2 (Equipped with SDA Control)

Appendix D of the guidance provides useful information for translating between 30-day rolling average and 1-hour average emissions for units equipped with a SDA. Specifically, based upon a review of 90 different units equipped with a SDA, the U.S. EPA arrived at a ratio of 0.63 when comparing the 99th percentile of the 30-day rolling average SO_2 emission rates to the 99th percentile of the associated 1-hour average emission rates. Using the preceding ratio, the permit-allowable 30-day SO_2 emission limit for DEK1 and DEK2 can be translated to 1-hour critical emission values, as shown in **Table 2**.

2.2.3 Natural Gas/Fuel Oil-Fired Units (DEK3 and DEK4)

The two natural gas/fuel oil-fired units, DEK3 and DEK4, serve as peaker units that are rarely called upon for electric generation purposes. Moreover, the units rarely fired fuel oil during the 3-year study period (2012-2014). As noted previously, Units 3 and 4 share a common stack. During the 3-year study period, there were only a total of 1,450 clock hours during which the common stack was operating while Units 3 and/or 4 were in service. Of the preceding hours, only 191 were associated with some level of oil-firing in Units 3 and/or 4.

To model an emission rate based on the allowable SO_2 emission limit (or its equivalent 1-hour critical emission value) for these two units would not be representative of the SO_2 impact being created by the Karn Generating Complex during the 3-year period. Therefore, the area designation modeling analyses were conducted using the actual SO_2 emissions for the two units, as recorded by continuous emissions monitoring systems ("CEMS") installed on the common stack shared by these units, during the 3-year period. Initial model simulations to designate the area in attainment were conducted using the peak 1-hour SO_2 emission rate during the 3-year period[2]. This approach is a conservative representation of the DEK3 and DEK4 impact on SO_2 concentrations in the area and sufficient to support the 1-hour SO_2 NAAQS designation for the area. Consumers fully expects that modeling of actual hour-by-hour SO_2 emissions from the Karn Units 3 and 4 common stack would have yielded substantially lower overall SO_2 impacts for the facility.

[2] The peak 1-hour emission rate recorded by the CEMS during the period 2012-2014 is 6,481.1 lbs/hr for the common stack shared by DEK3 and DEK4 (corresponds to 08/14/2012, Hour 18:00).

Although modeling of hour-by-hour actual emissions has not been conducted, **Attachment A** includes an electronic spreadsheet containing the hourly CEMS data for the DEK3 and DEK4 common stack, while **Attachment B** summarizes any SO_2 or Flow CEMS missing hourly data associated with the three year period. The standard missing data substitution procedures contained in Subpart D of 40 CFR Part 75 was used for any periods of missing SO_2 mass emission rate or flow rate CEMS data. However, there was no CEMS missing data during the hour associated with the peak 1-hour SO_2 emission rate used in the modeling analysis.

3 DISPERSION MODEL AND MODELING DATABASES

Ambient air quality dispersion modeling analyses were conducted to demonstrate that the area surrounding the Karn Generating Complex should be designated in attainment with the 1-hour SO_2 NAAQS. The following sections summarize the dispersion model that was employed in the analysis, site area characteristics, modeling databases developed in support of the analysis, the methodology for conducting the compliance demonstration, and resultant modeled impacts.

3.1 DISPERSION MODEL

Model simulations in support of the 1-hour SO_2 NAAQS area designation were conducted using the AMS/EPA Regulatory Model ("AERMOD", Release No. 14134) [3]. AERMOD is currently recommended and approved for use in near-field SO_2 modeling applications by both the U.S. EPA and the AQD. AERMOD is designed to simulate conditions associated with this area designation, including:

- Rural dispersion conditions;
- Both windy and calm meteorological conditions;
- Flat and simple terrain;
- Elevated point sources influenced by building downwash;
- Transport less than 50 kilometers; and
- Concentration estimates over a one-hour averaging period.

The AERMOD simulations were conducted in the Regulatory Default mode.

3.2 LAND USE CLASSIFICATION AND DISPERSION MODE

Atmospheric conditions affecting the downwind dispersion of air contaminants may be influenced by localized land use. Further, an exponential decay of SO_2 may occur during dispersion in an urban environment. As a result, AERMOD has been designed to

[3] In their review of the dispersion modeling protocol, the U.S. EPA Region 5 noted the imminent release of a new version of AERMOD. As of the date of this submittal, the new version of AERMOD has not been released to the public and was, therefore, not available to be used in the analysis.

simulate the downwind dispersion of SO_2 under both rural and urban conditions. To assess whether to run AERMOD in rural or urban mode for a particular application, the U.S. EPA's Guideline on Air Quality Models suggests using either a population density procedure or a land use classification procedure employing a typing scheme developed by Auer[4]. Of the two methods, the U.S. EPA considers the land use procedure to be the more definitive.

The Auer land use classification procedure is conducted as follows:

1) Classify the land use within the total area, A_o, circumscribed by a three kilometer radius circle around the source using Auer's land use typing scheme;

2) If land use types I1, I2, C1, R2, and R3 account for 50 percent or more of A_o, use urban dispersion coefficients; otherwise, use appropriate rural dispersion coefficients.

Consistent with U.S. EPA guidance, Auer's land use typing scheme was utilized to assess localized land use for the Karn Generating Complex. The land use typing scheme is summarized in **Table 3**.

The Karn Generating Complex is located in Essexville, a town with a population of 3,478 (2010 Census) located between Bay City and Saginaw Bay. Utilizing satellite imagery, shown in **Figure 1**, land use within a three kilometer radius around the complex has been assessed and clearly exhibits rural characteristics (e.g., agricultural, common residential, and water surfaces). As a result, AERMOD simulations in support of the SO_2 NAAQS area designation for the Karn Generating Complex were conducted in rural mode.

3.3 AERODYNAMIC DOWNWASH EFFECTS

As described in Section 2.1, the SO_2 NAAQS area designation analysis for the Karn Generating Complex included the following emission units:

- Two coal-fired boilers (DEK1 and DEK2) that vent to individual 350 foot tall stacks; and

[4] Correlation of Land Use and Cover with Meteorological Anomalies, Journal of Applied Meteorology, 1978.

- Two natural gas and fuel oil-fired boilers (DEK3 and DEK4) that vent to a common stack with a height of 450 feet.

The three Karn stacks are each lower than Good Engineering Practice ("GEP") height. Plumes emitted from stacks with heights less than GEP design may be influenced by nearby buildings or other structures. In accordance with Section 6.1 of the Modeling TAD, the BPIP-PRIME aerodynamic downwash pre-processor (Release No. 04274) was utilized to estimate the maximum projected lateral and vertical dimensions of those buildings or structures that could influence the boiler stacks on a wind direction-specific basis.

BPIP-PRIME requires as input the dimensions of buildings or structures that could potentially influence emissions from a stack that is located at a distance less than five times the lesser dimension of height or projected width of the nearby structure. Maximum projected lateral and vertical dimensions of influencing structures, as calculated by BPIP-PRIME, are subsequently input to AERMOD. Two existing Boiler Houses and related structures have the potential to influence the plumes emitted from the boilers.

A three dimensional depiction of the two existing Boiler Houses and related structures that may influence plumes emitted from the modeled emission points is provided in **Figure 2**.

3.4 RECEPTOR POINTS AND TERRAIN ELEVATION

AERMOD-predicted concentrations may be estimated at discrete receptor locations. A discrete cartesian-based receptor grid was developed in support of the area designation analysis according to the following methodology:

- Receptors were located along the secured property boundary at distances not exceeding 50 meters.
- Receptors were located off-property at 100 meter spacing out to a distance of approximately 2 kilometers from the facility.
- Additional receptors were located off-property at 200 meter spacing out to a distance of approximately 10 kilometers from the facility.
- Additional receptors were located off-property at 500 meter spacing out to a distance of approximately 20 kilometers from the facility.
- Additional receptors were located off-property at 1 kilometer spacing out to a distance of approximately 50 kilometers from the facility.
- Consistent with the Modeling TAD, receptors were located only where a monitor could reasonably be placed. Therefore, receptors were not located over Saginaw

Bay or the inlet to the Saginaw River. Though not likely a reasonable location for an ambient monitor, receptors were located over Shelter/Channel Island.

In addition to the preceding rector grids, an additional "nested" receptor grid at 100 meter spacing was placed in the area of the maximum impacts based on the form of the 1-hour SO_2 NAAQS (i.e., 3-year average of the 99^{th} percentile daily 1-hour maximum concentrations) as these impacts were occurring beyond 2 kilometers from the facility.

Fenceline and nearby receptors are shown in **Figure 3**. The receptor grid used in the SO_2 NAAQS area designation analysis consisted of 15,240 discrete receptor points and is illustrated in **Figure 4**. The nested receptor grid, which was sufficient to identify the maximum impact based on the form of the 1-hour SO_2 NAAQS, consisted of 121 discrete receptor points and is illustrated in **Figure 5**.

Elevated terrain features may affect the transport of atmospheric contaminants as well as serve as areas of potentially higher pollutant impacts. Where appropriate, terrain features should be included in the modeling analysis. A review of topographic projection data reveals minor fluctuations in terrain elevations around the Karn Generating Complex. In accordance with U.S. EPA guidance, terrain elevations for each modeled stack and receptor point were included in the dispersion modeling analysis.

Terrain elevations at stack locations and discrete receptor points were obtained using the U.S. EPA's AERMAP preprocessor (Release No. 11103)[5] in conjunction with U.S.G.S National Elevation Dataset ("NED") terrain files in NAD83 format.

3.5 METEOROLOGICAL DATA

The form of the SO_2 NAAQS is based on a 3-year average of the annual 99^{th} percentile of the 1-hour daily maximum concentrations. Consistent with the Modeling TAD, the area designation analysis was conducted using the most spatially representative and readily available meteorological database that coincides with the period covering the emissions data for the Karn Generating Complex (2012-2014).

The Karn Generating Complex is located approximately 14 miles northeast of the National Weather Service ("NWS") Automated Surface Observing System station in

[5] Terrain processing was conducted using the AERMAP module of the AERMODView software system, Version 8.8.9, developed by Lakes Environmental.

Saginaw ("MBS", Station No. 14845). A three-year composite wind rose for MBS, covering the years 2012-2014, is provided in **Figure 6**. The wind frequency distribution revealed in the figure shows wind flow patterns that would be expected to occur at a facility located along the southwestern shoreline of Saginaw Bay (i.e., predominate wind flow from the west, southwest, south, as well as northeast along the fetch of the bay).

Using the AERMET preprocessor, the AQD has compiled surface observations from MBS for the period 2012-2014 with coincident upper air observations measured at NWS station at White Lake, Michigan (Station No. 72632). Consumers used the MBS/White Lake meteorological database, as processed and provided by the AQD in a 1-minute format, in the SO_2 NAAQS area designation analysis.

3.6 DISPERSION MODELING METHODOLOGY AND RESULTANT IMPACTS

Dispersion model simulations of the Karn Generating Complex were conducted to provide the information necessary to designate the area in attainment with the 1-hour SO_2 NAAQS. The model simulations were conducted with AERMOD using a three-year meteorological database (2012-2014 MBS/White Lake). As described in **Section 2.2**, the simulations were based on the critical 1-hour allowable emission rate for the two primary boilers (DEK1 and DEK2) and the peak 1-hour actual emission rate measured in the common stack serving the two peaker boilers (DEK3 and DEK4) during the three-year period. Stack exhaust parameters for the modeled emission units is provided in **Table 4**.

The first step in the modeling analysis was to compare maximum predicted 1-hour impacts at each receptor point against the interim 1-hour significant impact level ("SIL") of 3 ppb (7.8 $\mu g/m^3$) published in the *"General Guidance for Implementing the 1-hour SO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour SO_2 Significant Impact Level"* (U.S. EPA, August 23, 2010). Maximum predicted 1-hour SO_2 impacts across the three-year meteorological database are summarized in **Table 5**. As shown in the table, the maximum of the three-year average of the maximum 1-hour SO_2 concentrations is 122.2 $\mu g/m^3$, which is well above the SIL.

Cumulative modeling analyses, taking into account additional sources that could contribute to the area of significant impacts (i.e., receptor points where model-predicted impacts are greater than the SIL) generated by the facility are typically conducted for each receptor point contained within the significant impact area ("SIA"). The AQD has conducted an analysis of additional sources in the area around the Karn Generating Complex and has determined that none of the sources is expected to have a significant impact within the Karn Generating Complex SIA. Therefore, no additional sources were included in the area designation modeling.

In order to assess compliance with the 1-hour SO_2 NAAQS, the model calculates the 99th percentile of the annual distribution of daily maximum 1-hour average SO_2 concentrations across the three-year meteorological database. As part of a cumulative modeling analysis, this design concentration is subsequently combined with a representative background design concentration. If this combined impact is less than 75 ppb (196 µg/m^3), then the area is designated as being in attainment with the 1-hour SO_2 NAAQS.

The AQD has provided a background design concentration of 17.9 ppb (46.9 µg/m^3). This value represents the 99th percentile 1-hour SO_2 concentration measured at the Lansing ambient monitor for the period 2012-2014. As a conservative "first tier" approach, this background design concentration was combined with the modeled design concentration.

Adhering to the form of the standard, the 99th percentile of the annual distribution of daily maximum 1-hour average SO_2 concentrations across the three-year meteorological database was predicted by AERMOD at 75.7 µg/m^3. Summing the model-predicted impact with the AQD-provided background concentration results in a combined impact of 122.5 µg/m^3, which is well under the 1-hour SO_2 NAAQS of 196 µg/m^3 (75 ppb). Therefore, dispersion modeling analyses have demonstrated that the area surrounding the Karn Generating Complex is in attainment with the 1-hour SO_2 NAAQS.

Modeled impacts are compared against the 1-hour SO_2 NAAQS in **Table 6**. The location of the 99th percentile daily 1-hour maximum concentration is shown in **Figure 7**. An electronic copy of all AERMOD and model preprocessor input/output files is submitted along with this technical report on DVD-ROM.

FIGURES

Figure 1
Location of
D.E. Karn – J.C. Weadock Generating Complex
Essexville, Michigan

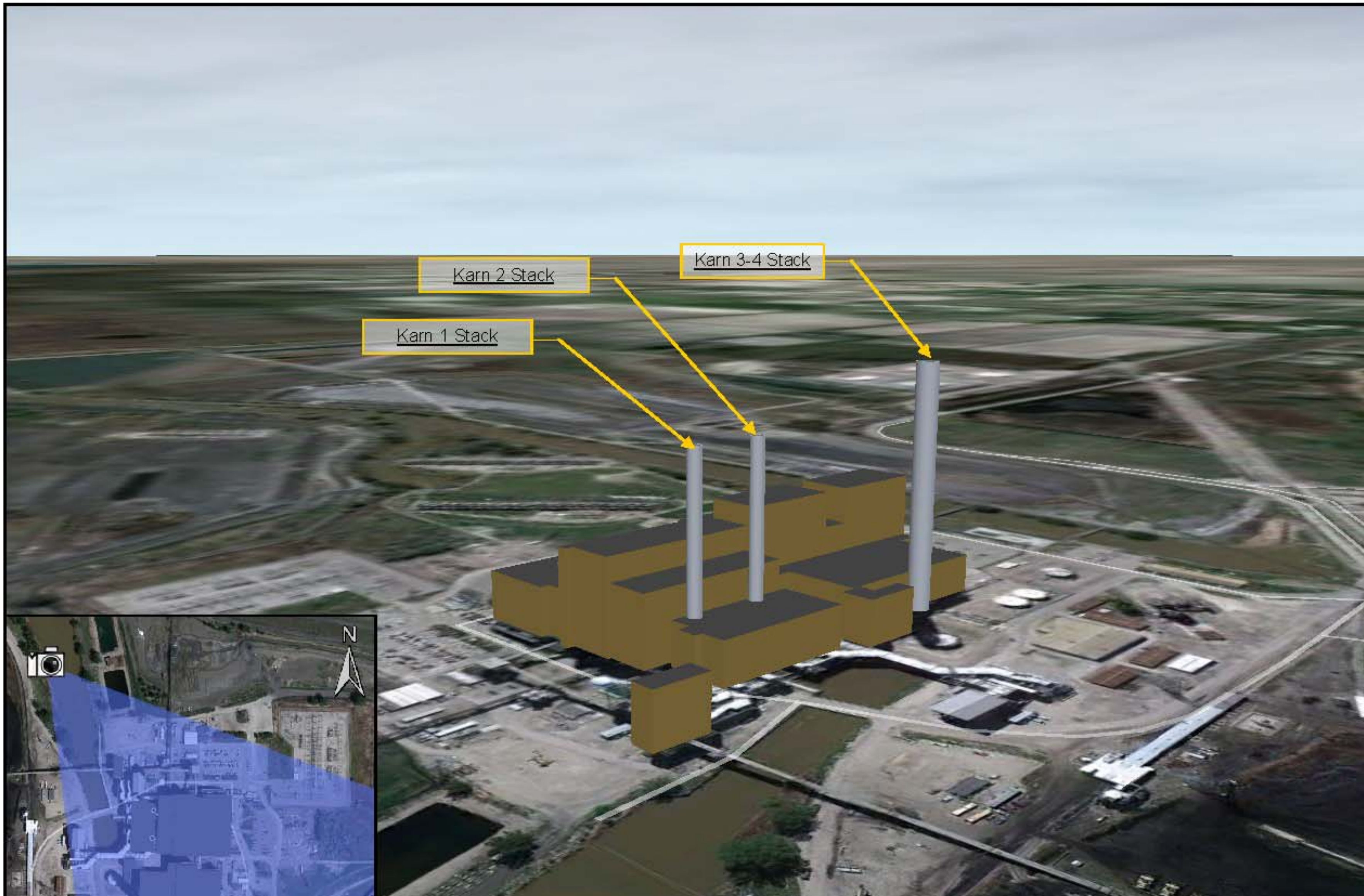


Figure 2
3D View of D.E. Karn Structures Considered in the Plume Downwash Analysis
D.E. Karn – J.C. Weadock Generating Complex
Essexville, Michigan

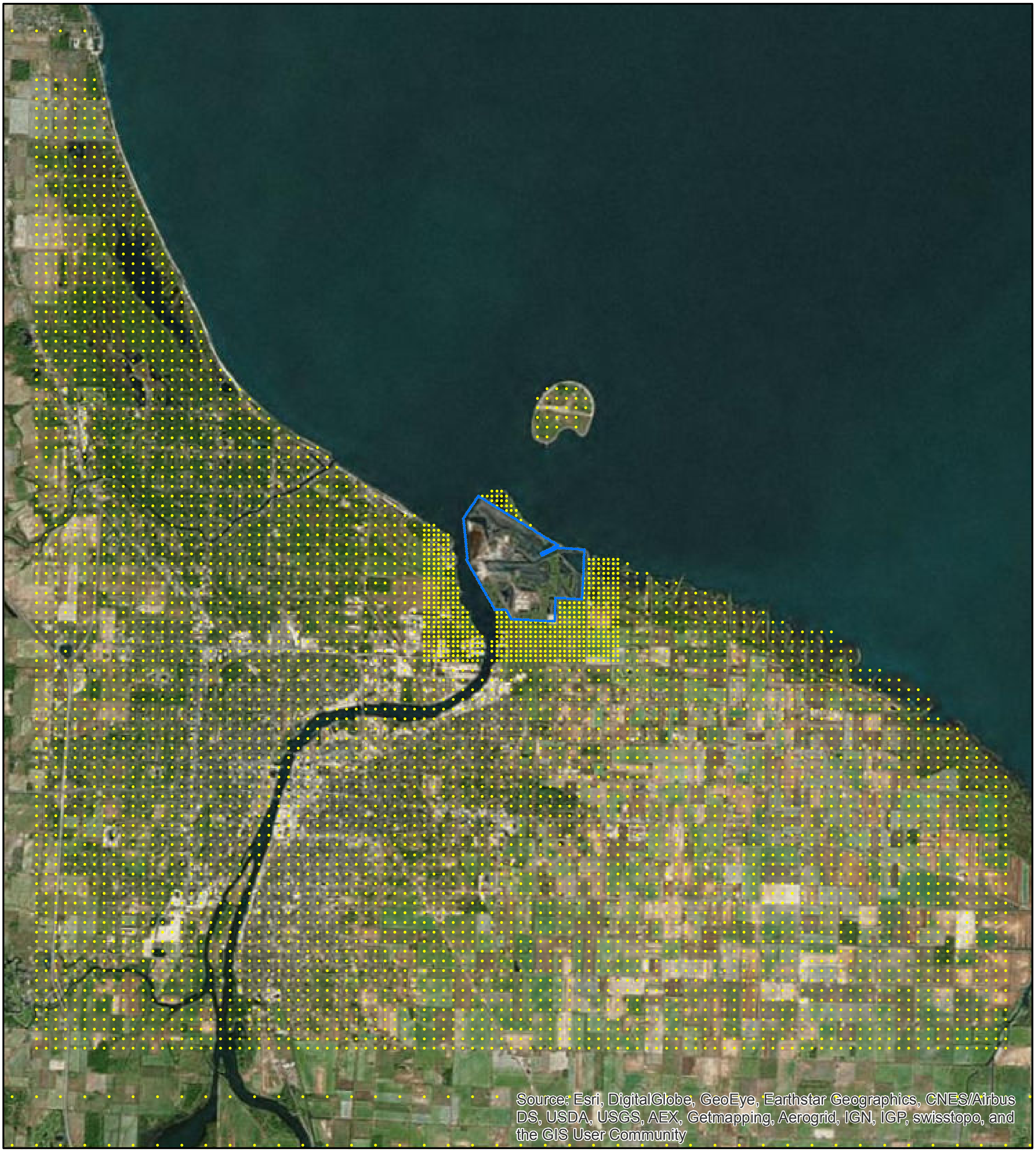


Figure 3
Fenceline and Nearby Receptors
D. E. Karn - J. C. Weadock Generating Complex

0 1,500 3,000 6,000 9,000 Meters

HORIZON ENVIRONMENTAL

July 2015

V:\GIS\Consumers\Karnl\Layouts\Zoom_In_Grid.mxd

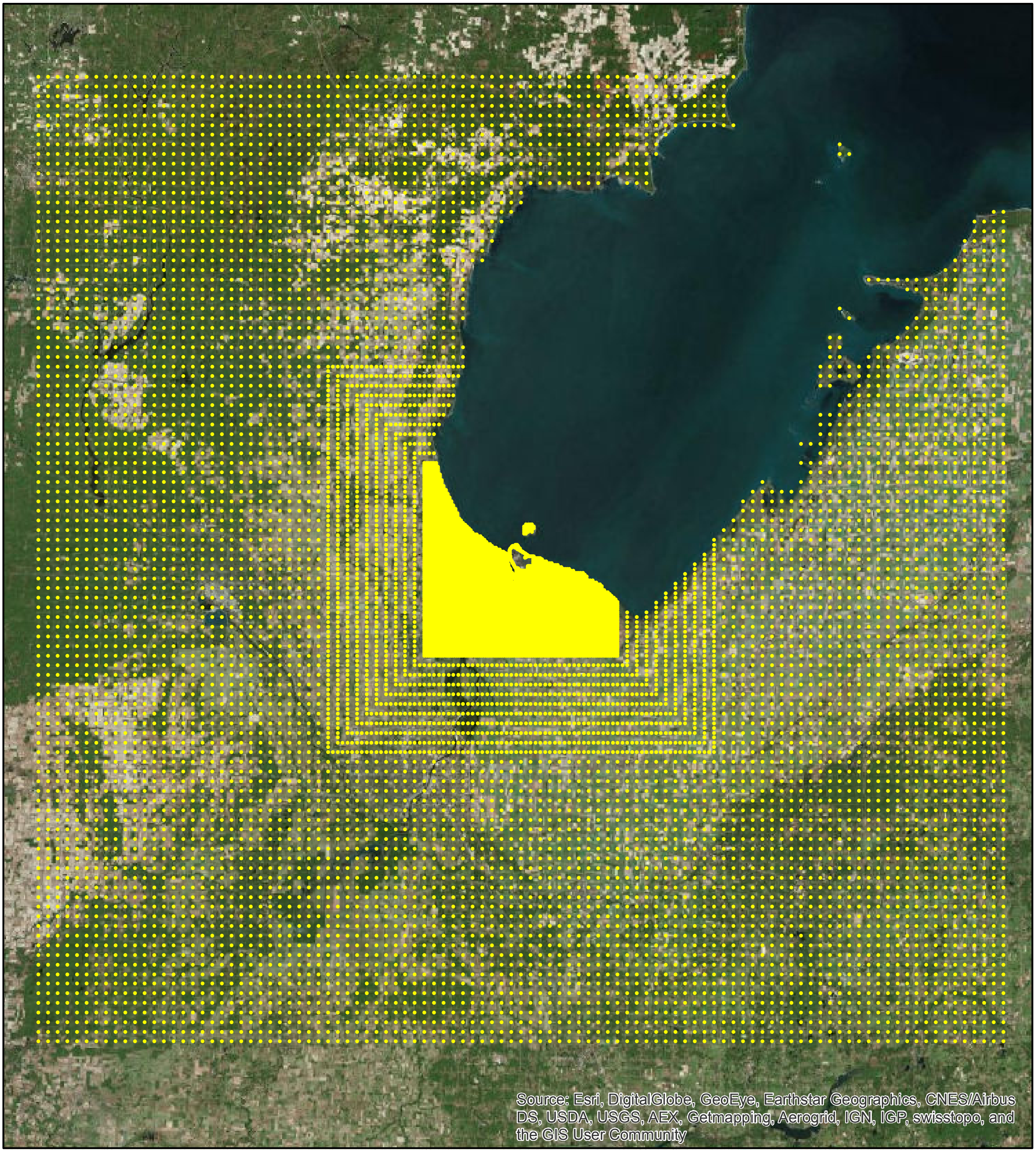


Figure 4
Receptor Grid Used in the
SO2 Area Designation Analysis
D. E. Karn - J. C. Weadock Generating Complex

0 7,500 15,000 30,000 45,000 Meters

HORIZON ENVIRONMENTAL

July 2015

V:\GIS\Consumers\Karnl\Layouts\50Km_Grid.mxd

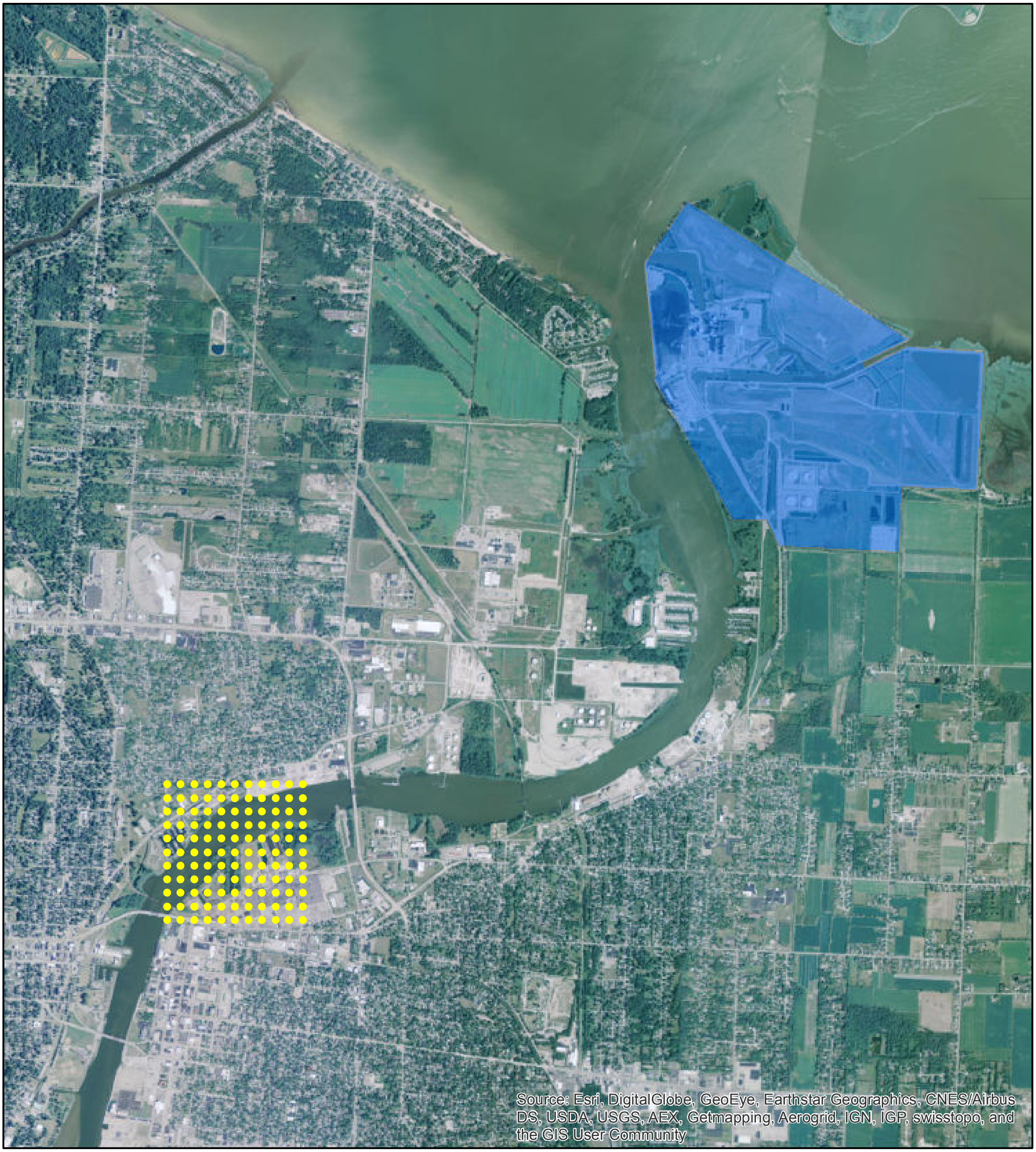


Figure 5
Nested Receptor Grid Used in the SO2 Area Designation Analysis D. E. Karn - J. C. Weadock Generating Complex

0 500 1,000 2,000 Meters

HORIZON ENVIRONMENTAL

July 2015

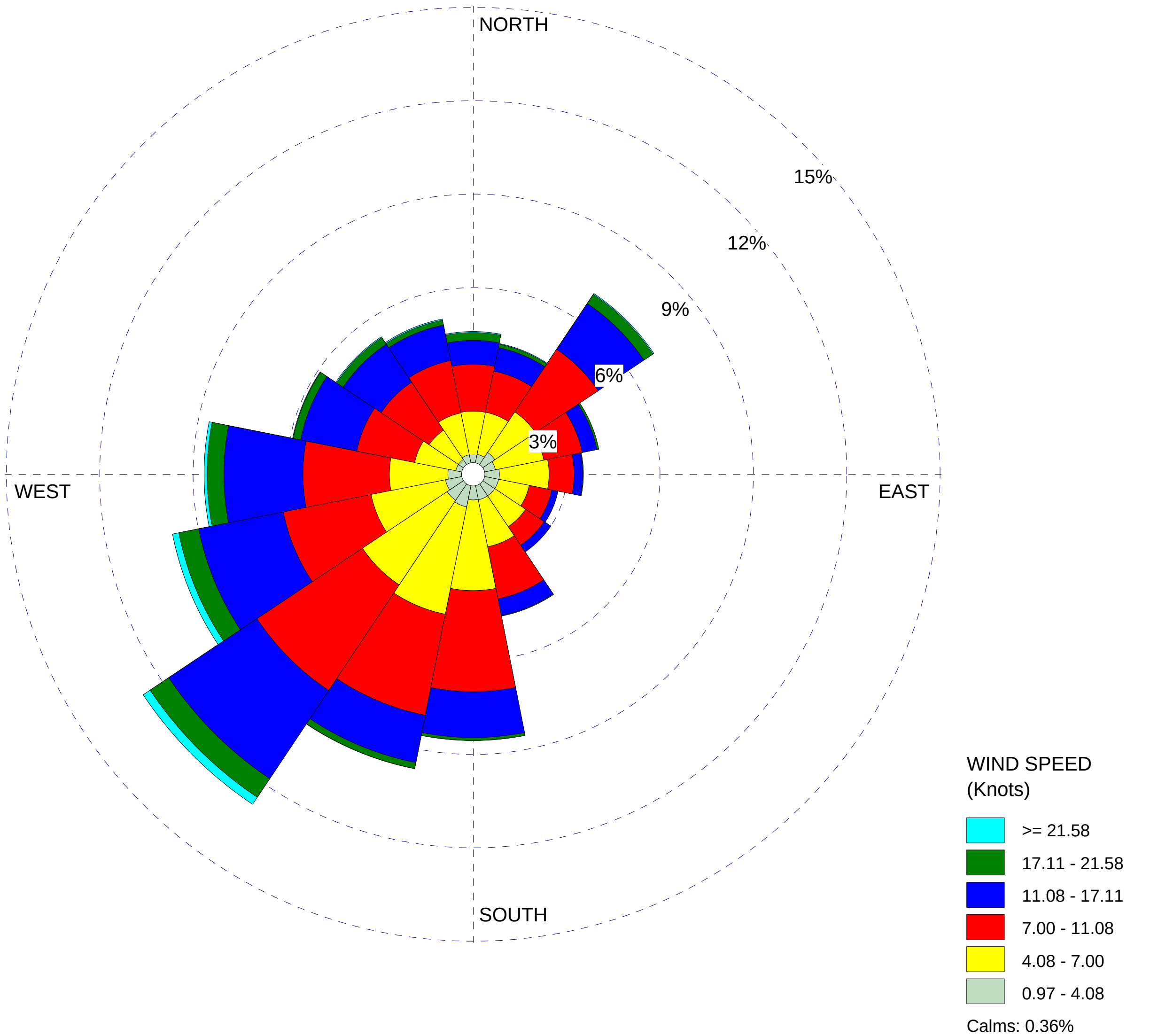
V:\GIS\Consumers\Karn\Layouts\Nested_Grid.mxd

WIND ROSE PLOT:

Figure 6 - Three Year Composite Wind Rose
Saginaw (2012-2014)

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/1/2012 - 00:00 **End Date: 12/31/2014 - 22:00**	**Horizon Environmental Corporation**	
	CALM WINDS: **0.36%**	TOTAL COUNT: **26260 hrs.**	
	AVG. WIND SPEED: **8.59 Knots**	DATE: **7/15/2015**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

Figure 7
Location of the 99th Percentile
Daily 1-Hour Maximum SO2 Impact
D. E. Karn - J. C. Weadock Generating Complex

0 5,000 10,000 20,000 Meters

HORIZON ENVIRONMENTAL

July 2015

V:\GIS\Consumers\Karnl\Layouts\SO2_Impact_Contour.mxd

TABLES

TABLE 1
SUMMARY OF SO_2 EMISSION LIMITS
CONSUMERS ENERGY COMPANY - D.E. KARN GENERATING COMPLEX

Emission Unit ID	Nominal Heat Input Rating (MMBtu/hr)	Primary Fuel	Alternate Fuel	Maximum Allowable Emissions (lbs/MMBtu)				Potential to Emit (lbs/hr)	
				Historic Limit [1]		Consumers CD Limit [2]			
				Numerical Limit	Averaging Period	Numerical Limit	Averaging Period	Based on Historic Limit	Based on Consumers CD Limit
EUKARN1 (DEK1)	2,500	Coal	Fuel Oil	1.67	Monthly	0.090	30-day rolling	4,175	225.0
EUKARN2 (DEK2)	2,540	Coal	Fuel Oil	1.67	Monthly	0.090	30-day rolling	4,242	228.6
EUKARN3 (DEK3)	7,290	Fuel Oil	Natural Gas	1.11	Monthly	NA	NA	8,092	NA
EUKARN4 (DEK4)	8,030	Fuel Oil	Natural Gas	1.11	Monthly	NA	NA	8,913	NA
							Total:	**25,422**	**454**

Notes:

1. The historic SO_2 emission limits for DEK 1-4 are based upon Michigan Air Pollution Control Rule 336.1401.
2. The Consumers CD Limits for DEK1 and DEK2 are stipulated under Permit to Install No. 40-15 and mandated by a federal Consent Decree. If the Consent Decree contains more than one SO_2 emission limit for a given boiler, this table reflects the SO_2 emission limit with the shortest averaging period.

TABLE 2
DEVELOPMENT OF CRITIAL 1-HOUR SO_2 EMISSION RATES [1]
CONSUMERS ENERGY COMPANY - D.E. KARN GENERATING COMPLEX

Emission Unit ID	Nominal Heat Input Rating (MMBtu/hr)	Permit-allowable Emisssion Limt Per Consumers CD (lb/MMBtu)	Associated Averaging Period	Equivalent SO_2 Mass Emission Rate for the Specified Averaging Period (lbs/hr)	Ratio Between the Averaging Period Associated with the Consumers CD Limit and a 1-hr Averaging Period [2]	Equivalent SO_2 Mass Emission Rate Based on a 1-hour Averaging Period (lbs/hr)
EUKARN1 (DEK1)	2,500	0.090	30-day rolling	225.0	0.630	357.1
EUKARN2 (DEK2)	2,540	0.090	30-day rolling	228.6	0.630	362.9

Notes:

1. Analysis conducted in accordance with the Guidance for 1-Hour SO_2 Nonattainment Area SIP Submissions (U.S. EPA, April 23, 2014).
2. Ratio for DEK1 and DEK2, which are each equpped with SDA control, was obtained from data provided in Appendix D of the U.S. EPA guidance.

TABLE 3
AUER LAND USE CLASSIFICATION SCHEME
CONSUMERS ENERGY COMPANY

Type	Use	Description	
		Structures	Vegetation
I1	Heavy Industrial	Major chemical, steel and fabrication industries; generally 3-5 story buildings, flat roofs.	Grass and tree growth extremely rare; <5% vegetation.
I2	Light-Moderate Industrial	Rail yards, truck depots, warehouses, industrial parks, minor fabrications; generally 1-3 story buildings, flat roofs.	Very limited grass, trees almost total absent; <5% vegetation.
C1	Commercial	Office and apartment buildings, hotels; >10 story heights, flat roofs.	Limited grass and trees; <15% vegetation <15% vegetation.
R1	Common Residential	Single family dwelling with normal easements; generally one story, pitched roof structures; frequent driveways.	Abundant grass lawns and light-moderately wooded; >30% vegetation.
R2	Compact Residential	Single, some multiple, family dwelling with close spacing; generally <2 story, pitched roof structures; garages (via alley), no driveways.	Limited lawn sizes and shade trees; <30% vegetation.
R3	Compact Residential	Old multi-family dwellings with close (<2 m) lateral separation; generally 2 story, flat roof structures; garages (via alley) and ashpits, no driveways.	Limited lawn sizes, old established shade trees; <35% vegetation.
R4	Estate Residential	Expansive family dwelling on multi-acre tracts.	Abundant grass lawns and lightly wooded; >80% vegetation.
A1	Metropolitan Natural	Major municipal, state, or federal parks, golf courses, cemeteries, campuses; occasional single story structures.	Nearly total grass and lightly wooded; >95% vegetation.
A2	Agricultural Rural		Local crops (e.g., corn, soybean); >95% vegetation.
A3	Undeveloped	Uncultivated; wasteland.	Mostly wild grasses and weeds, lightly wooded; >90% vegetation.
A4	Undeveloped Rural		Heavily wooded; >95% vegetation.
A5	Water Surfaces	Rivers, lakes.	

Notes:

1. Land use typing scheme recommended by Auer for use in assessing the most applicable dispersion coefficient.

TABLE 4
STACK EXHAUST PARAMETERS AND MODELED EMISSION RATES
CONSUMERS ENERGY COMPANY - D.E. KARN GENERATING COMPLEX

Source ID	Stack Coordinate [1] (UTM)		Emission Rate		Stack Height [2]		Stack Diameter [2]		Exit Gas Temperature		Exhaust Flow Rate	Exit Velocity
	Easting	Northing	(lbs/hr)	(g/s)	(ft)	(m)	(in)	(m)	(F)	(K)	(acfm)	(m/s)
EUKARN1-S1 [3]	270869.8	4836365.2	357.1	45.0	350	106.7	216	5.49	160	344.3	910,400	18.17
EUKARN2-S1 [3]	270867.3	4836323.3	362.9	45.7	350	106.7	216	5.49	160	344.3	910,400	18.17
EUKARN3-S2 [4]	270844.0	4836215.3	6,481.1	816.6	450	137.2	414	10.52	541	555.9	6,228,810	33.85

Notes:

1. UTM Coordinates obtained using aerial imagery in NAD 83 format.
2. Stack height and diameter for each emission unit limited under the ROP.
3. Stack temperature and exhaust flow data for DEK1 and DEK2 are based upon SDA design values at full load on the typical coal blend.
4. Stack temperature and exhaust flow data for the DEK3 and DEK4 common stack are based upon CEMS data for 08/14/2012, Hour 18:00 which corresponds to the maximum observed common stack SO_2 mass emission rate (6,481.1 lbs/hr) for the period 2012-2014.

TABLE 5
COMPARISON OF MODELED SO_2 CONCENTRATIONS TO THE 1-HOUR SIGNIFICANT IMPACT LEVEL
CONSUMERS ENERGY COMPANY - D.E. KARN GENERATING COMPLEX

Averaging Period	Year	Modeled Receptor Location UTM Coordinate (m)		1st Highest 1-Hour SO_2 Impact [1] (ug/m^3)	SIL [2] (ug/m^3)
		Easting	Northing		
1-Hour	2014	265525	4835077	143.4	**7.9**
	2013	261525	4838477	143.0	
	2012	266925	4834077	180.9	
	Maximum of the Three Year Average of the Maximum 1-Hour Concentrations (ug/m^3):			**122.2**	

Notes:

1. Model simulations conducted using AERMOD over a three-year meteorological dataset (MBS Airport Surface/White Lake Upper Air).
2. The Significant Impact Level (SIL) is an interim value published in the *"General Guidance for Implementing the 1-hour SO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour SO_2 Significant Impact Level"* (U.S. EPA, August 23, 2010).

TABLE 6
COMPARISON OF MODELED SO_2 CONCENTRATIONS TO THE 1-HOUR NAAQS
CONSUMERS ENERGY COMPANY - D.E. KARN GENERATING COMPLEX

Averaging Period	Year	Modeled Receptor Location UTM Coordinate (m)		4^{th} Highest Daily Max. 1-Hour SO_2 Impact [1] (ug/m^3)	Background Concentration [2] (ug/m^3)	Combined SO_2 Impact (ug/m^3)	NAAQS (ug/m^3)
		Easting	Northing				
1-Hour							
Maximum of the Three Year Average of the 4^{th} Highest (99^{th} Percentile) Daily 1-Hour Maximum Concentrations (ug/m^3):				75.7	46.9	122.6	196

Notes:
1. Model simulations conducted using AERMOD over a three-year meteorological dataset (MBS Airport Surface/White Lake Upper Air).
2. A background concentration of 46.9 ug/m^3 (17.9 ppb) was provided by the MDEQ-AQD.

ATTACHMENT A

CONTINUOUS EMISSIONS MONITORING DATA AND DISPERSION MODELING INPUT/OUTPUT FILES (DVD-ROM)

ATTACHMENT B

SUMMARY OF CEMS MISSING HOURLY SO_2 AND/OR FLOW DATA DURING THE 2012-2014 PERIOD (MODELED HOURLY VALUES BASED ON THE STANDARD 40 CFR PART 75, SUBPART D, MISSING DATA SUBSTITUTION PROCEDURES)

Missing Data Substitution Hours

Plant: KARN34

Report Period: 01/01/2012 00:00 Through 12/31/2014 23:59

Source: KARN34 **Units:** SCFH

Parameter: FLOW

Date	Hour	Avg Value	MC	Load Range	PMA	QA Hours
09/11/2012	15	40971158.3	2	2	99.7	6751

Number of Missing Hours for KARN34 FLOW: 1

Source: KARN34 **Units:** PPM

Parameter: SO2

Date	Hour	Avg Value	MC	Load Range	PMA	QA Hours
12/26/2012	07	2	6	1	99.6	6949
02/26/2013	17	2	6	1	99.7	8005
02/26/2013	18	2	6	1	99.7	8005
11/27/2013	04	2	6	1	99.7	8654
11/27/2013	05	2	6	1	99.7	8654
12/06/2013	11	2	6	1	99.7	8645
12/06/2013	12	2	6	1	99.7	8645
05/28/2014	22	2	6	1	99.7	8670
05/28/2014	23	2	6	1	99.7	8670
10/30/2014	22	2	6	1	99.9	7780
10/30/2014	23	2	6	1	99.9	7780

Number of Missing Hours for KARN34 SO2: 11

Total Number of Missing Hours for KARN34: 12

Grand Total Number of Missing Hours: 12

Sulfur Dioxide (SO_2) NAAQS Designation Dispersion Modeling

Support Document

Lansing Board of Water and Light
Lansing, Michigan

NTH Project No. 73-150188-01
July 7, 2015
Revised: July 22, 2015

NTH Consultants, Ltd.
608 S. Washington Avenue
Lansing, MI 48933

NTH

Table of Contents

ACEC MEMBER

NTH Consultants, Ltd.
608 S. Washington Avenue
Lansing, MI 48933
Phone: (517) 484-6900 · Fax: (517) 484-2909
www.nthconsultants.com

Table of Contents (continued)

TABLES

APPENDICIES

ACEC MEMBER

NTH Consultants, Ltd.
608 S. Washington Avenue
Lansing, MI 48933
Phone: (517) 484-6900 · Fax: (517) 484-2909
www.nthconsultants.com

1.0 INTRODUCTION

Lansing Board of Water and Light (BWL) has retained NTH Consultants, Ltd. (NTH) to assist in conducting dispersion modeling for sulfur dioxide (SO_2) from the existing BWL Eckert and Erickson Power Stations. Specifically, the U.S. Environmental Protection Agency (U.S. EPA) is addressing areas within multiple states that have larger sources of SO_2 emissions and determining if those areas are designated as in attainment or nonattainment with the 1-hour SO_2 National Ambient Air Quality Standard (NAAQS). State air agencies can use either monitoring or dispersion modeling to characterize the SO_2 air quality.

For Lansing, Michigan, preliminary dispersion modeling performed by the Michigan Department of Environmental Quality (MDEQ) Air Quality Division (AQD) utilizing actual SO_2 emissions shows that individual facilities in the area meet the 1-hour SO_2 NAAQS. Additionally, the nearby SO_2 ambient monitor supports attainment designation for the area. However, there is concern that multi-source allowable emissions may contribute to localized "hot spots" that do not meet the 1-hour SO_2 NAAQS. U.S. EPA has indicated that they would consider "weight of evidence" material if combined impact hot spots are close to the standard when using allowable emissions and all emission reductions have been vetted.

This compliance demonstration is being submitted for the purpose of refined dispersion modeling of SO_2 emissions from the BWL Erickson and Eckert facilities for comparison to the 1-hour SO_2 NAAQS. The modeling was conducted pursuant to the U.S. EPA DRAFT SO_2 NAAQS Designations Modeling Technical Assistance Document (TAD), dated December 2013.

The following sections provide a detailed description of the compliance demonstration.

2.0 FACILITY DESCRIPTION

The following sub-sections contain descriptions of the Eckert and Erickson stations.

2.1 Eckert Station

BWL Eckert facility consists of six (6) pulverized coal and fuel oil-fired boilers with electric generator units. Three (3) of the units are capable of producing steam for sale in addition to electric generation. One of the six (6) units (EUBOILER2) was permanently retired on March 31, 2014 and, therefore, was not included in the modeling pursuant to the letter entitled "Update on the EPA's next steps to implement the primary National Ambient Air Quality Standard for sulfur dioxide set in 2010," dated March 20, 2015 from U.S. EPA's Acting Assistant Administrator Janet McCabe. The five (5) remaining units were included in the model. Each of the remaining units utilize an electrostatic precipitator (ESP) to control emissions of particulate matter (PM), and utilize overfire air and low NO_x burners for control of nitrogen oxides (NO_x). BWL also has four (4) coal-fired stoker boilers adjacent to the Eckert units on the same property (i.e. the Moores Park Station); however these units have been decommissioned and were not included in the modeling.

The Eckert Station is located in Ingham County along the Grand River in central Lansing. See Appendix A, Figure 1 for a site layout showing the location of the Eckert boiler units, including a fenced property boundary.

Located adjacent to the existing Eckert and Moores Park Station is Lansing BWL's new REO Town combined heat and power (CHP) plant. The CHP plant is designed as a combined-cycle, cogeneration facility consisting of two natural gas-fired turbines, two heat recovery steam generators with duct burners, steam turbines, a natural gas-fired auxiliary boiler and a four cell mechanical draft cooling tower. The CHP plant has replaced the four coal-fired stoker boilers and steam production capacity that was formally supplied by the Moores Park Station.

2.2 Erickson Station

BWL Erickson facility consists of one (1) pulverized coal-fired boiler with a turbine generator unit. The boiler is equipped with an ESP to control emissions of PM, and utilizes overfire air and low NO_x burners for control of NO_x emissions. The coal boiler was the only unit modeled from the Erickson Station; however, the facility also contains ash handling equipment and an ultra-low sulfur diesel fired auxiliary boiler (EUAUXBLR) rated at 20.9 million British thermal units per hour (MMBtu/hr) that is used to maintain building temperature if the large boiler is offline.

The auxiliary boiler is not fired unless the main unit is not operating for long stretches and if the outside temperature is too cold to create problems in the building. The auxiliary boiler has been permitted as a limited-use boiler under the Boiler MACT in Permit to Install (PTI) No. 71-15. It now has an enforceable capacity factor 10% by heat input. The unit has fuel sulfur content restrictions (1 percent maximum) in the facility Renewable Operating Permit (ROP) to reduce potential emissions of SO_2. The unit uses ultra-low sulfur diesel fuel, and actual fuel sulfur content was below 0.02 percent each year for 2012-2014. Total fuel usage during this time was less than 25,000 gallons per year. This means that during the worst case year (2014) the unit emitted 31 pounds of sulfur based on the U.S. EPA AP-42 emission factor (0.015 tons per year). The unit is rated at 149 gallons per hour, and could emit at most, approximately 0.4 pounds per hour (lb/hr) of SO_2 based on the maximum 0.017 percent fuel sulfur content. Therefore, the auxiliary boiler was not included in the model since SO_2 emissions are very small in comparison to the coal boiler.

Additionally, the ash handling equipment was not modeled since it does not produce SO_2 emissions.

The facility is located in Eaton County on the southwest side of Lansing. See Appendix A, Figure 2 for a site layout including a fenced property boundary.

The following sections outline the model and methodologies used for the SO_2 modeling demonstration.

3.0 MODEL

On November 9, 2005, the U.S. Environmental Protection Agency (U.S. EPA) promulgated the use of the AMS/EPA Regulatory Model Improvement Committee (AERMIC) Model (AERMOD) for all regulatory applications requiring an ambient impact demonstration.

AERMOD is a steady-state Gaussian model capable of handling multiple source inputs and producing concentration impacts from point, area, volume, and open-pit sources. AERMOD is also capable of handling numerous source configurations, building inputs, receptor grids and elevated terrain.

The most current version of the AERMOD source code (version 14134) was used for this compliance demonstration. Also included in the current version are the most recent versions of AERMET and AERMAP (refer to Sections 7 and 8 for more detail on these features). In addition, AERMOD includes the U.S. EPA BPIP-PRIME program, which is based on the design building configurations and stack heights. Therefore, all impacts due to plume downwash, including impacts occurring within cavity regions of any building, were directly addressed within the AERMOD modeling system.

Only regulatory default options within AERMOD for the dispersion modeling analysis were used.

3.1 Proprietary Model Information

NTH has a license agreement with Lakes Environmental Software, Inc. for the AERMOD model. Lakes Environmental's ISC-AERMOD View was used for this compliance demonstration. This software is a graphical user interface (GUI) to the AERMOD model and provides the user with input screens for ease in setting up the model run stream, and viewing inputs and outputs through a graphical viewer. AERMOD View uses the U.S. EPA build of the AERMOD model. It produces results equivalent to running the model without a software interface. The textual input and output files, as well as the ISC-AERMOD View file (*.isc) are provided electronically to the MDEQ.

4.0 EMISSIONS CHARACTERIZATION

Pursuant to the TAD, the dispersion model utilized the three (3) most recent years of variable actual emissions data (2012-2014). Emissions have been obtained from the Eckert and Erickson boilers continuous emissions monitoring systems (CEMS). Emissions data was provided by BWL.

The variable emission rates were incorporated into the model utilizing the HOUREMIS keyword in the source pathway of the AERMOD input file. Specifically, CEMS data was uploaded via the Source Pathway and processed into an hourly emission file (i.e. filename.emi). For proper model execution, the file contains the exact hours matching the meteorology data file (meteorology is discussed further in Section 7). The variable emissions override any emission rate entered for SRCPARAM in the AERMOD input file. Table 1 summarizes variable emission rates that were used in the model.

Table 1. Summary of 3-Year (2012-2014) Variable Emissions at the Eckert and Erickson Power Stations

Source	Maximum 3-Year Emissions (lb/hr)	Average 3-Year Emissions (lb/hr)	Total 3-Year Emissions (lb)
EUBOILER1[1]	535	34	873,932
EUBOILER3[1]	497	68	1,773,919
EUBOILER4[1]	932	163	4,268,261
EUBOILER5[1]	976	109	2,872,925
EUBOILER6[1]	843	235	6,157,544
EU001[2]	5,484	788	20,450,596

[1] Boiler is located at the Eckert Power Station.

[2] Boiler is located at the Erickson Power Station.

Missing data was obtained using standard U.S. EPA data substitution procedures from 40 CFR Part 75. Hourly temperature and velocity data are not available.

Table 2 summarizes the continuous emission rates that were used in the model for units emitting SO_2 from the combined heat and power (CHP) REO Town plant located adjacent to the Eckert and Moores Park Station.

Table 2. Summary of Continuous Emission Rates at the REO Town Plant

Source	Continuous Emissions (lb/hr)
EUAUXBOILER	0.1
EUNGENGINE	0.0075
EUTURBINE1[1]	0.7
EUTURBINE2[1]	0.7
EUHRSG1[2]	0.7
EUHRSG2[2]	0.7

[1] EUTURBINE1 and EUTURBINE2 are in the model as BYPASS1 and BYPASS2.

[2] EUHRSG1 and EUHRSG2 are in the model MAIN1 and MAIN2.

5.0 SITE DESCRIPTION

The following sub-sections contain stack parameters and description of the surrounding area.

5.1 Stack Parameters

Table 3 displays the stack parameters from the Eckert and Erickson boilers as well as the REO Town units that were included in the model.

Table 3. Stack Parameters

Boiler ID	Height (ft)	Diameter (inches)	Exhaust Temperature (°F)	Exhaust Flowrate (acfm)
EUBOILER1[1]	619	72	415	243,377
EUBOILER2[1]	619	72	415	243,377
EUBOILER3[1]	619	72	415	243,377
EUBOILER4[1]	619	96	350	429,870
EUBOILERS5[1]	619	96	350	429,870
EUBOILER6[1]	619	96	350	429,870
EU001[2]	475	204	285	348,567
EUAUXBOILER[3]	120	72	300	70,033
EUNGENGINE[3]	120	15	875	8,537
EUTURBINE1[3,4]	160	120	877	510,573
EUTURBINE2[3,4]	160	120	877	510,573
EUHRSG1[3,5]	160	120	336	313,387
EUHRSG2[3,5]	160	120	336	313,387

[1] Boiler is located at the Eckert Power Station.

[2] Boiler is located at the Erickson Power Station.

[3] Unit is located at the REO Town Station.

[4] EUTURBINE1 and EUTURBINE2 are in the model as BYPASS1 and BYPASS2.

[5] EUHRSG1 and EUHRSG2 are in the model as MAIN1 and MAIN2.

Stack parameters used for modeling Erickson and Eckert are from historic modeling supporting previous permits. They are representative of operations at typical maximum operating loads during stack testing. Stack parameters for the REO Town plant were based on vendor specifications from the original design.

5.2 Rural/Urban Dispersion Options

Land use within a three-kilometer radius circle surrounding the facility was considered in making the determination on use of the RURAL or URBAN dispersion options. Based on an analysis of land use / land cover surrounding Eckert Station, approximately 53 percent of land use around the facility was of urban land use types including high intensity residential and commercial / industrial / transportation. This is greater than the 50 percent value considered to be the minimum for the use of urban dispersion coefficients; however, per historic modeling analysis for the Eckert Station and in consultation with MDEQ modeling staff, it was concluded that the use of rural dispersion coefficients was preferred for this location. The RURAL dispersion option was selected for Eckert Station, since the area is very borderline urban at most.

The area around the Erickson facility is neither heavily industrialized nor heavily populated. Therefore, based upon these observations, all modeling analyses utilized the RURAL dispersion option.

6.0 BACKGROUND CONCENTRATION

The most representative SO_2 background monitor in the area is located in Ingham County (monitor ID No. 260650012) located at 220 N. Pennsylvania Ave. The monitor is roughly 1.5 miles northeast of the Eckert Power Station, and about 6.8 miles northeast of the Erickson Power Station.

The SO_2 background concentration as determined by the monitor is 17.9 parts per billion (ppb), or 46.9 micrograms per cubic meter ($\mu g/m^3$). This information has been provided by the MDEQ.

7.0 METEOROLOGY

Meteorological data for use in AERMOD must be processed through the AERMET pre-processing program available from U.S. EPA. As part of processing the meteorological data files, the user must specify certain site-specific surface features and characteristics and can, therefore, tailor any meteorological data file to the site-specific conditions at the facility site. The MDEQ recently completed the process of determining representative surface characteristics for use in preparing pre-processed "AERMOD-ready" meteorological data. The MDEQ has provided the meteorological data for use in the SO_2 model. The meteorological data supplied by MDEQ was processed using the Region 5 meteorological processing protocol.

The surface data used for the modeling analyses was taken from the Capitol City Airport (LAN), Surface Station No. 14836, with a mean surface station elevation of 264 meters above mean sea level (MSL). The upper air station data are from the National Weather Service (NWS) White Lake Station No. 72632. The LAN meteorological data is the most representative data in the area, and is taken at 1-minute intervals averaged over the course of an hour.

Pursuant to the TAD, the most recent three (3) years of meteorological data were incorporated into the model (2012 – 2014). This corresponds to the most recent three (3) years of SO_2 data from both the Eckert and Erickson facilities via the boilers CEMS (as discussed in Section 4).

8.0 MODELING DOMAIN

The modeling analysis completed for this project incorporates a receptor grid sufficient to identify the point of maximum impact during dispersion modeling. An extensive receptor grid was utilized to determine areas of higher concentration, and then more refined grid(s) were used in those areas to ensure capture of "hotspot" impacts. In general, the grid is most dense within close proximity to the facility site and gradually becomes less dense traveling out from the source. Pursuant to the TAD, receptors were only placed in locations where it is feasible to place monitors.

The secured property boundary was used to define the receptor grid in the modeling. MDEQ Modeling guidance discusses the difference between ambient air and secured property as follows:

> *Ambient air is defined in 40 CFR Part 50.1(e) as "… that portion of the atmosphere, external to buildings, to which the general public has access …," which would include areas such as unsecured plant property, railroad tracks, waterways, and roadways. This definition was further clarified in a letter dated December 19, 1980, from Douglas Costle to Senator Jennings Randolph that stated the exemption from ambient air is available only for the atmosphere over land owned or controlled by the source and to which public*

access is precluded by a fence or other physical barriers. Receptors generally do not need to be placed within secured property. A "secured property line" means a boundary that prevents general public access to property owned by a facility. In certain circumstances, one or more combinations of other barriers and measures such as ones listed below may adequately deem an area as being "secured"; however, this would be subject to the approval of the Department on a case-by-case basis.

A body of water, such as a ditch, of sufficient size to preclude public access to the property. The body of water must not be available for recreational activities, such as boating, fishing or swimming.

Regular patrols by staff that are responsible for not allowing unauthorized personnel onto the property. The patrol must be conducted at least several times a day.

Continuous monitoring by surveillance cameras where staff is assigned to view video monitors and report any unauthorized access.

All boundaries using the above methods must be clearly posted to communicate private property/no public access.

The following receptor grid was used for this modeling analysis:

Fence-Line:	Receptors were placed along the secured property line at 25-meter spacing.
Near-Field:	Receptors were placed at 100-meter spacing in the near-field, from facility's source "center" out to a distance of 2 km.
Mid-Field:	Receptors were placed at 250-meter spacing in a far-field from a distance of 2 km to 10 km.
Far-Field:	A polar receptor grid was placed at 5,000-meter spacing in a far-field from a distance of 15 km to 35 km.
Refined Receptor Grid:	Receptors were placed in a grid with 50-meter spacing near the location of maximum impact, as determined with the fixed grids.

The center of each facility is located at approximately:

- Erickson **UTM Easting (m):** 691,940 **UTM Northing (m):** 4,729,089
- Eckert **UTM Easting (m):** 699,967 **UTM Northing (m):** 4,732,268

Within this grid, receptors were placed at 50-meter spacing in areas of "hotspots" as mentioned above. This ensures that the maximum impact is captured without creating an overly concentrated receptor grid resulting in long model runtimes. Additionally, a polar receptor grid using 36 radials at 10 degrees each was also added, from 15 km from the midpoint of the modeling domain out to 35 km to verify that hotspots were not occurring at distances beyond the square receptor grid. Addition of the polar grid did not change the maximum modeled impacts, nor are any hotspots expected beyond the first few kilometers of any facility.

The modeling domain also incorporates terrain features. AERMOD requires the use of an elevated terrain data file for establishing elevations for all sources, buildings and receptors. The AERMAP pre-processor is used to process digital elevation maps with location points for all sources, structures, and receptors. North American Datum 1927 (NAD27) based Digital Elevation Models (DEM) 7.5-minute digitized topographic files, available via the United States Geological Survey (USGS) website, for the area surrounding the Eckert and Erickson facilities was used to obtain elevations and hill heights as required by the AERMOD model. This terrain information was incorporated into the AERMOD model via the AERMAP pre-processor.

9.0 OFF-SITE EMISSIONS INVENTORY

For this modeling analysis, off-site sources are included. Recent U.S. EPA guidance requires an emission inventory for emissions of all existing sources which have a "significant concentration gradient" overlapping the source being modeled. U.S. EPA guidance also suggests that *"the number of such [nearby] sources is expected to be small except in unusual situations"* and that most off-site sources should not be explicitly modeled but should be considered part of the background concentration. The MDEQ has conducted an emissions analysis for the area and provided an off-site source listing according to the most recent U.S. EPA guidance. These sources were incorporated into the model.

The offsite inventory resulting from MDEQ's emissions analysis for the area is provided in Appendix B.

10.0 AMBIENT IMPACT ANALYSIS (SO_2)

The U.S. EPA has deemed BWL Erickson and Eckert as large sources of SO_2 emissions and, therefore, subject to a compliance demonstration via monitoring or dispersion modeling to characterize the SO_2 air quality.

The following subsections summarize the ambient impact analysis of SO_2 emissions from the BWL Erickson and Eckert facilities for comparison to the 1-hour SO_2 NAAQS.

10.1 Dispersion Model Description

The modeling follows the protocol submitted to MDEQ on May 28, 2015 and accepted by MDEQ and U.S. EPA. The dispersion modeling protocol ensures that the analyses have been conducted in a manner consistent with MDEQ's Air Dispersion Modeling Guidance Document (September 2009 revision), AQD's September 2013 PSD Workbook, TAD, and U.S. EPA guidance and standard practices. Guidance for the use and application of dispersion models is presented in the U.S. EPA document, *Guidance on Air Quality Models*, as published in Appendix W of 40 CFR Part 51 (updated as of November 9, 2005 to include the promulgation of AERMOD).

10.2 Results

Table 4 below summarizes the modeling results from the combined impacts from the BWL Erickson and Eckert facilities against the SIP attainment threshold (1-hour SO_2 NAAQS) of 196 $\mu g/m^3$.

Table 4. Erickson and Eckert Modeling Results

Pollutant	Averaging Time Period	1-Hour NAAQS ($\mu g/m^3$)	Maximum Modeled Impact [1] ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Impact + Background ($\mu g/m^3$)	% of NAAQS ($\mu g/m^3$)
SO_2	1-hour	196	92.7	46.9	139.6	71%

[1] Modeled results are based on the average highest 4th high (H4H) impact from actual variable emissions over a 3-Year (2012-2014) period

Table 4 shows that the maximum modeled impacts from the Erickson and Eckert facilities combined with the background concentrations are below the 1-hour NAAQS. Therefore, based on this demonstration, the BWL Erickson and Eckert facilities do not cause any SO_2 "hot spots" within the area in question. Additionally, the modeling does not indicate any location that a monitor could be placed that would register impacts above the NAAQS.

10.3 Dispersion Modeling Files

The complete Lakes Environmental ISC-AERMOD View modeling project files are provided in Appendix C on compact disc for modeling analysis conducted with AERMOD.

APPENDIX A

ECKERT AND ERICKSON SITE LAYOUTS

PROJECT TITLE:

Lansing Board of Water & Light
Figure 1. Eckert Power Station

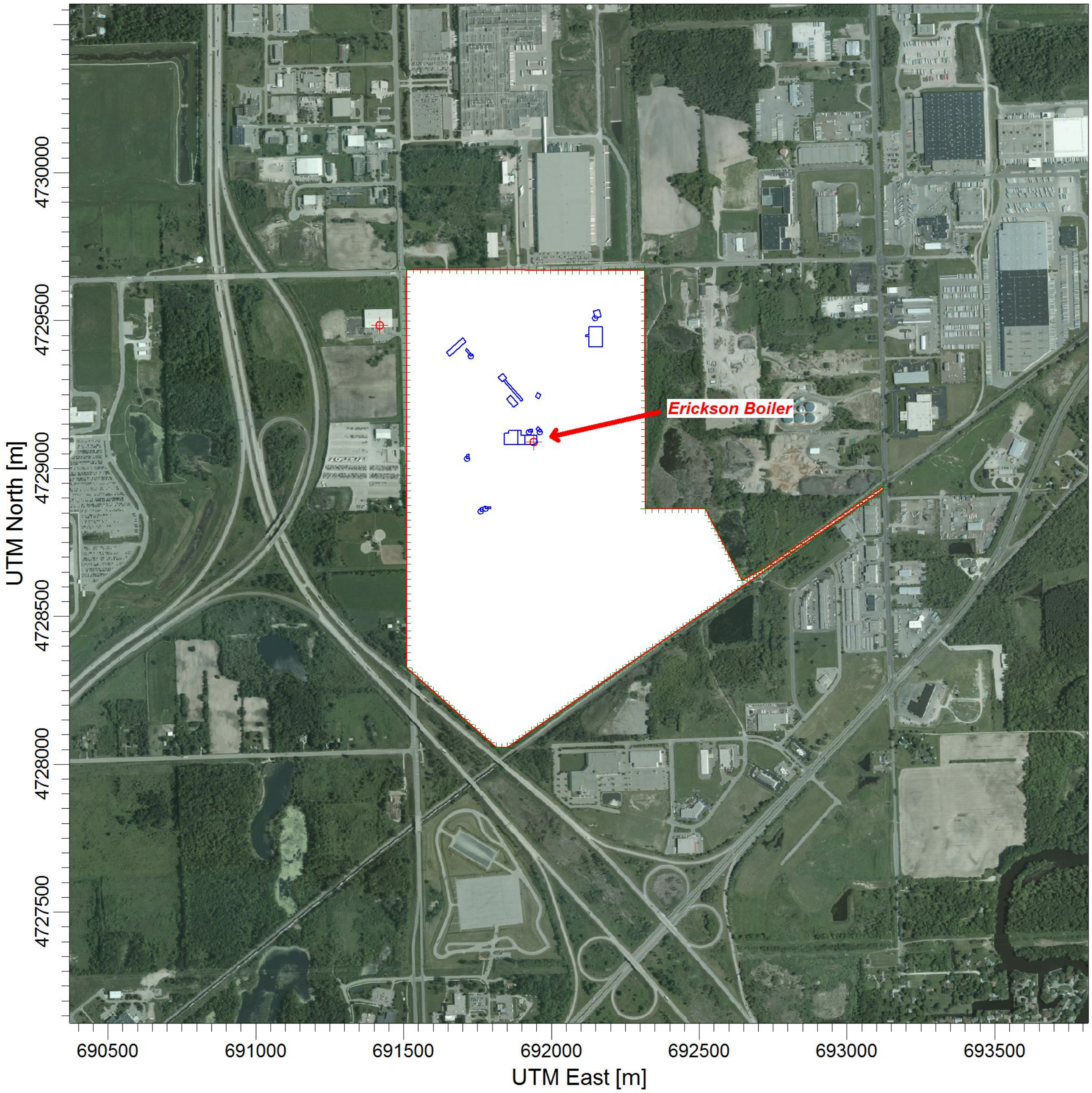
COMMENTS:	SOURCES:	COMPANY NAME:	
	17	**NTH Consultants, Ltd.**	
	RECEPTORS: **13615**	MODELER: **COO**	
		SCALE: 1:8,176 (0 — 0.3 km)	
		DATE: **5/18/2015**	PROJECT NO.:

AERMOD View - Lakes Environmental Software

C:\Modeling\LBWL\2015 SO2\2015-05-14 SO2\CO_R2.isc

PROJECT TITLE:

Lansing Board of Water & Light
Figure 2. Erickson Power Station



COMMENTS:	SOURCES:	COMPANY NAME:	
	17	**NTH Consultants, Ltd.**	
	RECEPTORS: 13615	MODELER: COO	
		SCALE: 1:21,675 0 — 0.5 km	
		DATE: 5/18/2015	PROJECT NO.:

APPENDIX B

OFFSITE SOURCE INVENTORY

Appendix B - MDEQ Offsite Source Inventory

			Facility Emissions					Stack Information					
SRN	COMPANY	POL	(pph)	(tpy)	TYPE	UTM EAST	UTM NORTH	Hgt. (ft)	Dia (feet)	Temp (deg F)	Flow (ACFM)	Velocity (m/s)	Discharge Type
N1502	THOMPSON-MCCULLY COMPANY	SO2	55.0	240.9	Allowed	690,715	4,725,692	42.0	2.25	240.0	63000.0	80.5	Upward
P0198	SUPERIOR ASPHALT, INC	SO2	18.4	80.6	Allowed	691419	4729485	60.0	3.92	221.0	61391.0	25.9	Upward
K3249	Michigan State University	SO2	357.1	473.3	Actuals	706040	4732960	275	11.77	325	284865.81	13.391147	Vertical

APPENDIX C

MODELING FILES

This page left intentionally blank.

12445 55th Street North | Suite A2 | Lake Elmo, MN 55042 | P (651) 275-9900 | F (651) 351-3987
trinityconsultants.com

Trinity Consultants

VIA E-MAIL: haywoodj@michigan.gov

June 26, 2015

Mr. Jim Haywood
Senior Meteorologist
Air Quality Division
Michigan Department of Environmental Quality
525 West Allegan Street
P.O. Box 30473
Lansing, MI 48909

RE: SO_2 State Implementation Plan (SIP) Modeling Results for the We Energies Presque Isle Power Plant

Dear Mr. Haywood:

In response to a request by the Michigan Department of Environmental Quality (MDEQ), Trinity Consultants, Inc. (Trinity), on behalf of Wisconsin Electric Power Company, doing business as We Energies, respectfully submits the sulfur dioxide (SO_2) SIP dispersion modeling results for the Presque Isle Power Plant (PIPP). This submittal follows the air dispersion modeling protocol submitted to MDEQ on May 22, 2015.

FACILITY DESCRIPTION

We Energies owns and operates PIPP in Marquette, Michigan, which is located along Lake Superior in Michigan's Upper Peninsula. Figures 1 and 2 below show aerial views of the facility; Figure 2 includes a depiction of the fenceline.[1]

The plant was originally constructed in 1955. Boilers 1-4 were installed by Cleveland Cliffs to provide power to the nearby mines. The plant was later sold to Upper Peninsula Power Company (UPPCo), and Boilers 5-9 were installed. We Energies acquired PIPP in the late 1980's after the construction of Boilers 5-9 was complete. In recent years, Boilers 1-4 were retired and removed, although the original structure which housed the boilers remains at the plant. The remaining units, Boilers 5-9, are pulverized coal wall fired dry bottom utility units each with a 90 Megawatt generating capacity. Boilers 5-6 have historically burned both Colorado bituminous and subbituminous Powder River Basin (PRB) coal over the years, but are currently burning subbituminous PRB coal, which is consistent with the fuel combusted in Boilers 7-9.

Other SO_2 emission sources at the plant include two emergency diesel generators, one emergency diesel fire pump, and small natural gas fired comfort heaters. The modeling focused on the coal-fired boilers, which are the

[1] The fenceline shown in Figure 2 represents the fenceline modeled in the 2013 PSD permit application submitted to MDEQ. MDEQ subsequently issued a PSD permit based on this application.

principal sources of SO_2, and are the reason the facility has been requested to conduct SO_2 1-hour SIP modeling. The small size and infrequent use of this equipment yields a small contribution to the annual distribution of the maximum daily 1-hour SO_2 concentrations. Pursuant to the March 2011 Intermittent Source Policy, these small emissions units have been excluded from the 1-hour SO_2 SIP modeling analysis.[2]

Figure 1. Presque Isle Power Plant

Figure 2. Presque Isle Power Plant Fenceline

[2] Exclusion of the intermittent sources in the 1-hour SO_2 SIP modeling analysis is consistent with MDEQ's internal policy and is appropriate for this analysis due to the infrequent use of this equipment and the small overall contribution to SO_2 as discussed between Jim Haywood, MDEQ, and Angie Wanger, Trinity, on 6/23/2015.

MODELING ANALYSIS

We Energies prepared a modeling analysis addressing SO_2 SIP dispersion modeling as requested by MDEQ and the United States Environmental Protection Agency (EPA). A discussion of the modeling analysis requirements and modeling methodology is included in the sections below.

Modeling Requirements

A modeling protocol approach specific to the 1-hour SO_2 SIP modeling analysis for PIPP was submitted to MDEQ in accordance with the MDEQ Modeling Protocol Template.[3] As actual hourly emissions data were used in the modeling analysis, the stack temperature and exit velocity were also varied on an hourly basis, which is a change from the previously submitted modeling protocol. Further, the effective stack diameter was also revised when compared to the previously submitted modeling protocol. These changes are described in a later section of this letter. The modeled impacts of the facility were compared to the 1-hour SO_2 National Ambient Air Quality Standards (NAAQS) of 196 $\mu g/m^3$.

Selection of Model

We Energies has conducted the dispersion modeling analysis using the latest version of AERMOD (version 14134) along with Trinity's *BREEZE™ AERMOD Suite* software to estimate maximum ground-level concentrations. All regulatory default options were used in the modeling. The pollutant ID was set to SO_2, and the output options were configured such that the model predicted an SO_2 design value based on the 3-year average of the 99^{th} percentile of the annual distribution of the daily maximum 1-hour concentrations.

Coordinate System

In all modeling input and output files, the locations of emission sources, structures, and receptors were represented in the Universal Transverse Mercator (UTM) coordinate system using North American Datum 1983 (NAD83).[4] The UTM grid divides the world into coordinates that are measured in north meters (measured from the equator) and east meters (measured from the central meridian of a particular zone, which is set at 500 km). PIPP is approximately centered at UTM, Zone 16, coordinates 469,725 meters East and 5,158,475 meters North. The base elevation of the facility is approximately 185 meters above mean sea level.

Building Downwash and GEP Stack Height Analysis

The Building Profile Input Program (BPIP) with Plume Rise Model Enhancements (PRIME) (version 04274) was used to determine the building downwash characteristics for each stack in 10 degree directional intervals. The

[3] Modeling protocol template sent from Jim Haywood, MDEQ, to Bob Greco, We Energies, on 5/13/2015. A modeling protocol specific to PIPP was developed using this template and sent to MDEQ for approval on 5/22/2015. Comments on this protocol were sent from Randall Robinson, EPA, to Jim Haywood on 6/5/2015, and responses were sent from Jim Haywood on 6/8/2015 and Clay Raasch, Trinity, on 6/11/2015.

[4] Google Earth was referenced for the model digitization. According to the Google Earth User Guide, the axes of the World Geodetic System 1984 (WGS84) and NAD83 coordinate systems differ by a very small amount. Therefore, the NAD83 and WGS84 datums are roughly equivalent.

PRIME version of BPIP features enhanced plume dispersion coefficients due to turbulent wake and reduced plume rise caused by a combination of the descending streamlines in the lee of the building and the increased entrainment in the wake. For PRIME downwash analyses, the building downwash data include the following parameters for the dominant building:

- Building height
- Building width
- Building length
- X-dimension building adjustment
- Y-dimension building adjustment

We Energies utilized BPIP PRIME to calculate building downwash parameters for the SO_2 SIP modeling analysis.

Land-Use/Land Cover Data

We Energies used pre-processed meteorological data provided by the MDEQ. Therefore, the land use/land cover (LULC) analysis required as part of the AERMET meteorological data processing was completed by the MDEQ.

Meteorological Data

The meteorological data utilizes minute-reported information which were pre-processed and provided by MDEQ for download using the AERMOD meteorological preprocessor AERMET (version 14134) for the years 2012 through 2014 (consistent with the three years of actual emissions data that was relied upon for PIPP). Meteorological data for the Munising Lakeshore surface station (Surface Station No. 54813) and Gaylord, Michigan upper air station (Station No. 4837) were used due to its proximity to the facility, the availability of 1-minute meteorological data, and its placement on Lake Superior, which is similar to PIPP.[5]

Receptor Grids

We Energies used a combination of a Cartesian grid system centered on PIPP and discrete receptor points along the PIPP fenceline. Receptors were placed at 25 meter intervals along the fenceline, 100 meter intervals out to a distance of 2.5 kilometers (km) and at 500 meter intervals out to 15 km. Based on the EPA's draft 2013 Technical Assistance Document and the 2015 SO_2 Area Designation Guidance, the receptor grid only included receptors at those locations where it is feasible to place a monitor (i.e., not over water). Therefore, no receptors were placed over Lake Superior.

---

[5] MDEQ recommended the use of Munising data which was used by We Energies in the 2013 PSD application submitted to MDEQ.

Terrain Elevations

The terrain elevation for each receptor, building, and emission source[6] was determined using USGS 1/3 arc-second National Elevation Dataset (NED) data. The data, obtained from the USGS, has terrain elevations at 10-meter intervals. The terrain height for each individual modeled receptor was determined by assigning the interpolated height from the digital terrain elevations surrounding each modeled receptor.

In addition, the AERMOD terrain processor, AERMAP (version 11103), was used to compute the hill height scales for each receptor. AERMAP searches all NED points for the terrain height and location that has the greatest influence on each receptor to determine the hill height scale for that receptor. AERMOD then uses the hill height scale in order to select the correct critical dividing streamline and concentration algorithm for each receptor.

Modeled Source Parameters

As noted in past correspondence with the MDEQ, the five boilers at PIPP were modeled as two separate stacks due to the flues sharing two chimney stacks: one stack represented Boilers 5 and 6 (modeled source ID B56), while a second stack represented Boilers 7, 8, and 9 (modeled source ID B789). The merged flue exhaust parameters were recalculated for the 1-hour SO_2 SIP modeling analysis and were updated as compared to the exhaust parameters which were previously submitted in the modeling protocol. Modeled stack parameters and emission rate reference information can be found in Table 1.

Table 1: PIPP Emission Source Modeling Parameters

Source ID	UTM NAD83 X Coord. (m)	UTM NAD83 Y Coord. (m)	Elevation (ft)	Stack Height (ft)	Effective Stack Temp.* (F)	Effective Exit Velocity* (m/s)	Effective Stack Diameter† (m)	SO_2 Emission Rate Basis
B56	469,722	5,158,443	606.5	400	--	--	3.59	CEMS
B789	469,725	5,158,504	606.5	410	--	--	4.53	CEMS

*Effective stack temperature and exit velocity parameters are calculated utilizing CEMS data, using a weighted average of each flue's stack temperature and exit velocity based on its contribution to the overall airflow rate.
†Effective diameter is calculated utilizing CEMS data, using the sum of each flue's airflow rate and the calculated effective velocity.

We Energies used actual emissions data from the SO_2 continuous emission monitoring system (CEMS) for each of the five boilers. Pursuant to EPA's draft 2013 Technical Assistance Document, SO_2 designations are intended to address current actual air quality (i.e., modeling simulates a monitor) and EPA recommends modeling the most recent three years of actual emissions. Therefore, CEMS data for 2012 through 2014 were used to generate the hourly varying emissions input file. The SO_2 CEMS data were obtained from the Clean Air Market Database (CAMD).[7] In order to match the hourly varying emission rates on the same time scale, the hourly

[6] Base elevation of 606.5 ft was utilized for the boiler stacks as specified in the modeling protocol submitted to MDEQ on May 22, 2015. All other facility elevations were determined through use of AERMAP.

[7] CAMD data for PIPP from 2012-2014, including SO_2 hourly emission rates and hourly heat inputs, was queried on 6/17/2015.

varying stack temperature and airflow data for each of the five boilers as measured by the CEMS were also included in the development of the hourly varying emissions input file.

Nearby Source Inventory

As provided by MDEQ, SO_2 emissions from Marquette Board of Light & Power (MBLP) and Northern Michigan University (NMU) were included in the modeling analysis.[8] The modeling parameters and emission rates for these sources can be found in Table 2.

Table 2: Neighboring Source Modeling Parameters

Source ID	UTM NAD83 X Coord. (m)	UTM NAD83 Y Coord. (m)	Elevation (ft)	Stack Height (ft)	Stack Temp. (F)	Exit Velocity (m/s)	Stack Diameter (m)	SO_2 Emission Rate* (lb/hr)
MBLP	469,900	5,153,000	616.24	301.8	239.4	18.3	2.52	264.9
NMU	468,889	5,156,615	640.22	150.0	260.0	4.8	2.50	22.8

*MBLP SO_2 emission rates reflect actual emissions. NMU SO_2 emission rates reflect allowable emissions.

MODELING RESULTS

This section summarizes the results of the 1-hour SO_2 SIP modeling analyses. An electronic zip archive containing all modeling input and output files, building downwash files, and meteorological data is included.

Tabular Modeling Results

The 1-hour SO_2 modeling results are shown in Table 3 below. These results consider the combined impact of PIPP and the two neighboring sources, adding the modeled results to the background concentration to yield the total modeled impacts. The total modeled impacts were then compared to the NAAQS.

Table 3: Summary of 1-hour SO_2 NAAQS Results

Pollutant	Averaging Period	Modeled Impacts ($\mu g/m^3$)	Background Concentration* ($\mu g/m^3$)	Total Impacts ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	% of NAAQS
SO_2	1-hour	111.19	17.9	129.09	196	66%

*The 1-hour SO_2 background concentration was sent by Jim Haywood, MDEQ, to Bob Greco, We Energies, on 5/13/2015. Background concentrations for Forest County, Wisconsin were used in this analysis as it is the most representative monitor for the site as described in the modeling protocol submitted 5/22/2015.

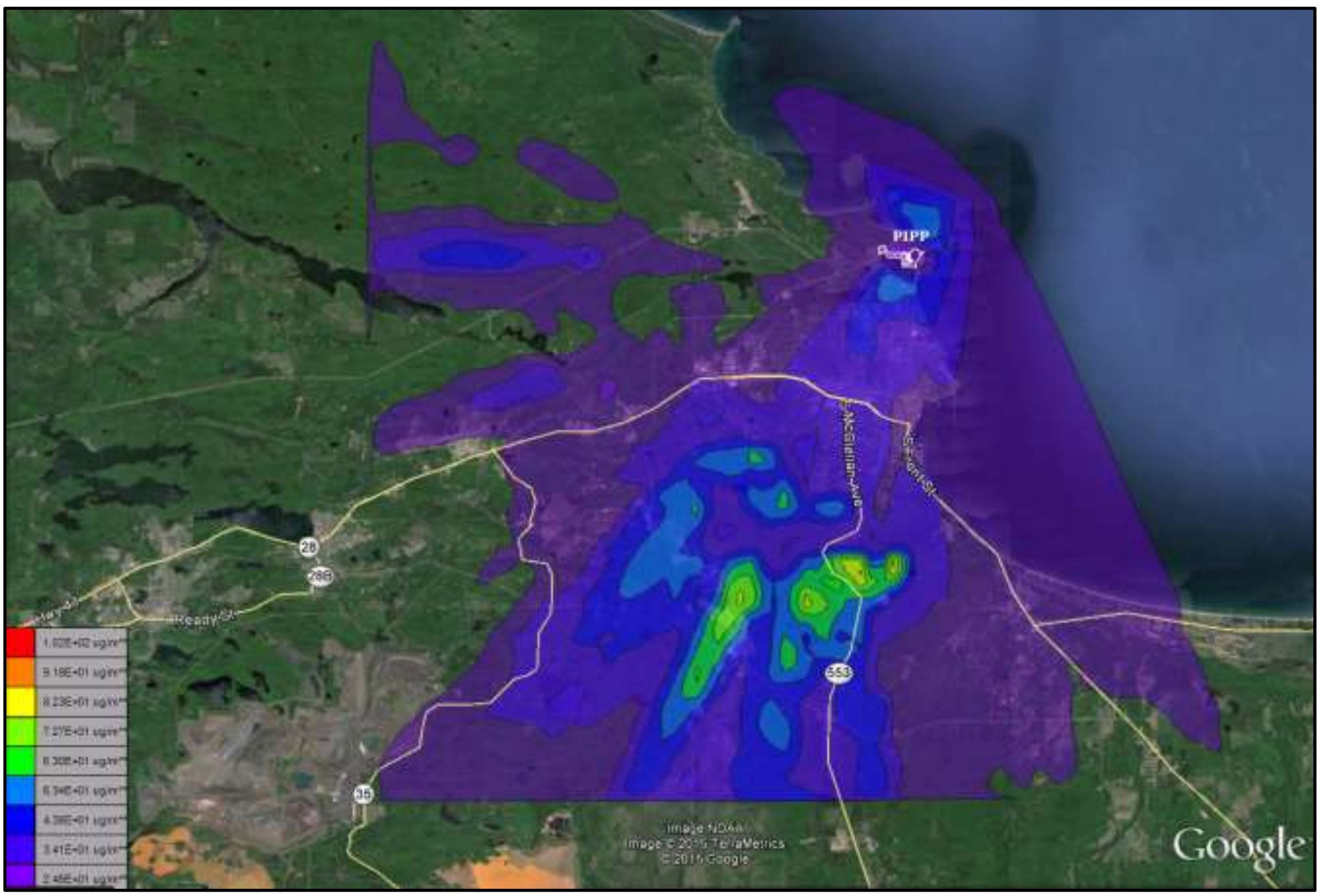
[8] Neighboring source guidance sent from Stephanie Hengesbach, MDEQ, to Kathleen Standen, We Energies, on 5/15/2015. Additional clarification on elevation parameters for these sources sent from Stephanie Hengesbach to Angie Wanger, Trinity, on 6/15/2015.

As shown in Table 3, the combined impact from PIPP, the neighboring sources, and the background concentration are less than the NAAQS. Graphical illustrations depicting the areas of impact are shown in the next section.

Graphical Results

The locations of the maximum impacts of the 1-hour SO_2 SIP modeling analysis were plotted using BREEZE® 3D Analyst. As illustrated in Figure 3, the highest modeled concentrations are located southwest of PIPP. Results in the figures are shown in units of μg/m³.

Figure 3. SO_2 H4H 1-hour Concentration for All Sources (2012-2014)



CONCLUSION

When utilizing the source parameters and emission rates discussed in the modeling methodology section of this letter, the results shown above demonstrate that the predicted ambient impacts of PIPP and its two neighboring sources are less than the 1-hour SO_2 NAAQS.

If you have any questions or comments about the information presented in this letter, please do not hesitate to call Bob Greco with We Energies at (414) 221-5441 or me at (651) 275-9900.

Sincerely,

TRINITY CONSULTANTS

Angie Wanger
Managing Consultant

Enclosure

cc: Robert A. Greco, P.E. (We Energies)
Stephanie Hengesbach (MDEQ)
Bob Irvine (MDEQ)
Clay Raasch (Trinity)

Enclosure 1

Modeling Files

This page left intentionally blank.

Outstate Michigan 1-Hour SO_2 NAAQS Designations
For Specified Large SO_2 Sources (Round 1 Sources)

DTE Energy Monroe Power Plant
Monroe, Michigan
Dispersion Modeling Protocol
July 6, 2015

Introduction

The United States Environmental Protection Agency (EPA) promulgated a revised primary sulfur dioxide (SO_2) national ambient air quality standard (NAAQS) in June 2010. The averaging time for this new NAAQS is 1 hour, which is much shorter than the previous primary NAAQS averaging period, 24 hours. The new NAAQS is the 99^{th} percentile maximum daily 1-hour average, averaged over the most recent three years of monitoring data. The level of the new SO_2 NAAQS (75 ppb) is much lower than the previous 24-hour SO_2 NAAQS (140 ppb). EPA is requiring states to determine whether areas within their borders meet or exceed this new NAAQS to provide designation recommendations to EPA.

Initially, EPA recommended that states use dispersion modeling for identifying locations where this NAAQS is not met. However, there was an outcry to this proposal from many state air quality agencies and other affected parties. EPA decided to proceed designating new nonattainment areas where at least one SO_2 monitoring site violates this NAAQS with the last 3 years of monitoring data. Michigan has been working with source operators that contribute to the monitored violation in Wayne County, and will soon submit their state implementation plan (SIP) for EPA to review. However, EPA decided to delay designations for other portions of the country.

In response to a lawsuit that was brought against EPA by the Sierra Club, and others, to force EPA to designate other areas on an expedited schedule, the parties settled and additional NAAQS designations are being undertaken. The judge issued the settlement order finalizing the agreed upon details on March 2, 2015. The next phase where SO_2 NAAQS designations must be finalized by July 2016 includes areas around 68 large SO_2 sources listed in the settlement agreement between the parties. **This dispersion modeling protocol describes the methodology that will be used to determine whether this revised NAAQS is met in Monroe County, Michigan, where DTE Energy's Monroe Power Plant (Monroe PP) is located. Also, Monroe PP has been included in AERMOD runs for the Wayne County SIP, but this upcoming analysis is confined to Monroe County. This plant is listed in the table of sources meeting the criteria of large SO_2 sources in the settlement document.**

Facility Description

Monroe PP is DTE Energy's largest electric generating facility in its generating fleet with 3,280 (Gross) MW of combined generating capacity. It has four main units (Units 1-4) that burn bituminous coal, sub-bituminous coal and petroleum coke as their primary fuels. All four units have low-NO_x burners, over-fired air (OFA) and selective catalytic reduction (SCR) systems operating for NO_x control. Each unit employs dry-wire electrostatic precipitators (ESP) and sulfur trioxide and ammonia injection for particulate matter control. Also, Units 1 and 2 finished installing wet flue gas desulfurization (FGD) systems for controlling SO_2 emissions in 2014. Wet FGD systems have been operating continuously on Units 3 and 4 before the base year, 2012. Monroe PP likely made it on the list for expedited 1-hour SO_2 NAAQS designations because two of its four main units were operating in 2012, and 2013, without FGD systems. Therefore, the plant met the criteria established in the settlement agreement, previously cited in this protocol.

Monroe PP is located along the western shore of Lake Erie, just south of the mouth of the River Raisin. It is about four miles southeast of downtown Monroe, between Interstate-75 and Lake Erie, about 12 miles north of the Michigan-Ohio border. One of Michigan's state parks, Sterling State Park, is located just north of this facility. There are a few industrial businesses west of the plant, and the City of Monroe's Water Treatment Plant. There is quite an expanse of wetlands northwest from Monroe PP as well. Figure 1 is an aerial photograph of the plant from 2006, prior to installation of FGD systems at the facility.

A rigorous impact assessment was performed for Monroe Power Plant as part of the Permit to Install (PTI No. 93-09A) application package to establish Best Available Control Technology (BACT) SO_2 limits for each of its four main units (0.107 lbs/MMBtu & 815.8 lbs/hour). The 1-hour SO_2 modeling runs predicted Monroe PP impacts below the NAAQS with these limits. With nearby sources included there were predicted excursions, with nearly all of the impact from the J. R. Whiting Plant, owned by Consumers Energy. However, Monroe Power Plant did not significantly contribute to the receptors during the hours the high SO_2 concentrations were predicted. Since the J. R. Whiting plant will be retired by April 2016, at the latest, it will not be modeled in the upcoming impact assessment. EPA staff has agreed that this exclusion is appropriate.

Table 1-A

Actual Monroe PP SO_2 Emissions (2012-2014)			
	2012 (tons)	**2013** (tons)	**2014** (tons)
Monroe PP			
Unit 1	25,267	18,189	383
Unit 2	22,859	24,377	4,654
Unit 3	619	509	621
Unit 4	405	691	629
Auxiliary Boilers	0.002	0.026	0.065
Diesel Gen No. 11-1	0.001	0.000	0.001
Diesel Gen No. 11-2	0.000	0.000	0.001
Diesel Gen No. 11-3	0.001	0.000	0.001
Diesel Gen No. 11-4	0.001	0.000	0.001
Diesel Gen No. 11-5	0.001	0.001	0.001
Diesel Quench Pumps	0.004	0.005	0.009
Monroe Main Units	49,150	43,766	6,287
Monroe Other Sources	0.010	0.032	0.079
Site Total	**49,150**	**43,766**	**6,287**

Table 1-A lists actual SO_2 emissions from point sources at Monroe PP from the last three operating years (2012-2014). It clearly shows that nearly all of the SO_2 is emitted by the four coal-fired units at this plant for the most recent three year period (2012-2014). Previously submitted modeling analyses showed that these other small SO_2 sources only contributed 0.03 ug/m^3 to the highest predicted 99th percentile 5-year average impact, which was 86.54 ug/m^3. This extremely small impact is inconsequential when compared to the main units' combined peak short-term impact. The following table identifies which Monroe PP SO_2 sources will be included in the impact modeling, and those that will be excluded and the reason(s) for this decision.

Table 1-B
Basis for Including or Excluding SO_2 Source from Impact Assessment

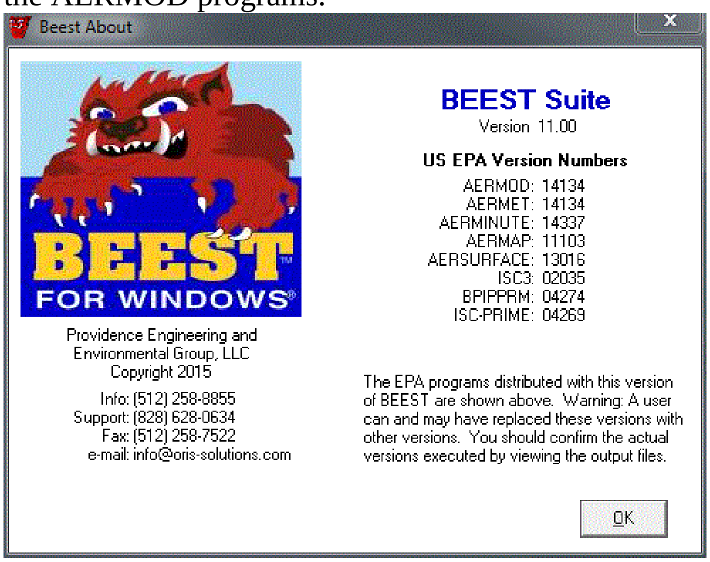
SO_2 Source(s)	Include / Exclude	Reason(s)
Unit Nos. 1-4	**Include**	**Main units, Large SO_2 source**
Auxiliary Boilers	**Exclude**	**Infrequent operation, 15 ppm Sulfur Oil**
Diesel Generator Nos. 11-(1-5)	**Exclude**	**Infrequent operation, 15 ppm Sulfur Oil**
Diesel Quench Pumps	**Exclude**	**Infrequent operation, 15 ppm Sulfur Oil**

The secured property line for this modeling study is assumed to be the actual property line of the Monroe PP complex. Its boundaries are primarily water bodies with: Lake Erie to the east, River Raisin to the north and its discharge canal to the west and south. This power plant, also, has its own wet fly ash storage basin to the southwest of the main plant buildings that is surrounded by a security fence. This basin runs all the way west to the edge of the northbound I-75 freeway right-of-way. There is security staff at the site at all times maintaining an adequate security presence for the plant.

DTE Energy staff will make the 1-hour SO_2 AERMOD runs using the allowable SO_2 emission rates for Unit Nos. 1-4 with the appropriate other nearby SO_2 sources identified by the Air Quality Division Modeling staff. This option was chosen because we believe design 1-hour SO_2 predicted impacts, including background concentrations will be well below the NAAQS. Also, if the actual emission option was chosen, Units 1 and 2 would have at least two years of operation without the FGD system, and part of 2014 with this control device operational. The SO_2 emission rates are very different with this scenario, as well as most of the stack parameters, which would make the AERMOD runs even more complicated. Our best estimate of the date for the modeling to be completed is by July 10, which is about two weeks after the draft schedule submittal date (June 26).

Model Selection

The version of AERMOD and its support files is shown in the following picture: DTE Energy staff use the BEEST software package, and receive updated versions as EPA makes changes to the AERMOD programs.



The structures that were included in the previous dispersion modeling analysis will be included in these AERMOD runs for the 1-hour SO_2 NAAQS. They include all of the tall buildings near the four main units at Monroe PP, including the relatively new structures associated with the SCR and FGD control systems to reduce NO_x and SO_2 emissions from this facility. Detailed building profile data is shown in Table 2. The latest version of BPIP (Version dated 04274) will be used to develop building height and width values for each 10 degree wind direction category used in AERMOD.

Emissions Characterization

DTE Energy will model SO_2 impacts from Monroe PP using allowable emission rates for each of its four main units(0.107 lbs/MMBtu & 815.8 lbs/hour). Stack parameters for these units will remain constant representing full load operation, which corresponds with highest SO_2 emission rates for each unit, and the highest combined impact from all four units. Other small SO_2 point sources are not modeled from this plant, as detailed in the Facility Description. Table 1-A lists the most recent 3 years of actual SO_2 emissions.

Source Description

The detailed plant description is provided in the Facility Description Section of this modeling protocol, including the justification for including only the main units from Monroe PP in this impact analysis. Table 2 lists the UTM coordinates for the large SO_2 sources that will be modeled as well as the stack data and structure data (height, tiers, corners or tank center/diameter details).

Rural dispersion coefficients are utilized in this model. The area surrounding the power plant is predominantly rural with: Lake Erie dominating its eastern boundary, Sterling State park to the north, and wetlands to the south. The small acreage of industrial property to the west-northwest of Monroe PP is overshadowed by land cover having a rural character. Figure 2 illustrates the area surrounding Monroe PP with the various land use types. Therefore, rural dispersion is appropriate for this large power plant.

Background Concentration

Identifying a representative SO_2 concentration for this site is much less difficult than for the previous SO_2 impact assessment. The MDEQ-AQD sited a new SO_2 monitor at Sterling State Park, just over a mile due north of the main unit stacks, late in 2012. It began collecting data in January 2013. Two years of SO_2 data are available to calculate a background concentration. Hours when the wind direction is from Monroe PP's main unit stacks towards this new monitoring site were not eliminated from the calculation, leading to a conservative background concentration. MDEQ-AQD staff calculated a SO_2 background concentration of 47.6 ug/m3 or 18.2ppb to add to the impact from the modeled sources. The previous background concentrations were based on data from Michigan City, Indiana, about 200 miles from Monroe PP.

Meteorology

The most appropriate meteorological data set for this 1-hour SO_2 NAAQS designation analysis in Monroe County utilizes 2012-2014 data, with surface data from the Monroe Custer Airport This airport is only six miles away from Monroe PP, just north of the City of Monroe. Upper air data from White Lake Township will also be used. The Monroe Custer Airport site does not have 1-minute wind data, but it is most representative for Monroe County, especially the portion including Monroe PP. The dataset has 404 (1.54%) missing hours and 2,530 (9.61%) calm hours identified. This data set has been compiled, and is available from the Air Quality Division staff.

Modeling Domain

The receptor grid modeled follows the MDEQ guidance for receptors around a large point source. The receptor grid that was used in the previous air permit met the requirements for a Prevention of Significant Deterioration (PSD) permit. Therefore, it will be reused in the upcoming 1-hour SO_2 NAAQS designation modeling, but only out to a distance of 10 kilometers from the main units' stacks. Note, that receptors over the following areas will not be included in the impact analysis:

- DTE Energy Monroe PP property
- US waters (i.e.,Lake Erie, River Raisin, Plum Creek)
- Landfills (On-Site Storage Basin & Sterling State Park Dredge Spoils Area)
- On roadways (i.e., I-75 & other local roads)
- On modeled SO_2 source secured property

Receptor elevation data will be used in the analysis.

Off-Site Emission Inventory

The other Michigan SO_2 sources that will be included in the AERMOD runs are: IKO Monroe, Guardian Industries, and Gerdau MacSteel-Monroe. These three sources will be included in the AERMOD impact assessment using their actual or allowable emission rate, whichever is provided by MDEQ-AQD. The provided emission rates are shown in Table 2. As previously mentioned, Consumers Energy's J. R. Whiting Plant will not be modeled since it will be retired by April 2016, at the latest.

Table 2

Outstate Michigan 1-Hour SO_2 NAAQS Designations
For Specified Large SO_2 Sources (Round 1 Sources)

DTE Energy Monroe Power Plant
SO_2 Source Emission Data

Source Data

Source	Load (%)	Sulfur Dioxide Allowable Emission Rate Short-term (lb/hr)	Notes
*Monroe PP Unit 1	100	815.8	Emission limit – 0.107 lbs/MMBtu
*Monroe PP Unit 2	100	815.8	Emission limit – 0.107 lbs/MMBtu
*Monroe PP Unit 3	100	815.8	Emission limit – 0.107 lbs/MMBtu
*Monroe PP Unit 4	100	815.8	Emission limit – 0.107 lbs/MMBtu
Monroe PP Aux. Blrs.	100	0.65	15 ppm sulfur oil
Monroe PP DG 11-1	100	4.27×10^{-4}	15 ppm sulfur oil & < 100 hrs/yr
Monroe PP DG 11-2	100	4.27×10^{-4}	15 ppm sulfur oil & < 100 hrs/yr
Monroe PP DG 11-3	100	4.27×10^{-4}	15 ppm sulfur oil & < 100 hrs/yr
Monroe PP DG 11-4	100	4.27×10^{-4}	15 ppm sulfur oil & < 100 hrs/yr
Monroe PP DG 11-5	100	4.27×10^{-4}	15 ppm sulfur oil & < 100 hrs/yr
Quench Pump Engine 1	100	0.0032	15 ppm sulfur oil
Quench Pump Engine 2	100	0.0032	15 ppm sulfur oil
Quench Pump Engine 3	100	0.0032	15 ppm sulfur oil
Quench Pump Engine 4	100	0.0032	15 ppm sulfur oil
*IKO Monroe	100	20.0	Allowable SO_2 emission rate
*Guardian Industries	NA	132.6	Actual SO_2 emission rate
*Gerdau MacSteel Monroe	NA	6.1	Actual SO_2 emission rate

*Note: The only sources that will be modeled are the four main units at Monroe PP (Nos. 1-4) and the three interaction sources provided by MDEQ-AQD staff

Table 2 (Continued)

Outstate Michigan 1-Hour SO_2 NAAQS Designations
For Specified Large SO_2 Sources (Round 1 Sources)

DTE Energy Monroe Power Plant
SO_2 Source Stack Data

Stack Data	Stack: UTM Coordinates East (m)	North (m)	Base Elevation (feet)	Height (feet)	Type
MONPP Sources					
*Monroe Unit 1	305544	4640266	580	579	Vertical
*Monroe Unit 2	305535	4640261	580	579	Vertical
*Monroe Unit 3	305380	4640194	580	579	Vertical
*Monroe Unit 4	305370	4640192	580	579	Vertical
Auxiliary Boilers	305482	4640400	580	231	Vertical
Diesel Gen 11-1	305568	4640562	580	20	Vertical
Diesel Gen 11-2	305575	4640564	580	20	Vertical
Diesel Gen 11-3	305581	4640566	580	20	Vertical
Diesel Gen 11-4	305587	4640569	580	20	Vertical
Diesel Gen 11-5	305593	4640572	580	20	Vertical
Quench Pump Engine 1	305516	4640205	580	34.1	Vertical
Quench Pump Engine 2	305518	4640200	580	34.1	Vertical
Quench Pump Engine 3	305349	4640140	580	34.1	Vertical
Quench Pump Engine 4	305351	4640137	580	34.1	Vertical
Other Nearby Sources					
*IKO Monroe	300200	4644200	600	56.0	Vertical
*Guardian Industries	304915	4662490	620	199	Vertical
*Gerdau MacSteel Monroe	304524	4640317	580	133.7	Vertical

*Note: The only sources that will be modeled are the four main units at Monroe PP (Nos. 1-4) and the three interaction sources provided by MDEQ-AQD staff

Table 2 (Continued)

Outstate Michigan 1-Hour SO_2 NAAQS Designations
For Specified Large SO_2 Sources (Round 1 Sources)

DTE Energy Monroe Power Plant
SO_2 Source Stack Data

Refined Modeling Inputs

	Stack				
Point Source Data	Height (feet)	Inside Diam. (feet)	Exit Gas Flow (acfm)	Exit Velocity (ft/sec)	Exit Temp. (F)
MONPP Sources					
*Monroe Unit 1	579	28.0	2.15 E6	58.2	120
*Monroe Unit 2	579	28.0	2.15 E6	58.2	120
*Monroe Unit 3	579	28.0	2.15 E6	58.2	120
*Monroe Unit	579	28.0	2.15 E6	58.2	120
Auxiliary Boilers	231	9.0	5.41 E3	14.2	900
Diesel Generator 11-1	20	2.67	2.5 E3	74.4	750
Diesel Generator 11-2	20	2.67	2.5 E3	74.4	750
Diesel Generator 11-3	20	2.67	2.5 E3	74.4	750
Diesel Generator 11-4	20	2.67	2.5 E3	74.4	750
Diesel Generator 11-5	20	2.67	2.5 E3	74.4	750
Quench Pump Engine 1	34.1	0.5	1.6 E3	136	850
Quench Pump Engine 2	34.1	0.5	1.6 E3	136	850
Quench Pump Engine 3	34.1	0.5	1.6 E3	136	850
Quench Pump Engine 4	34.1	0.5	1.6 E3	136	850
Other Nearby Point Sources					
*IKO Monroe	56.0	4.00	3.05 E4	40.4	480
*Guardian Industries	199.0	8.50	1.11 E5	32.5	790
*Gerdau MacSteel Monroe	133.7	7.32	2.01 E5	64.0	403

*Note: The only sources that will be modeled are the four main units at Monroe PP (Nos. 1-4) and the three interaction sources provided by MDEQ-AQD staff

Table 2 (Continued)

Outstate Michigan 1-Hour SO_2 NAAQS Designations For Specified Large SO_2 Sources (Round 1 Sources)

DTE Energy Monroe Power Plant Structure Data

	Monroe Power Plant - Critical Buildings Affecting Main Unit / Aux Boiler / Diesel Gen Stack Downwash										
Monroe Power Plant Structure	Unit No(s).	Base Elevation (feet)	Height (feet)	Corner 1 UTME (m)	Corner 1 UTMN (m)	Corner 2 UTME (m)	Corner 2 UTMN (m)	Corner 3 UTME (m)	Corner 3 UTMN (m)	Corner 4 UTME (m)	Corner 4 UTMN (m)
SCR Roof	1	580	231.5	305436	4640358	305476	4640373	305483	4640358	305443	4640342
SCR Roof	2	580	231.5	305497	4640386	305537	4640401	305544	4640386	305504	4640371
SCR Roof	3	580	231.5	305345	4640322	305383	4640337	305392	4640320	305352	4640304
SCR Roof	4	580	231.5	305277	4640293	305314	4640309	305322	4640293	305284	4640278
Boiler House Roof	3 & 4	580	209.7	305244	4640361	305380	4640416	305386	4640403	305376	4640399
				305390	4640366	305263	4640313				
Boiler House Roof	1 & 2	580	207.5	305391	4640421	305545	4640483	305549	4640469	305544	4640466
				305558	4640432	305421	4640378	305406	4640416	305395	4640411
Turbine Building	1 - 4	580	108	305222	4640399	305366	4640458	305359	4640472	305391	4640485
				305397	4640471	305526	4640523	305542	4640483	305237	4640359
Limestone Silo	1 - 4	580	142	305448	4640192	305485	4640207	305489	4640197	305452	4640182
Limestone Prep Building	1 - 4	580	66	305460	4640161	305452	4640182	305489	4640197	305497	4640176
Gypsum Dewatering Building	1 - 4	580	73	305412	4640167	305444	4640180	305462	4640133	305430	4640120
Gypsum Storage Building	1 - 4	580	60	305314	4639981	305350	4640008	305410	4639928	305374	4639900
Water Treatment Bldg. 1 (Top Tier)	1 - 4	580	102	305354	4640163	305382	4640174	305381	4640179	305399	4640186
				305398	4640189	305351	4640170				
Water Treatment Bldg. 1 (Middle Tier)	1 - 4	580	44	305384	4640168	305403	4640176	305397	4640189	305352	4640170
				305354	4640163	305382	4640174				
Water Treatment Bldg. 1 (Lowest Tier)	1 - 4	580	28	305355	4640137	305386	4640150	305383	4640158	305406	4640168
				305398	4640189	305351	4640170	305355	4640159	305347	4640156
Water Treatment Bldg. 2 (Top Tier)	1 - 4	580	102	305520	4640228	305548	4640239	305547	4640243	305565	4640250
				305564	4640253	305518	4640234				
Water Treatment Bldg. 2 (Middle Tier)	1 - 4	580	44	305550	4640233	305569	4640240	305564	4640253	305517	4640234
				305520	4640228	305548	4640239				
Water Treatment Bldg. 2 (Lowest Tier)	1 - 4	580	28	305521	4640201	305552	4640214	305549	4640223	305573	4640233
				305564	4640253	305517	4640235	305522	4640223	305513	4640220
Wastewater Treatment - Hydrated Lime	1 - 4	580	65	305231	4639903	305254	4639958	305279	4639947	305257	4639892
North Hydrated Lime Tank	1 - 4	580	81.7	Center = 305251, 4639956, Diameter = 13.92 feet							
South Hydrated Lime Tank	1 - 4	580	81.7	Center = 305249, 4639952, Diameter = 13.92 feet							
Chem Waste Tank	1 - 4	580	35	Center = 305320, 4639889, Diameter = 203.4 feet							
Diesel Gen No. 11-1	DG 11-1	580	13	305564	4640568	305567	4640569	305572	4640555	305569	4640554
Diesel Gen No. 11-2	DG 11-2	580	13	305571	4640570	305574	4640572	305579	4640558	305576	4640556
Diesel Gen No. 11-3	DG 11-3	580	13	305576	4640572	305579	4640573	305584	4640559	305581	4640558
Diesel Gen No. 11-4	DG 11-4	580	13	305582	4640575	305586	4640577	305591	4640563	305587	4640561
Diesel Gen No. 11-5	DG 11-5	580	13	305588	4640578	305592	4640579	305597	4640565	305593	4640564
Makeup Water Building 1	1 - 4	580	65	305370.4	4640133.4	305370.2	4640134.9	305369.8	4640136.4	305369.1	4640137.8
				305368.1	4640139	305366.9	4640140	305365.5	4640140.7	305364	4640141.1
				305362.5	4640141.3	305360.9	4640141.1	305359.4	4640140.7	305358.1	4640140
				305356.9	4640139	305355.9	4640137.8	305355.2	4640136.4	305354.7	4640134.9
				305354.6	4640133.4	305354.7	4640131.8	305355.2	4640130.3	305355.9	4640129
				305356.9	4640127.8	305358.1	4640126.8	305359.4	4640126	305360.9	4640125.6
				305362.5	4640125.4	305364	4640125.6	305365.5	4640126	305366.9	4640126.8
				305368.1	4640127.8	305369.1	4640129	305369.8	4640130.3	305370.2	4640131.8

Note: Other buildings in the area are not modeled because the proposed source’s stacks are outside of the wake zone of these structures.

Table 2 (Continued)

Outstate Michigan 1-Hour SO_2 NAAQS Designations
For Specified Large SO_2 Sources (Round 1 Sources)

DTE Energy Monroe Power Plant
Structure Data

	Monroe Power Plant - Critical Buildings Affecting Main Unit / Aux Boiler / Diesel Gen Stack Downwash										
Monroe		Base		Corner 1		Corner 2		Corner 3		Corner 4	
Power Plant		Elevation	Height	UTME	UTMN	UTME	UTMN	UTME	UTMN	UTME	UTMN
Structure	Unit No(s).	(feet)	(feet)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
Makeup Water Building 2	1 - 4	580	65	305542.6	4640196.8	305542.4	4640198.3	305542.0	4640199.8	305541.2	4640201.2
				305540.2	4640202.4	305539.0	4640203.4	305537.7	4640204.1	305536.2	4640204.5
				305534.6	4640204.7	305533.1	4640204.5	305531.6	4640204.1	305530.2	4640203.4
				305529.0	4640202.4	305528.1	4640201.2	305527.3	4640199.8	305526.9	4640198.3
				305526.7	4640196.8	305526.9	4640195.2	305527.3	4640193.7	305528.1	4640192.4
				305529.0	4640191.2	305530.2	4640190.2	305531.6	4640189.4	305533.1	4640189.0
				305534.6	4640188.8	305536.2	4640189.0	305537.7	4640189.4	305539.0	4640190.2
				305540.2	4640191.2	305541.2	4640192.4	305542.0	4640193.7	305542.4	4640195.2
FGD Absorber	1	580	126	305569.8	4640267.8	305569.6	4640269.9	305569.0	4640271.9	305568.0	4640273.8
				305566.6	4640275.4	305565.0	4640276.7	305563.1	4640277.7	305561.1	4640278.3
				305559.0	4640278.5	305556.9	4640278.3	305554.9	4640277.7	305553.1	4640276.7
				305551.4	4640275.4	305550.1	4640273.8	305549.1	4640271.9	305548.5	4640269.9
				305548.3	4640267.8	305548.5	4640265.7	305549.1	4640263.7	305550.1	4640261.8
				305551.4	4640260.2	305553.1	4640258.9	305554.9	4640257.9	305556.9	4640257.3
				305559.0	4640257.1	305561.1	4640257.3	305563.1	4640257.9	305565.0	4640258.9
				305566.6	4640260.2	305568.0	4640261.8	305569.0	4640263.7	305569.6	4640265.7
FGD Absorber	2	580	126	305533.3	4640250.3	305533.1	4640252.5	305532.5	4640254.6	305531.5	4640256.5
				305530.1	4640258.2	305528.4	4640259.5	305526.5	4640260.6	305524.4	4640261.2
				305522.2	4640261.4	305520.1	4640261.2	305518.0	4640260.6	305516.1	4640259.5
				305514.4	4640259.2	305513.0	4640256.5	305512.0	4640254.6	305511.4	4640252.5
				305511.2	4640250.3	305511.4	4640248.2	305512.0	4640246.1	305513.0	4640244.2
				305514.4	4640242.5	305516.1	4640241.1	305518.0	4640240.1	305520.1	4640239.5
				305522.2	4640239.2	305524.4	4640239.5	305526.5	4640240.1	305528.4	4640241.1
				305530.1	4640242.5	305531.5	4640244.2	305532.5	4640246.1	305533.1	4640248.2
FGD Absorber	3	580	126	305413.0	4640204.0	305412.8	4640206.1	305412.2	4640208.1	305411.2	4640209.9
				305409.9	4640211.6	305408.2	4640212.9	305406.4	4640213.9	305404.4	4640214.5
				305402.3	4640214.7	305400.2	4640214.5	305398.2	4640213.9	305396.3	4640212.9
				305394.7	4640211.6	305393.4	4640209.9	305392.4	4640208.1	305391.8	4640206.1
				305391.6	4640204.0	305391.8	4640201.9	305392.4	4640199.9	305393.4	4640198.0
				305394.7	4640196.4	305396.3	4640195.0	305398.2	4640194.0	305400.2	4640193.4
				305402.3	4640193.2	305404.4	4640193.4	305406.4	4640194.0	305408.2	4640195.0
				305409.9	4640196.4	305411.2	4640198.0	305412.2	4640199.9	305412.8	4640201.9
FGD Absorber	4	580	126	305375.5	4640188.1	305375.3	4640190.2	305374.6	4640192.3	305373.6	4640194.2
				305372.2	4640195.9	305370.6	4640197.3	305368.6	4640198.3	305366.6	4640199.0
				305364.4	4640199.2	305362.2	4640199.0	305360.2	4640198.3	305358.2	4640197.3
				305356.6	4640195.9	305355.2	4640194.2	305354.2	4640192.3	305353.5	4640190.2
				305353.3	4640188.1	305353.5	4640185.9	305354.2	4640183.8	305355.2	4640181.9
				305356.6	4640180.2	305358.2	4640178.9	305360.2	4640177.8	305362.2	4640177.2
				305364.4	4640177.0	305366.6	4640177.2	305368.6	4640177.8	305370.6	4640178.9
				305372.2	4640180.2	305373.6	4640191.9	305374.6	4640183.8	305375.3	4640185.9

Note: Other buildings in the area are not modeled because the proposed source's stacks are outside of the wake zone of these structures.

Table 2 (Continued)

Outstate Michigan 1-Hour SO_2 NAAQS Designations
For Specified Large SO_2 Sources (Round 1 Sources)

DTE Energy Monroe Power Plant
Modeling Input Parameters

<u>Building Data</u>

Building Influence Model: BPIP (Version 8.80, dated 04274)

Refined Model:	AERMOD (BEE-Line Version 11.00, dated 14134)
Model Options:	Terrain elevations considered - Yes
	Dispersion coefficients - Rural
	Default wind exponents - Yes
	Default vertical temperature gradients - Yes
	Emissions scaled - No
	Final plume rise - Yes
	Stack tip downwash - Yes
	Buoyancy induced dispersion - Yes
	Calm processing routine - Yes
	Regulatory default option - Yes
	Type of pollutant – SO_2
Meteorological Data:	Surface – Monroe Custer Airport (TTF)
	Upper Air – White Lake NWS Office (DTX)
	Dates – 2012-2014
	Anemometer height – 10 m

Property Line Receptor Grid
Grid: 25 m spacing at the fence line
Receptor Grid (1st Grid)
Grid Type: Rectangular
Grid: 50m spacing outside of the fence line out to 2 km from the facility
Receptor Grid (2nd Grid)
Grid Type: Rectangular
Grid: 250 m spacing outside of the 1st Grid to 5 km from the facility
Receptor Grid (3rd Grid)
Grid Type: Rectangular
Grid: 500 m spacing outside of the 2nd Grid to 10 km from the facility

Figure 1

Outstate Michigan 1-Hour SO_2 NAAQS Designations
For Specified Large SO_2 Sources (Round 1 Sources)

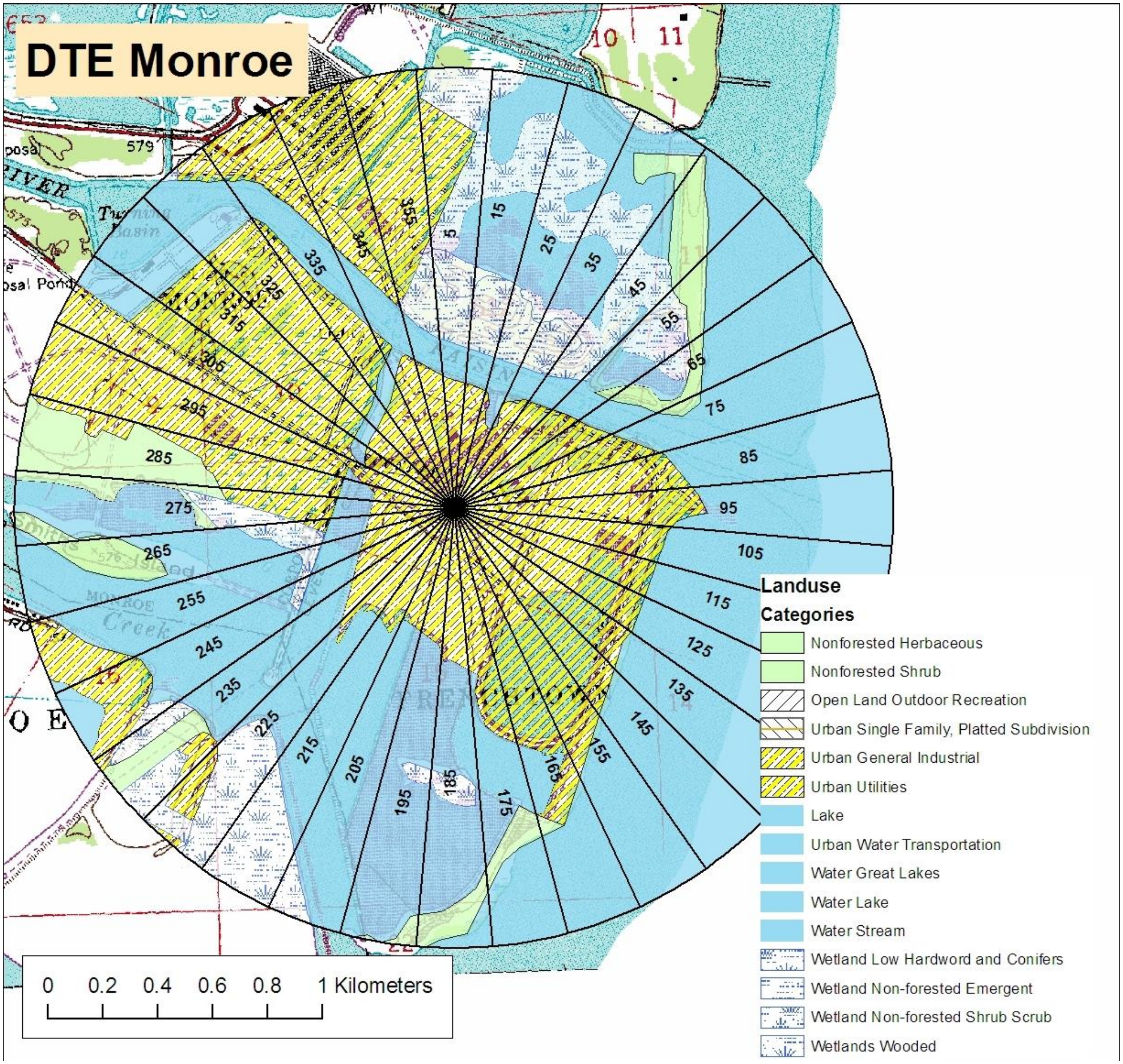
Monroe Power Plant

Aerial Photograph from 2006
(Prior to FGD Installation on all Four Units)

Figure 2

Outstate Michigan 1-Hour SO_2 NAAQS Designations
For Specified Large SO_2 Sources (Round 1 Sources)

Land Use Diagram for Sectors Surrounding DTE Energy's Monroe Power Plant



This page left intentionally blank.

Dispersion Modeling Report

1-Hour SO_2 NAAQS Area Designation
J.H. Campbell Generating Station
Consumers Energy Company

Prepared for:

Consumers Energy Company
1945 W. Parnall Road
Jackson, Michigan 49201

Prepared by:

Horizon Environmental Corporation
4771 50th Street SE, Suite One
Grand Rapids, Michigan 49512

July 15, 2015

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ATTACHMENTS

1 INTRODUCTION

On behalf of the Consumers Energy Company ("Consumers"), Horizon Environmental Corporation ("Horizon") has conducted ambient air quality dispersion modeling analyses to demonstrate that the area surrounding the J.H. Campbell Generating Complex (SRN: B2835) is in attainment with the 1-hour sulfur dioxide ("SO_2") national ambient air quality standard ("NAAQS"). The dispersion modeling analyses were conducted in accordance with the relevant provisions of the draft *SO_2 NAAQS Designations Modeling Technical Assistance Document* (the "Modeling TAD", U.S. EPA, December 2013), the *Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standard* (U.S. EPA, March 20, 2015), and *Guidance for 1-Hour SO_2 Nonattainment Area SIP Submissions* (U.S. EPA, April 23, 2014). Moreover, the dispersion modeling analyses were conducted consistent with a protocol submitted to the Michigan Department of Environmental Quality, Air Quality Division ("AQD") on May 28, 2015 and subsequently approved by the U.S. EPA, Region 5.

This submittal constitutes the technical report summarizing the methodology and results of the dispersion model simulations that Consumers conducted in support of the 1-hour SO_2 NAAQS attainment designation. A description of the J.H. Campbell ("Campbell") Generating Complex, including a discussion of the SO_2 emissions data that were analyzed in support of the attainment designation, is provided in **Section 2**. The dispersion model, databases, and methodology employed in the analysis, as well as resultant model-predicted impacts, are detailed in **Section 3**.

1.1 REGULATORY FRAMEWORK FOR SO_2 AREA DESIGNATION

On June 2, 2010, the U.S. EPA established for the first time a primary 1-hour SO_2 NAAQS,[1] while at the same time revoking both the existing 24-hour and annual primary SO_2 NAAQS. Attainment with the new standard in an airshed is demonstrated when the 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average SO_2 concentrations does not exceed 75 ppb. To date, attainment designations have been established for 29 areas in 16 states. On March 2, 2015, the U.S. District Court for the Northern District of California entered a Consent Decree and issued an enforceable order for the U.S. EPA to complete its area designations according to a specified time schedule.

[1] The 1-hour standard became effective on August 23, 2010.

Based on current SO_2 emission levels, an attainment designation for the area surrounding the Campbell Generating Complex must be completed no later than July 2, 2016. The U.S. EPA has requested that the states, including Michigan, submit their designation recommendations by September 18, 2015. Considering the accelerated submittal schedule and limited representative ambient monitoring data, designation recommendations for the area surrounding the Campbell Generating Complex will be based on source modeling.

In contrast to a typical 1-hour SO_2 NAAQS compliance demonstration, the Modeling TAD recommends that an area designation request follow an ambient monitoring approach by conducting the modeling analyses as follows:

- Use actual emissions as an input for assessing violations to provide results that reflect current actual air quality;
- Conduct three years of modeling to calculate a simulated design value consistent with the 3-year monitoring period required to develop a design value;
- Place receptors only in locations where a monitor could be reasonably placed; and
- When simulating actual emission rates, use actual stack heights rather than stack heights based on good engineering practice (if different).

Upon the request of the AQD and in order to support them with their area designation recommendations, Consumers conducted air quality dispersion modeling analyses to assess compliance with the 1-hour SO_2 NAAQS in the area surrounding the Campbell Generating Complex. Consumers followed the approach recommended in the Modeling TAD, deviating only to the extent that more site-specific guidance was provided by the U.S. EPA Region 5 or the AQD, or an emissions strategy more conservative than one based on actual emissions is sufficient to demonstrate attainment with the standard.

2 FACILITY DESCRIPTION

The Campbell Generating Complex is located at 17000 Croswell, West Olive, Michigan. Emission units operating at the Campbell Generating Complex are covered under ROP No. MI-ROP-B2835-2013, and Permit to Install Nos. 39-15 and 18-15. The location of the Campbell Generating Complex in relation to the surrounding area is illustrated in **Figure 1**.

2.1 INVENTORY OF COMBUSTION SOURCES

The primary steam-generating units for electric generation at the Campbell Generating Complex are identified as JHC1, JHC2 and JHC3. Though not often used, the Campbell Generating Complex also has the capacity to generate electricity from a small capacity combustion turbine. These combustion units as well as other smaller combustion units operating at the Campbell Generating Complex that have the potential to emit SO_2 (i.e., excluding units which are limited to firing natural gas or propane only via enforceable restriction/design) are summarized as follows:

- One 2,490 MMBtu/hr coal-fired boiler with fuel oil startup ("JHC1");
- One 3,560 MMBtu/hr coal-fired boiler with fuel oil startup ("JHC2");
- One 8,240 MMBtu/hr coal-fired boiler with fuel oil startup ("JHC3");
- One 233 MMBtu/hr distillate oil-fired combustion turbine;
- One auxiliary distillate oil-fired boiler, rated at 17 MMBtu/hr;
- Two auxiliary distillate oil-fired boilers, each rated at 9.8 MMBtu/hr;
- One 380 Hp diesel-fired emergency fire water pump engine;
- Three diesel-fired emergency boiler house water pump engines (each <10 MMBtu/hr); and
- Four diesel-fired emergency generators of various sizes (each <10 MMBtu/hr).

Considering their heat input capacity, fuel type, and historical and projected operations, the area designation modeling analyses included emissions from JHC1, JHC2, JHC3, and the combustion turbine.

2.1.1 Emergency Generators and Pumps

The four diesel-fired emergency generator engines and four diesel-fired emergency water pump engines listed in the last three bullet points above in 2.1 are intermittent sources that operate only during emergency situations (or readiness testing). Actual operation of the emergency engines for the previous two years, as recorded by an hour meter, is summarized as follows[2]:

2013

EUCATDIESEL – 16 hours
EUHPHSWP15001 – 1.5 hours
EUHPHSWP15002 – 1.8 hours
EUHPHSWP3000 – 1.3 hours
EUCAT3DIESEL – 6.9 hours
EUCUMMINSDIESEL – 59.6 hours
2000KW Generator – 13.4 hours
890 KWh Generator – 14.4 hours

2014

EUCATDIESEL – 28 hours
EUHPHSWP15001 – 6.2 hours
EUHPHSWP15002 – 9.2 hours
EUHPHSWP3000 – 14.4 hours
EUCAT3DIESEL – 12.4 hours
EUCUMMINSDIESEL – 24.5 hours
2000 KW Generator – 10.9 hours
890 KWh Generator – 19.8 hours

As shown above, the emergency generators and pumps operate as intermittent sources. Therefore, consistent with Section 5.4 of the Modeling TAD, modeling of these intermittent sources was not conducted as part of the area designation analysis.

2.1.2 Auxiliary Boilers

The 17 MMBtu/hr auxiliary boiler services JHC1 and JHC2, providing necessary heat during unit startup and shut down conditions or for general building heat when both utility boilers are offline. Accordingly, the auxiliary boiler is not operated concurrently with JHC1 and JHC2 when those units are operating at typical load conditions. It should

[2] The last two emergency generators do not yet have official Emission Unit designations as they have not yet been incorporated into the facility Renewable Operating Permit.

be further noted that recently issued Permit to Install No. 18-15 imposes a 10% capacity factor limitation on the JHC 1 and 2 auxiliary boiler, and that this boiler was also used to supply steam to a flue gas conditioning system which was retired in early 2013. The two 9.8 MMBtu/hr auxiliary boilers are also limited in their use as they also provide heat to facilitate startup and shutdown or for general building heating purposes when Unit 3 is offline. Fuel usage in the three auxiliary boilers during the three-year period covered by the area designation analysis (2012-2014) has been limited to ultra-low sulfur diesel ("ULSD") even though the station's Renewable Operating Permit ("ROP") allows for a higher sulfur content distillate.

Actual fuel usage for the three year period has been tracked and is summarized in **Table 1**. Using the heat input rating of the boilers and the heating value of ULSD (138,000 Btu/gallon), the actual monthly fuel usage has been converted to an equivalent monthly hours of operation. As shown in **Table 1**, the boilers are rarely used more than 100 hours in any given month.

Considering their low heat input rating, fuel sulfur content, and intermittent use, modeling of the three auxiliary boilers was not conducted as part of the area designation analysis.

2.2 EMISSIONS CHARACTERIZATION

Pursuant to the Modeling TAD, area designation modeling may be conducted following an "actual emissions" approach or, if sufficient to demonstrate compliance with the 1-hour standard, a more conservative approach based on allowable emissions. Actual emissions data is beneficial for assessing whether an area has been in attainment with the 1-hour SO_2 NAAQS, but may have limited benefit looking forward if a source is in the process of implementing an emissions control strategy. In that event, future actual emissions will likely be much lower than recent historical actual emissions. Similarly, federally-enforceable allowable emission limits for the source are also typically lower after implementation of the control strategy.

Such is the case with JHC1, JHC2 and JHC3. In November 2014, Consumers entered into a Consent Decree ("Consumers CD") with the Environmental Protection Agency (EPA) and Department of Justice (DOJ). On April 16, 2015, the AQD issued Permit to Install No. 39-15, which contains federally-enforceable emission limits and operating restrictions for the three units based on the implementation of an enhanced SO_2 emissions control strategy mandated by the Consumers CD. As stipulated by the permit, JHC1 and

JHC2 will be equipped with dry sorbent injection ("DSI") systems, operation of which must commence no later than June 30, 2016; JHC3 will be equipped with a spray dry absorber ("SDA"), operation of which must commence no later than December 31, 2016.

Historically, the only SO_2 emission limits for JHC Units 1 and 2 consisted of lb/mmBtu emission limits (calendar month average) which originated from Michigan Air Pollution Control Rule 336.1401, while the SO_2 emission limit for Unit 3 consisted of a lb/mmBtu emission limit (3-hour average) originating from 40 CFR Part 60, Subpart D. For each of the JHC units, the Consumers CD introduces the following additional SO_2 emission limits based on application of the required DSI/SDA controls: JHC1 = 30-day and 90-day rolling lb/mmBtu limits; JHC2 = 365-day rolling lb/mmBtu limit; JHC3 = 30-day and 365-day rolling lb/mmBtu limits.

The historic SO_2 lb/mmBtu emission limits (based on Michigan Air Pollution Control Rule 336.1401/40 CFR 60, Subpart D) and the new 30-day (JHC1 & 3) and 365-day (JHC2) rolling SO_2 emission limits and resultant allowable mass emission rates for the three units and the combustion turbine, are shown in **Table 2**. The effect of the emissions control strategy is to reduce the SO_2 combined potential to emit of the four emission units from 20,381 pounds per hour to 3,100 pounds per hour (an 85% reduction).

2.2.1 Modeled Emission Rates for Area Designation

Considering the enhanced SO_2 emissions control strategy mandated by the Consumers CD, now stipulated in a Permit to Install, substantial reductions in the SO_2 emissions profile for the Campbell Generating Complex will commence in 2016. Under this future operating scenario, SO_2 impacts due to the Campbell Generating Complex (modeled or otherwise measured at a recently installed ambient monitor located adjacent to the facility) are expected to be well under the NAAQS over all regulated averaging periods.

However, by court order an attainment designation for the area surrounding the Campbell Generating Complex must be completed no later than July 2, 2016. This precedes the date that implementation of the enhanced SO_2 emissions control strategy at the Campbell Generating Complex may be completed, and for which a sufficient amount of actual emissions data with the required DSI/SDA controls in place will have been recorded. Therefore, to demonstrate that the area surrounding the Campbell Generating Complex is currently in attainment with the 1-hour SO_2 NAAQS, model simulations of actual hourly emissions from Units 1-3 for the three-year period of 2012-2014, as measured with continuous emissions monitoring systems ("CEMS") that comply with the procedures contained in 40 CFR Part 75, were conducted. This methodology is more conservative than using allowable emission rates as future emissions will be substantially reduced with the additional pollution control equipment to be installed and operated.

Actual hourly SO_2 emissions data utilized for the modeling analyses was coupled with hourly actual exhaust velocity and temperature data also gathered using the CEMS. The standard missing data substitution procedures contained in Subpart D of 40 CFR Part 75 was used for any periods of missing SO_2 mass emission rate or flow rate CEMS data. The hourly CEMS data input to AERMOD is provided in electronic format in **Attachment A**, while **Attachment B** summarizes any SO_2 or Flow CEMS missing hourly data associated with the three year period. Please note that CEMS for JHC3 are located in separate “A” and “B” ducts located upstream of the stack, so missing data is assessed for each duct-level monitoring system.

For the combustion turbine, Consumers modeled a SO_2 emission rate consistent with continuous operation at rated capacity, but based upon a sulfur content of 15 ppm (consistent with the diesel fuel currently being used at the plant). Based on the SO_2 emission factor in AP-42 Table 3.1-2a, the SO_2 emission rate for 15 ppm sulfur is 1.515E-03 lb/mmBtu or 0.353 lbs/hour at the rated heat input of 233 mmBtu/hr. Based on the limited operating hours of this unit in the past few years, this is a very conservative approach as the unit operates very intermittently.

3 DISPERSION MODEL AND MODELING DATABASES

Ambient air quality dispersion modeling analyses were conducted to demonstrate that the area surrounding the Campbell Generating Complex should be designated in attainment with the 1-hour SO_2 NAAQS. The following sections summarize the dispersion model that was employed in the analysis, site area characteristics, modeling databases developed in support of the analysis, the methodology for conducting the compliance demonstration, and resultant modeled impacts.

3.1 DISPERSION MODEL

Model simulations in support of the 1-hour SO_2 NAAQS area designation were conducted using the AMS/EPA Regulatory Model ("AERMOD", Release No. 14134) [3]. AERMOD is currently recommended and approved for use in near-field SO_2 modeling applications by both the U.S. EPA and the AQD. AERMOD is designed to simulate conditions associated with this area designation, including:

- Rural dispersion conditions;
- Both windy and calm meteorological conditions;
- Flat and simple terrain;
- Elevated point sources influenced by building downwash;
- Transport less than 50 kilometers; and
- Concentration estimates over a one-hour averaging period.

The AERMOD simulations were conducted in the Regulatory Default mode.

3.2 LAND USE CLASSIFICATION AND DISPERSION MODE

Atmospheric conditions affecting the downwind dispersion of air contaminants may be influenced by localized land use. Further, an exponential decay of SO_2 may occur during dispersion in an urban environment. As a result, AERMOD has been designed to

[3] In their review of the dispersion modeling protocol, the U.S. EPA Region 5 noted the imminent release of a new version of AERMOD. As of the date of this submittal, the new version of AERMOD has not been released to the public and was, therefore, not available to be used in the analysis.

simulate the downwind dispersion of SO_2 under both rural and urban conditions. To assess whether to run AERMOD in rural or urban mode for a particular application, the U.S. EPA's Guideline on Air Quality Models suggests using either a population density procedure or a land use classification procedure employing a typing scheme developed by Auer[4]. Of the two methods, the U.S. EPA considers the land use procedure to be the more definitive.

The Auer land use classification procedure is conducted as follows:

1) Classify the land use within the total area, A_o, circumscribed by a three kilometer radius circle around the source using Auer's land use typing scheme;

2) If land use types I1, I2, C1, R2, and R3 account for 50 percent or more of A_o, use urban dispersion coefficients; otherwise, use appropriate rural dispersion coefficients.

Consistent with U.S. EPA guidance, Auer's land use typing scheme was utilized to assess localized land use for the Campbell Generating Complex. The land use typing scheme is summarized in **Table 3**.

The Campbell Generating Complex is located in West Olive, a low population density area between Grand Haven and Holland. Utilizing satellite imagery, shown in **Figure 1**, land use within a three kilometer radius around the complex has been assessed and clearly exhibits rural characteristics (e.g., agricultural, undeveloped, and water surfaces). As a result, AERMOD simulations in support of the SO_2 NAAQS area designation for the Campbell Generating Complex were conducted in rural mode.

3.3 AERODYNAMIC DOWNWASH EFFECTS

As described in Section 2.1, the SO_2 NAAQS area designation analysis for the Campbell Generating Complex will include the following emission units:

- Two coal-fired boilers (JHC1 and JHC2) that vent to a common stack with a height of 400 feet;
- One coal-fired boiler (JHC3) that vents to a 642 foot tall stack; and

[4] Correlation of Land Use and Cover with Meteorological Anomalies, Journal of Applied Meteorology, 1978.

- One ULSD combustion turbine that vents to a 17 foot tall stack.

The coal-fired boiler stacks and the turbine stack are each lower than Good Engineering Practice ("GEP") height. Plumes emitted from stacks with heights less than GEP design may be influenced by nearby buildings or other structures. In accordance with Section 6.1 of the Modeling TAD, the BPIP-PRIME aerodynamic downwash pre-processor (Release No. 04274) was utilized to estimate the maximum projected lateral and vertical dimensions of those buildings or structures that could influence the boiler and turbine stacks on a wind direction-specific basis.

BPIP-PRIME requires as input the dimensions of buildings or structures that could potentially influence emissions from a stack that is located at a distance less than five times the lesser dimension of height or projected width of the nearby structure. Maximum projected lateral and vertical dimensions of influencing structures, as calculated by BPIP-PRIME, are subsequently input to AERMOD. Two existing Boiler Houses and related structures, the turbine housing and a large fuel oil storage tank have the potential to influence the plumes emitted from the boiler and/or turbine stacks.

A three dimensional depiction of the preceding structures in relation to modeled emission points is provided in **Figure 2**.

3.4 RECEPTOR POINTS AND TERRAIN ELEVATION

AERMOD-predicted concentrations may be estimated at discrete receptor locations. A discrete cartesian-based receptor grid was developed in support of the area designation analysis according to the following methodology:

- Receptors were located along the secured property boundary at distances not exceeding 50 meters.
- Receptors were located off-property at 100 meter spacing out to a distance of approximately 2 kilometers from the facility.
- Additional receptors were located off-property at 200 meter spacing out to a distance of approximately 10 kilometers from the facility.
- Additional receptors were located off-property at 500 meter spacing out to a distance of approximately 20 kilometers from the facility.
- Additional receptors were located off-property at 1 kilometer spacing out to a distance of approximately 50 kilometers from the facility.

- Consistent with the Modeling TAD, receptors were located only where a monitor could reasonably be placed. Therefore, receptors were not located over Lake Michigan or Pigeon Lake, both of which are adjacent to the facility.

In addition to the preceding rector grids, an additional “nested” receptor grid at 100 meter spacing was placed in the area of the maximum impacts based on the form of the 1-hour SO_2 NAAQS (i.e., 3-year average of the 99^{th} percentile daily 1-hour maximum concentrations) as these impacts were occurring beyond 2 kilometers from the facility.

Fenceline and nearby receptors are shown in **Figure 3**. The full receptor grid used in the SO_2 NAAQS area designation analysis consisted of 12,447 discrete receptor points and is illustrated in **Figure 4**. The nested receptor grid, which was sufficient to identify the maximum impact based on the form of the 1-hour SO_2 NAAQS, consisted of 121 discrete receptor points and is illustrated in **Figure 5**.

Elevated terrain features may affect the transport of atmospheric contaminants as well as serve as areas of potentially higher pollutant impacts. Where appropriate, terrain features should be included in the modeling analysis. A review of topographic projection data reveals fluctuations in terrain elevations around the Campbell Generating Complex. In accordance with U.S. EPA guidance, terrain elevations for each modeled stack and receptor point were included in the dispersion modeling analysis.

Terrain elevations at stack locations and discrete receptor points were obtained using the U.S. EPA’s AERMAP preprocessor (Release No. 11103)[5] in conjunction with U.S.G.S National Elevation Dataset (“NED”) terrain files in NAD83 format.

3.5 METEOROLOGICAL DATA

The form of the SO_2 NAAQS is based on a 3-year average of the annual 99^{th} percentile of the 1-hour daily maximum concentrations. Consistent with the Modeling TAD, the area designation analysis was conducted using the most spatially representative and readily available meteorological database for the most recent three calendar years (2012-2014).

The Campbell Generating Complex is located along the Lake Michigan shoreline nearly equidistant from two National Weather Service (“NWS”) Automated Surface Observing

[5] Terrain processing was conducted using the AERMAP module of the AERMODView software system, Version 8.8.9, developed by Lakes Environmental.

System stations: the Muskegon County Airport (Station No. 14840) and the Tulip City Airport in Holland (Station No. 12636). Both stations have recorded 1-minute surface observations for the period 2012-2014. Using the AERMET preprocessor, the AQD compiled the Muskegon station observations along with coincident upper air observations measured at the NWS station in Green Bay, Wisconsin (Station No. 72645), while the Holland station observations were compiled along with coincident upper air observations measured at the NWS station in White Lake, Michigan (Station No. 72632). Because upper air observations measured at Green Bay may better represent atmospheric conditions approaching the Campbell Generating Complex, versus the White Lake station which is located over 150 miles downwind of the facility, the model simulations supporting the SO_2 NAAQS area designation were conducted using the Muskegon/Green Bay meteorological database, as processed and provided by the AQD in a 1-minute format.

A three-year composite wind rose for Muskegon, covering the years 2012-2014, is provided in **Figure 6**. The wind frequency distribution revealed in the figure exhibits seasonal variation in wind flow patterns as well as the likely variable influence of the sea breeze circulation, which would be expected to occur at a facility located along the Lake Michigan shoreline.

3.6 DISPERSION MODELING METHODOLOGY

Dispersion model simulations of the Campbell Generating Complex were conducted to provide the information necessary to designate the area in attainment with the 1-hour SO_2 NAAQS. The model simulations were conducted with AERMOD using over a three-year meteorological database (2012-2014 Muskegon/Green Bay). As described in **Section 2.2.1**, the simulations were based on hourly actual emissions, temperature, and flow rate data for the three primary boilers (JHC1, JHC2 and JHC3) during the three-year period and representative emissions for the combustion turbine. The hourly emissions and operating data was simulated in AERMOD using the HOUREMIS command. Stack exhaust parameters for the modeled emission units is provided in **Table 4**.

The first step in the modeling analysis was to compare maximum predicted 1-hour impacts at each receptor point against the interim 1-hour significant impact level ("SIL") of 3 ppb (7.8 µg/m^3) published in the *"General Guidance for Implementing the 1-hour SO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour SO_2 Significant Impact Level"* (U.S. EPA, August 23, 2010). Maximum predicted 1-hour SO_2 impacts across the three-year meteorological database are summarized in **Table 5**. As shown in the table, the maximum of the three-year average of the maximum 1-hour SO_2 concentrations is 222.3 µg/m^3, which is well above the SIL.

Cumulative modeling analyses, taking into account additional sources that could contribute to the area of significant impacts (i.e., receptor points where model-predicted impacts are greater than the SIL) generated by the facility are typically conducted for each receptor point contained within the significant impact area ("SIA"). The AQD has conducted an analysis of additional sources in the area around the Campbell Generating Complex and has determined that none of the sources is expected to have a significant impact within the Campbell Generating Complex SIA. Therefore, no additional sources were included in the area designation modeling.

In order to assess compliance with the 1-hour SO_2 NAAQS, the model calculates the 99th percentile of the annual distribution of daily maximum 1-hour average SO_2 concentrations across the three-year meteorological database. As part of a cumulative modeling analysis, this design concentration is subsequently combined with a representative background design concentration. If this combined impact is less than 75 ppb (196 µg/m^3), then the area is designated as being in attainment with the 1-hour SO_2 NAAQS.

The AQD has provided a background design concentration of 10.3 ppb (27 µg/m^3). This value represents the 99th percentile 1-hour SO_2 concentration measured at the Grand Rapids ambient monitor for the period 2012-2014. As a conservative "first tier" approach, this background design concentration was combined with the modeled design concentration.

Adhering to the form of the standard, the 99th percentile of the annual distribution of daily maximum 1-hour average SO_2 concentrations across the three-year meteorological database was predicted by AERMOD at 112.0 µg/m^3. Summing the model-predicted impact with the AQD-provided background concentration results in a combined impact of 139 µg/m^3, which is well under the 1-hour SO_2 NAAQS of 196 µg/m^3 (75 ppb). Therefore, dispersion modeling analyses have demonstrated that the area surrounding the Campbell Generating Complex is in attainment with the 1-hour SO_2 NAAQS.

Consumers also notes that the AQD has installed a SO_2 ambient air quality monitoring station in West Olive, just north/northeast of the JH Campbell Plant. This station has been collecting data since January 24, 2015 and the highest observed 1-hour average SO_2 concentration as of July 13, 2014 has been 53 ppb (06/10/2015), or the equivalent of 138.5 µg/m^3. Although limited SO_2 ambient data has been collected thus far and a maximum 1-

hour average concentration is not directly comparable to the form of the 1-hour SO_2 NAAQS, this limited monitoring data further supports the concept that the JH Campbell Plant is not causing or contributing to an exceedance of the 1-hour SO_2 NAAQS.

Modeled impacts are compared against the 1-hour SO_2 NAAQS in **Table 6**. The location of the 99th percentile daily 1-hour maximum concentration is shown in **Figure 7**. An electronic copy of all AERMOD and model preprocessor input/output files is submitted along with this technical report on DVD-ROM.

FIGURES

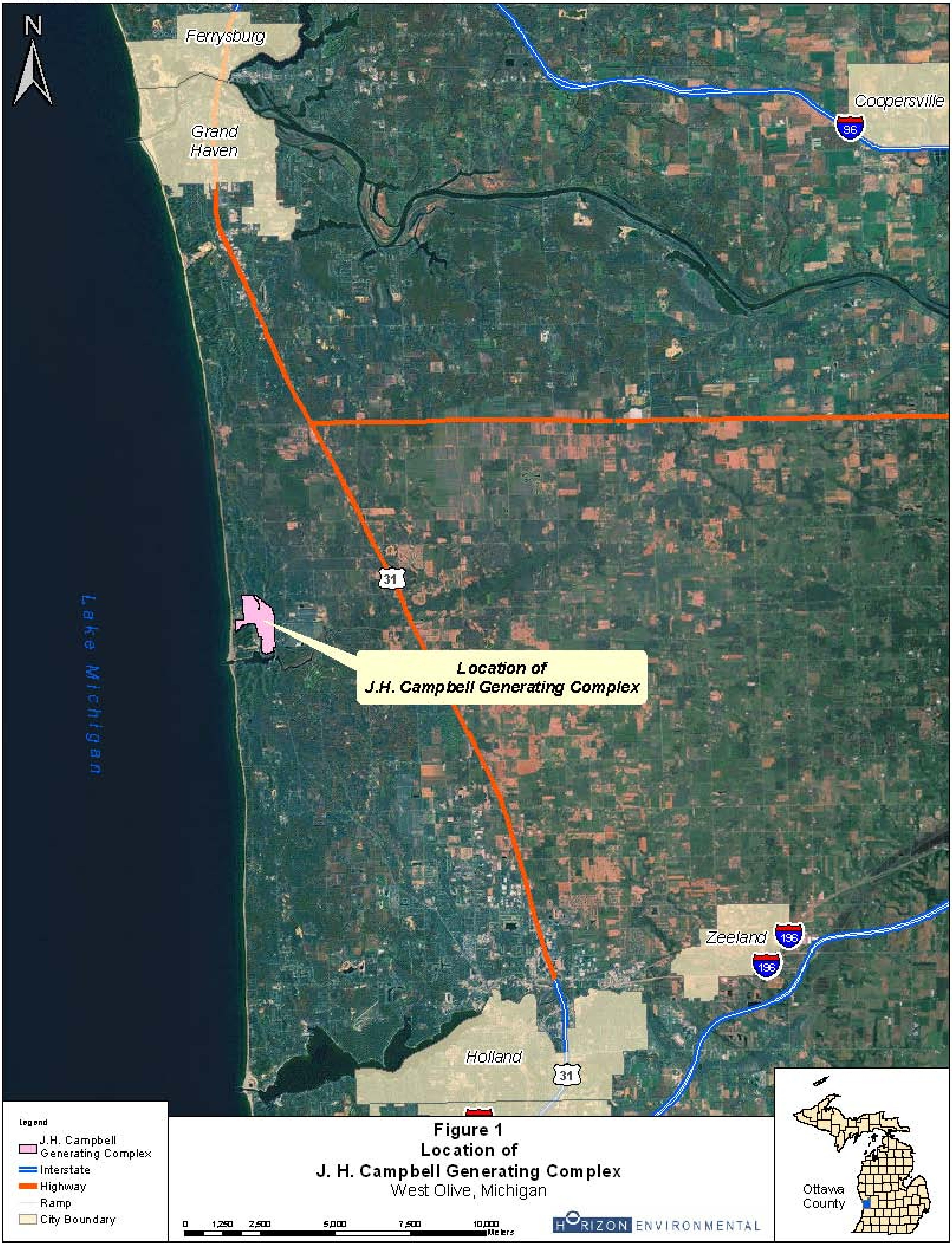


Figure 1
Location of
J. H. Campbell Generating Complex
West Olive, Michigan

HORIZON ENVIRONMENTAL

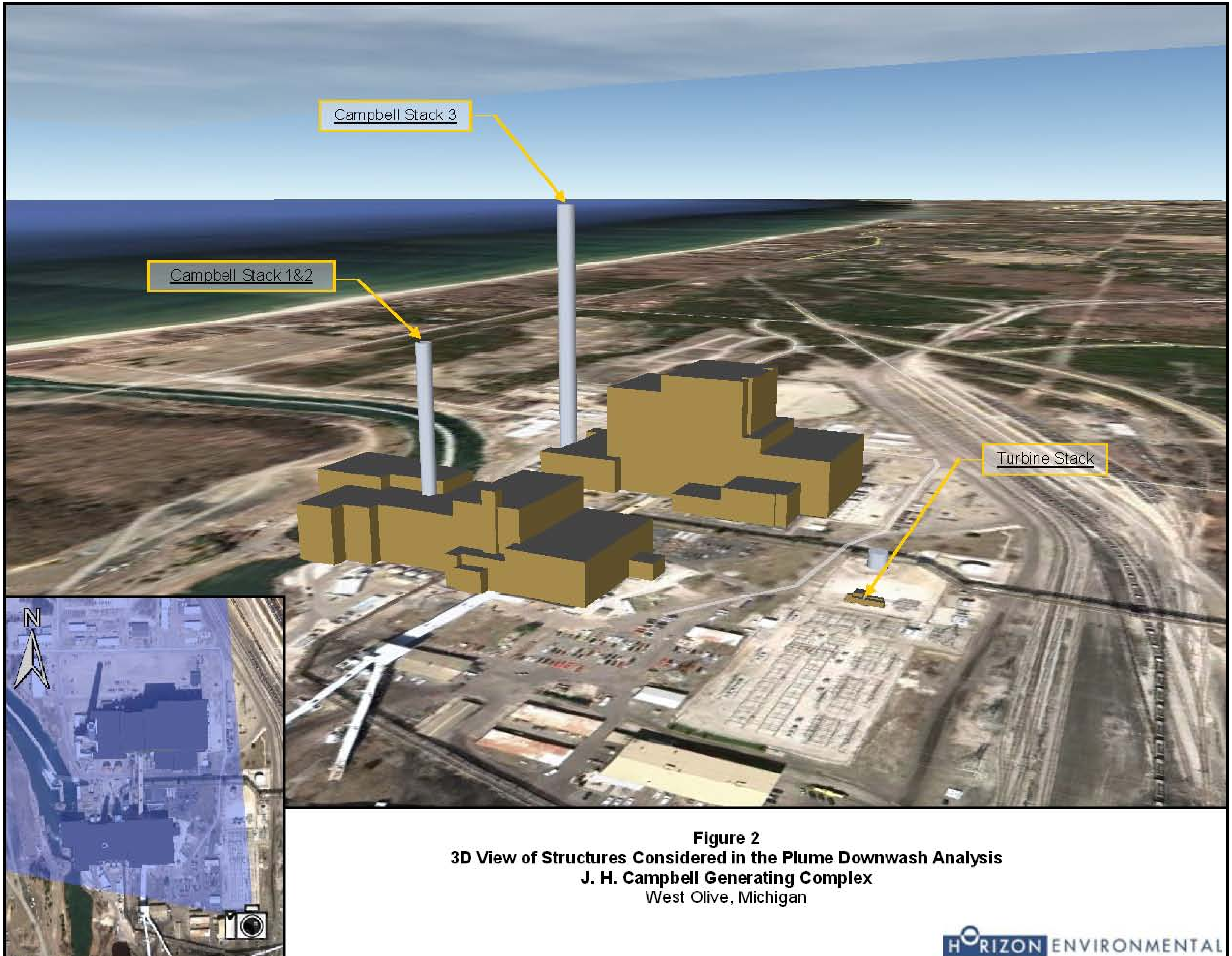


Figure 2
3D View of Structures Considered in the Plume Downwash Analysis
J. H. Campbell Generating Complex
West Olive, Michigan

HORIZON ENVIRONMENTAL

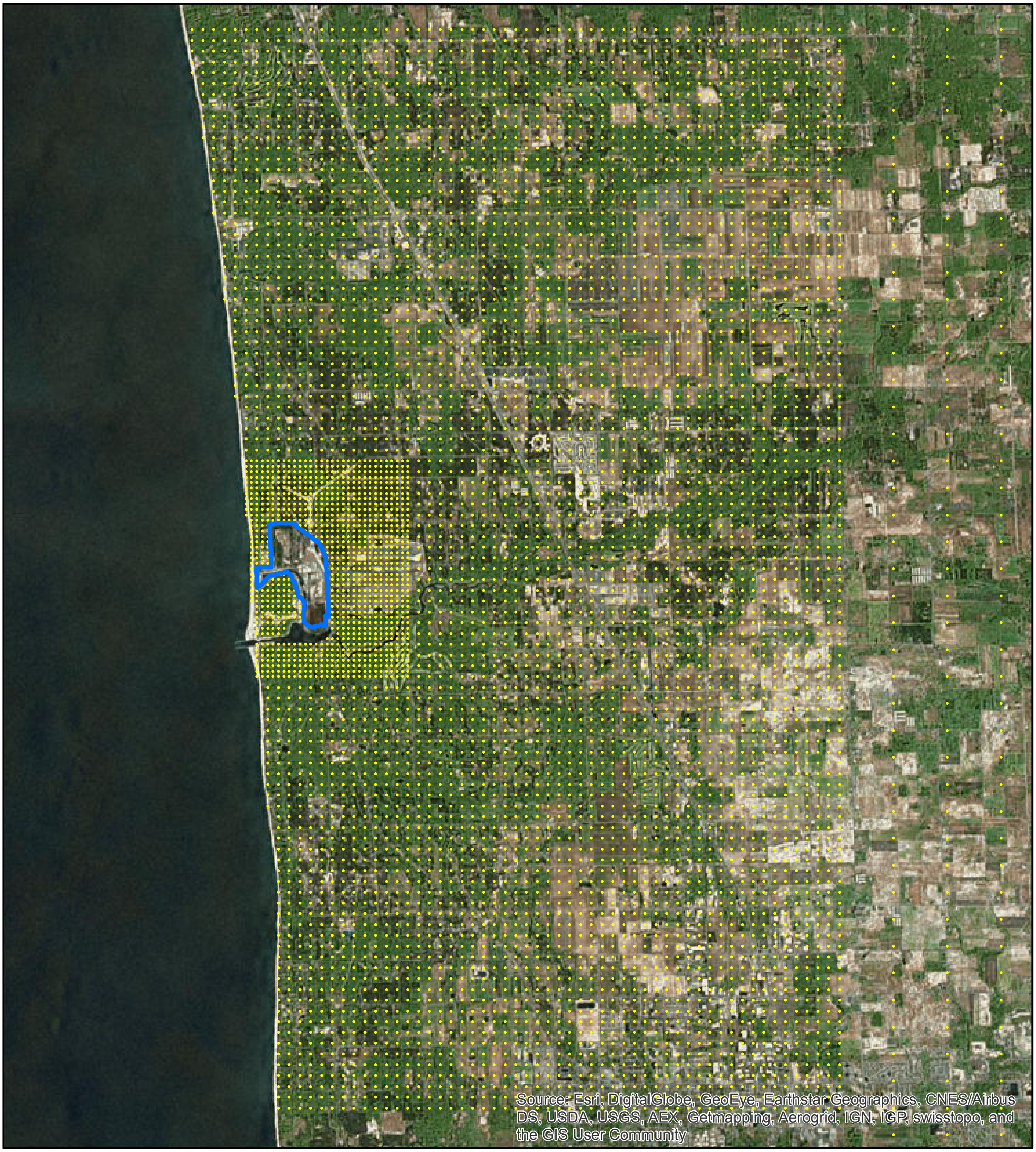
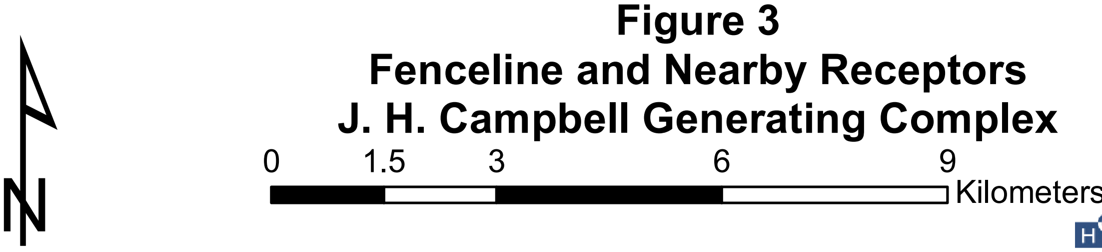


Figure 3
Fenceline and Nearby Receptors
J. H. Campbell Generating Complex



HORIZON ENVIRONMENTAL

July 2015

V:\GIS\Consumers\Campbell\Layouts\ Zoom_In_Grid.mxd

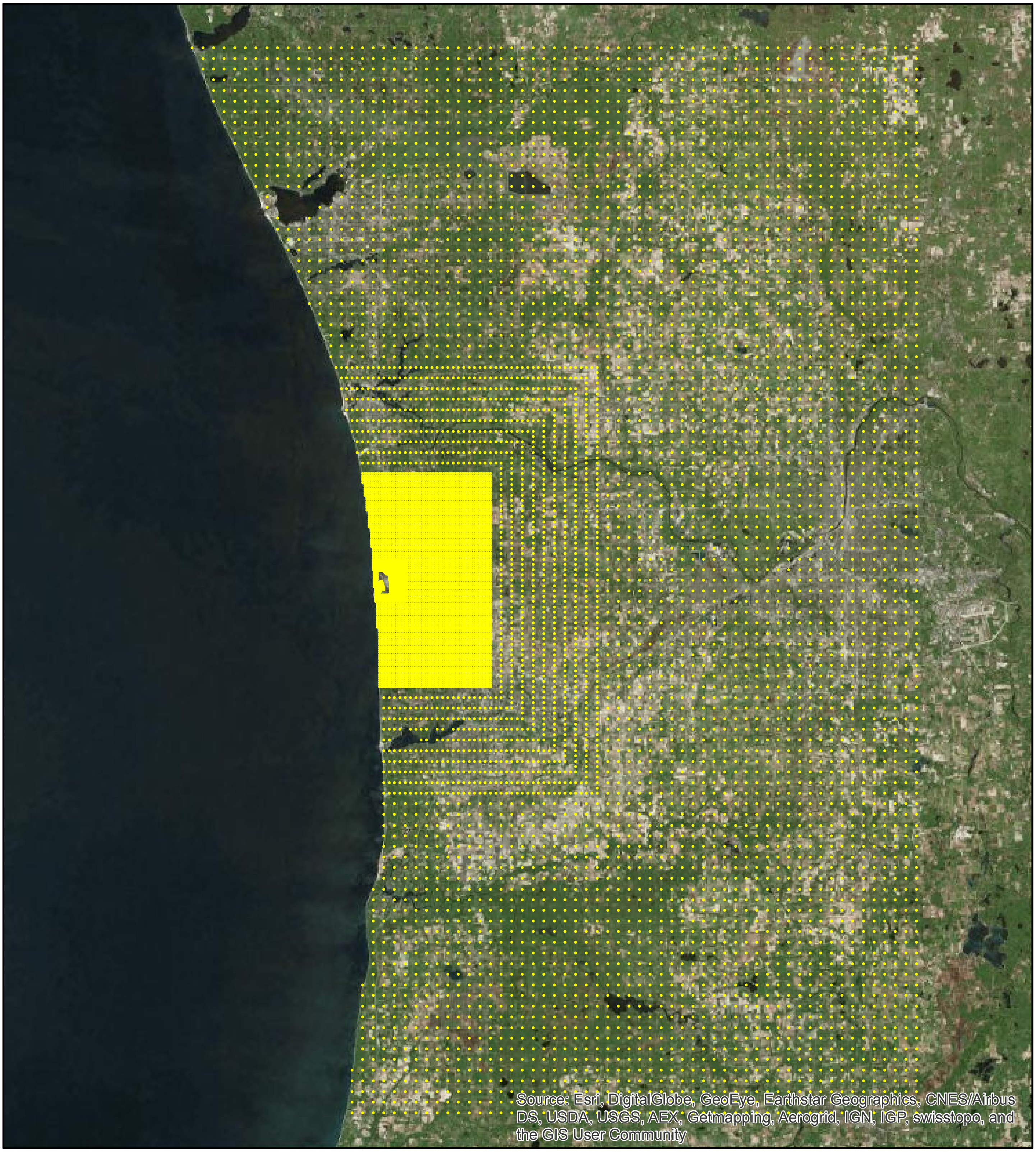
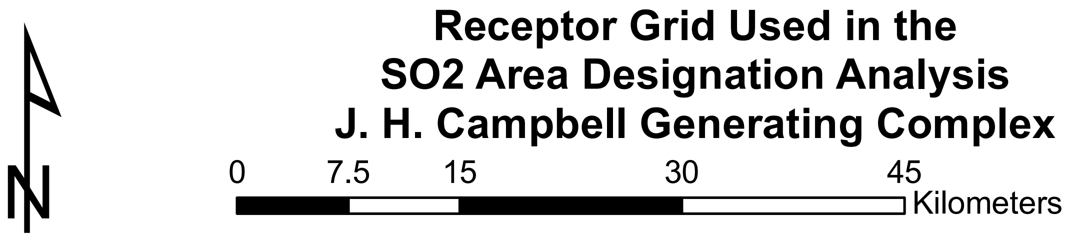


Figure 4
Receptor Grid Used in the SO2 Area Designation Analysis J. H. Campbell Generating Complex



HORIZON ENVIRONMENTAL

July 2015

V:\GIS\Consumers\Campbell\Layouts\ ReceptorGrid.mxd

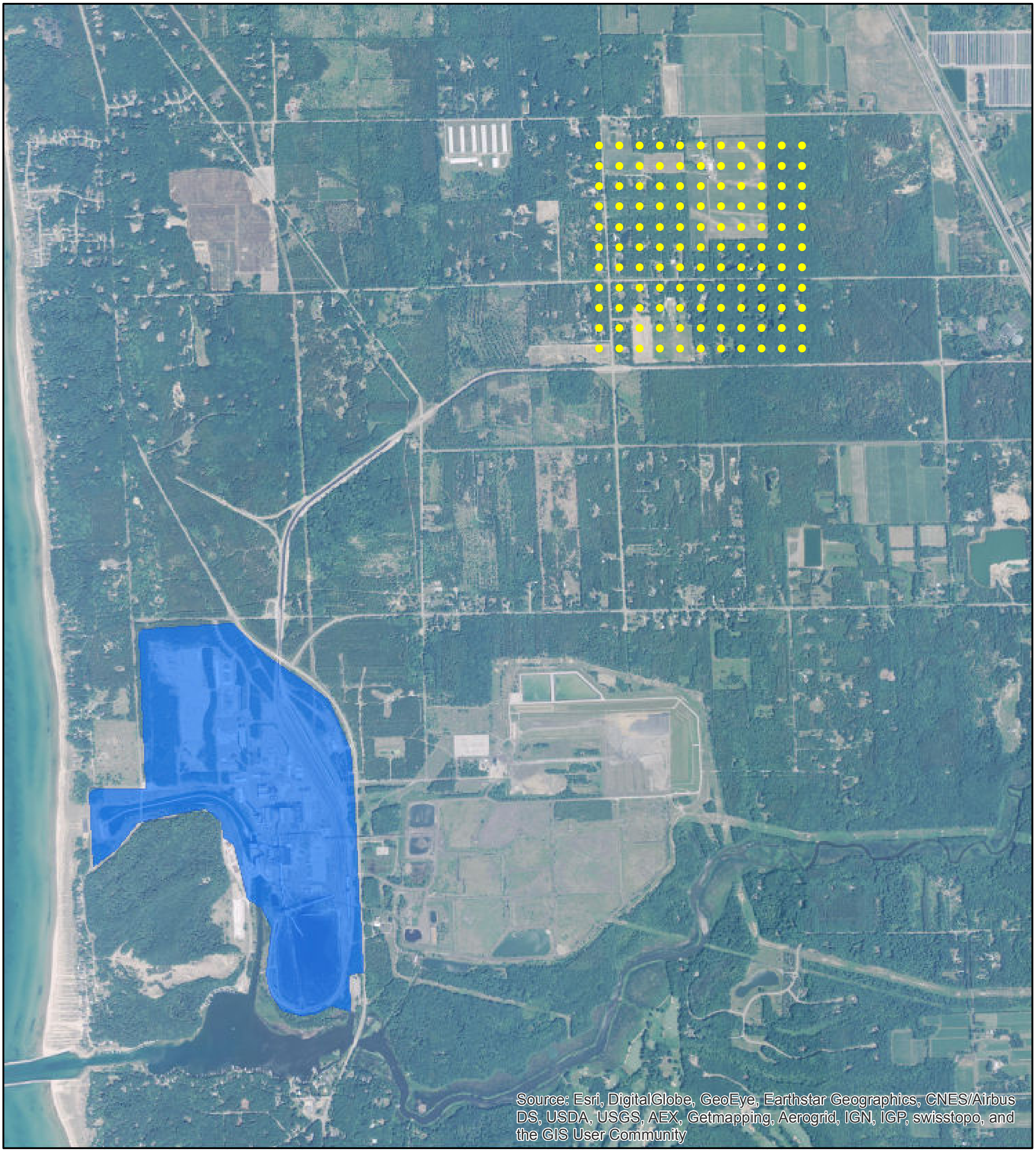


Figure 5
Nested Receptor Grid Used in the SO2 Area Designation Analysis J. H. Campbell Generating Complex

0 500 1,000 2,000 Meters

HORIZON ENVIRONMENTAL

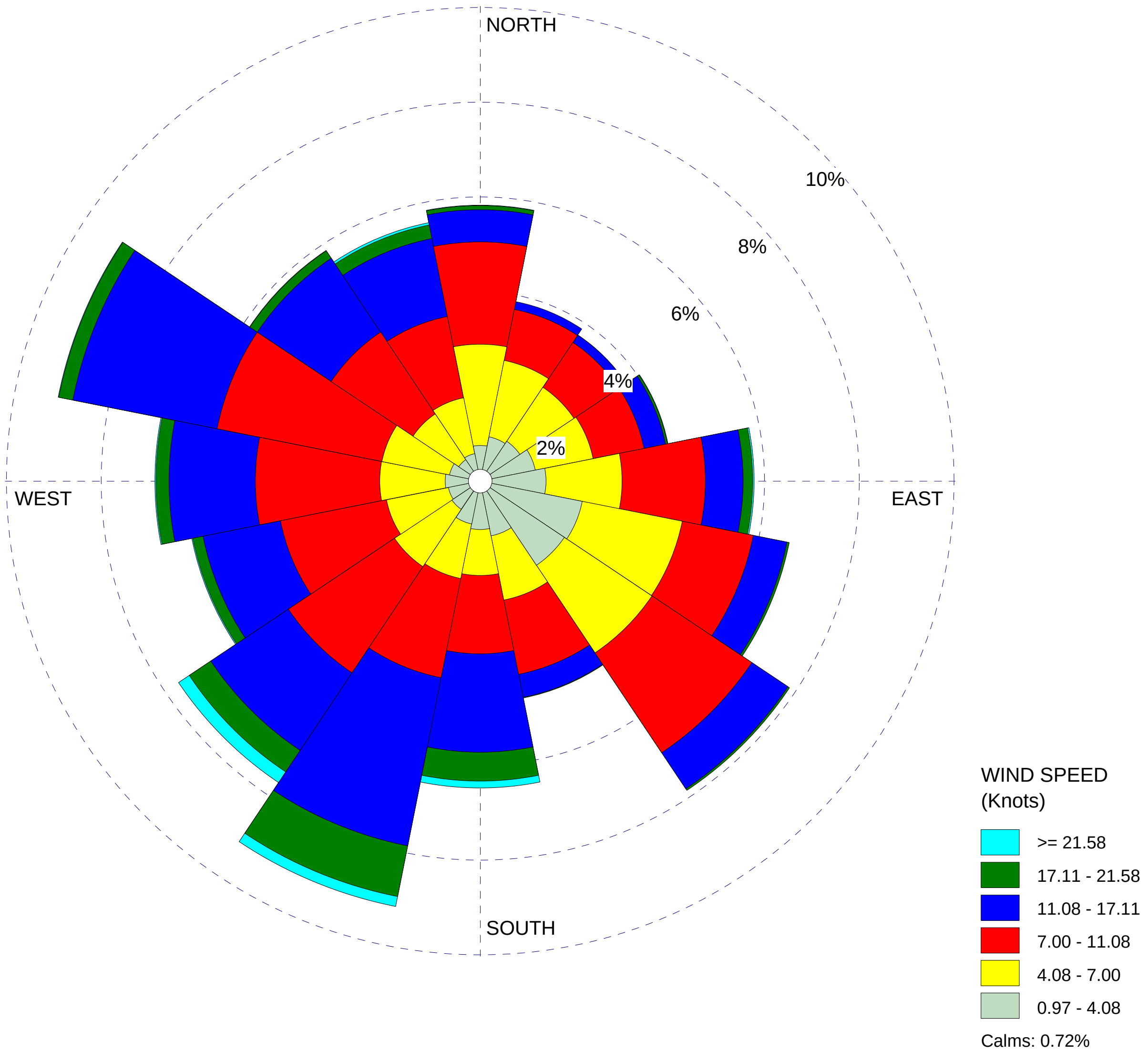
July 2015

V:\GIS\Consumers\Campbell\Layouts\ Nested_Grid.mxd

WIND ROSE PLOT:

Figure 6 - Three Year Composite Wind Rose
Muskegon County Airport (2012-2014)

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/1/2012 - 00:00 **End Date: 12/31/2014 - 22:00**	**Horizon Environmental Corporation**	
	CALM WINDS: **0.72%**	TOTAL COUNT: **26236 hrs.**	
	AVG. WIND SPEED: **8.54 Knots**	DATE: **7/15/2015**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

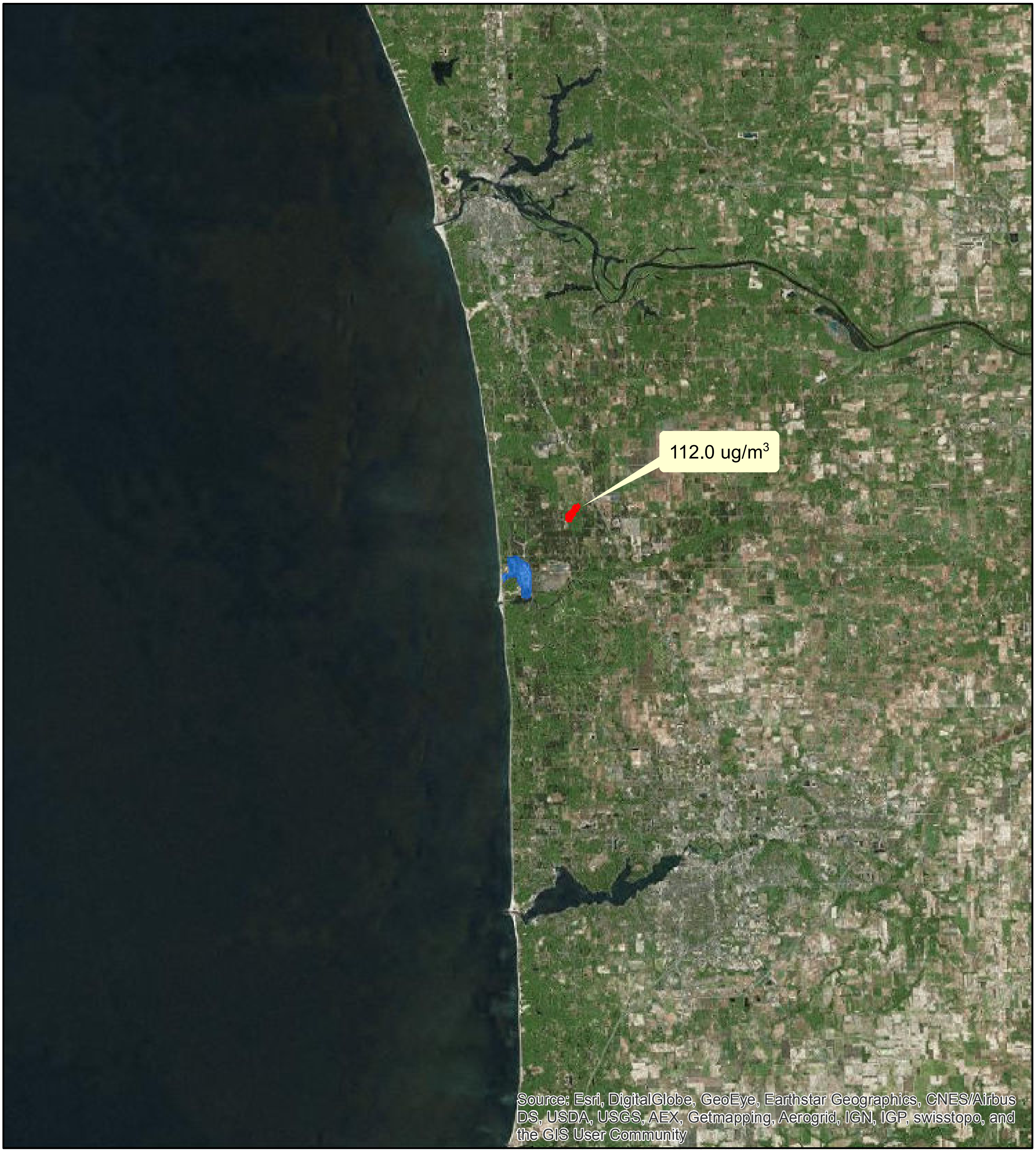


Figure 7
Location of the 99th Percentile
Daily 1-Hour Maximum SO2 Impact
J. H. Campbell Generating Complex

0 5 10 20 Kilometers

HORIZON ENVIRONMENTAL

July 2015

V:\GIS\Consumers\Campbell\Layouts\ SO2_Impact_Contour.mxd

TABLES

TABLE 1

AUXILIARY BOILER MONTHLY FUEL USAGE AND EQUIVALENT HOURS OF OPERATION[1]

CONSUMERS ENERGY COMPANY - J.H. CAMPBELL GENERATING COMPLEX

Calendar Month	JHC1&2 Aux Blr Fuel Usage [2, 3] (gallons)	JHC3 Aux Blrs Fuel Usage (gallons)	JHC1&2 Aux Blr Equiv. Op Hrs/Month [2, 3]	JHC3 Aux Blrs Equiv. Op Hrs/Month
12-Jan	1,840	543	15	4
12-Feb	6,740	15,083	55	106
12-Mar	7,190	5,107	58	36
12-Apr	8,490	56,035	69	395
12-May	9,470	10,585	77	75
12-Jun	6,290	0	51	0
12-Jul	6,350	0	52	0
12-Aug	2,880	0	23	0
12-Sep	1,050	34	9	0
12-Oct	14,230	14	116	0
12-Nov	880	0	7	0
12-Dec	930	438	8	3
13-Jan	1,550	16,651	13	117
13-Feb	1,810	447	15	3
13-Mar	10,040	15,599	82	110
13-Apr	5,430	18,798	44	132
13-May	2,400	0	20	0
13-Jun	1,120	0	9	0
13-Jul	880	0	7	0
13-Aug	160	18	1	0
13-Sep	180	21	2	0
13-Oct	1,330	2	11	0
13-Nov	840	236	7	2
13-Dec	850	0	7	0
14-Jan	1,010	2	8	0
14-Feb	650	0	5	0
14-Mar	830	0	7	0
14-Apr	750	0	6	0
14-May	740	0	6	0
14-Jun	710	0	6	0
14-Jul	680	0	6	0
14-Aug	270	0	2	0
14-Sep	780	0	6	0
14-Oct	940	0	8	0
14-Nov	850	0	7	0
14-Dec	890	22,192	7	156

Notes:

1. Actual fuel usage was converted to equivalent hours of operation based on the heat input rating of the boiler and a typical heating value for No. 2 fuel oil (138,000 Btu/gallon).
2. Utilization of the JHC 1 and 2 Auxiliary Boilers dropped off substantially in 2013 as a flue gas conditioning system that relied upon steam from the boilers was decommissioned.
3. Permit to Install No. 18-15, issued April 23, 2015, limits the capacity of the JHC1 and 2 Auxiliary Boiler to no greater than 10% on an annual basis.

TABLE 2
SUMMARY OF SO_2 EMISSION LIMITS
CONSUMERS ENERGY COMPANY - J.H. CAMPBELL GENERATING COMPLEX

Emission Unit ID	Nominal Heat Input Rating (MMBtu/hr)	Primary Fuel	Alternate Fuel	Maximum Allowable Emissions (lbs/MMBtu)				Potential to Emit (lbs/hr)	
				Historic Limit [1]		Consumers CD Limit [2]		Based on Historic Limit	Based on Consumers CD Limit
				Numerical Limit	Averaging Period	Numerical Limit	Averaging Period		
EUBOILER1 (JHC1)	2,490	Coal	Fuel Oil	1.67	31-day	0.350	30-day rolling	4,158	872
EUBOILER2 (JHC2)	3,560	Coal	Fuel Oil	1.67	31-day	0.320	365-day rolling	5,945	1,139
EUBOILER3 (JHC3)	8,240	Coal	Fuel Oil	1.20	3-hour	0.085	30-day rolling	9,888	700
EUCOMBTURB [3]	233	No. 2 Fuel Oil	-	1.67	Instantaneous	NA	NA	389	NA
							Total:	**20,381**	**2,711**

Notes:

1. The historic SO_2 emission limits for JHC 1&2 are based upon Michigan Air Pollution Control Rule 336.1401, while the historic SO_2 limit for JHC3 is based upon 40 CFR Part 60, Subpart D.
2. The Consumers CD Limits are stipulated under Permit to Install No. 39-15 and mandated by a federal Consent Decree. If the Consent Decree contains more than one SO_2 emission limit for a given boiler, this table reflects the SO_2 emission limit with the shortest averaging period.
3. Though not reflected in the Renewable Operating Permit, Fuel usage in EUCOMBTURB is now limited to ultra low sulfur diesel (15 ppm sulfur content). Using the emission factor provided in Section 1.3 of AP-42, the hourly potential to emit from EUCOMBTURB is 0.353 lbs/hr.

TABLE 3
AUER LAND USE CLASSIFICATION SCHEME
CONSUMERS ENERGY COMPANY

Type	Use	Description	
		Structures	**Vegetation**
I1	Heavy Industrial	Major chemical, steel and fabrication industries; generally 3-5 story buildings, flat roofs.	Grass and tree growth extremely rare; <5% vegetation.
I2	Light-Moderate Industrial	Rail yards, truck depots, warehouses, industrial parks, minor fabrications; generally 1-3 story buildings, flat roofs.	Very limited grass, trees almost total absent; <5% vegetation.
C1	Commercial	Office and apartment buildings, hotels; >10 story heights, flat roofs.	Limited grass and trees; <15% vegetation <15% vegetation.
R1	Common Residential	Single family dwelling with normal easements; generally one story, pitched roof structures; frequent driveways.	Abundant grass lawns and light-moderately wooded; >30% vegetation.
R2	Compact Residential	Single, some multiple, family dwelling with close spacing; generally <2 story, pitched roof structures; garages (via alley), no driveways.	Limited lawn sizes and shade trees; <30% vegetation.
R3	Compact Residential	Old multi-family dwellings with close (<2 m) lateral separation; generally 2 story, flat roof structures; garages (via alley) and ashpits, no driveways.	Limited lawn sizes, old established shade trees; <35% vegetation.
R4	Estate Residential	Expansive family dwelling on multi-acre tracts.	Abundant grass lawns and lightly wooded; >80% vegetation.
A1	Metropolitan Natural	Major municipal, state, or federal parks, golf courses, cemeteries, campuses; occasional single story structures.	Nearly total grass and lightly wooded; >95% vegetation.
A2	Agricultural Rural		Local crops (e.g., corn, soybean); >95% vegetation.
A3	Undeveloped	Uncultivated; wasteland.	Mostly wild grasses and weeds, lightly wooded; >90% vegetation.
A4	Undeveloped Rural		Heavily wooded; >95% vegetation.
A5	Water Surfaces	Rivers, lakes.	

Notes:

1. Land use typing scheme recommended by Auer for use in assessing the most applicable dispersion coefficient.

TABLE 4
STACK EXHAUST PARAMETERS
CONSUMERS ENERGY COMPANY - J.H. CAMPBELL GENERATING COMPLEX

Source ID	Stack Coordinate [1] (UTM)		Stack Height [2]		Stack Diameter [2]		Exit Gas Temperature		Exhaust Flow Rate	Exit Velocity
	Easting	Northing	(ft)	(m)	(in)	(m)	(F)	(K)	(acfm)	(m/s)
EUBOILER1 (JHC1) [3] EUBOILER2 (JHC2) [3]	565030.7	4751165.3	400	121.9	228	5.79	-	-	-	-
EUBOILER3 (JHC3) [3]	565009.7	4751360.8	642	195.7	327	8.31	-	-	-	-
EUCOMBTURB [4]	565283.1	4751199.9	17	5.2	162	4.11	850	727.6	460,000	16.33

Notes:

1. UTM Coordinates obtained using aerial imagery in NAD 83 format.
2. Stack height and diameter of each emission unit limited under the ROP, except for EUCOMBTURB, which was obtained from MAERS.
3. Stack temperature and exhaust flow data for JHC1, JHC2, and JHC3 vary by hour, as measured by continuous emissions monitoring systems.
4. Stack temperature and exhaust flow data for EUCOMBTURB obtained from MAERS.

TABLE 5
COMPARISON OF MODELED SO_2 CONCENTRATIONS TO THE 1-HOUR SIGNIFICANT IMPACT LEVEL
CONSUMERS ENERGY COMPANY - J.H. CAMPBELL GENERATING COMPLEX

Averaging Period	Year	Modeled Receptor Location UTM Coordinate (m)		1st Highest 1-Hour SO_2 Impact [1] (ug/m^3)	SIL [2] (ug/m^3)
		Easting	Northing		
1-Hour	2014	564970	4755068	424.9	**7.9**
	2013	564070	4750968	157.4	
	2012	563970	4754068	209.5	
	Maximum of the Three Year Average of the Maximum 1-Hour Concentrations (ug/m^3):			**223.2**	

Notes:

1. Model simulations conducted using AERMOD over a three-year meteorological dataset (MKG Airport Surface/Green Bay Upper Air.
2. The Significant Impact Level (SIL) is an interim value published in the *"General Guidance for Implementing the 1-hour SO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour SO_2 Significant Impact Level"* (U.S. EPA, August 23, 2010).

TABLE 6
COMPARISON OF MODELED SO_2 CONCENTRATIONS TO THE 1-HOUR NAAQS
CONSUMERS ENERGY COMPANY - J.H. CAMPBELL GENERATING COMPLEX

Averaging Period	Year	Modeled Receptor Location UTM Coordinate (m)		4^{th} Highest Daily Max. 1-Hour SO_2 Impact [1] (ug/m^3)	Background Concentration [2] (ug/m^3)	Combined SO_2 Impact (ug/m^3)	NAAQS (ug/m^3)
		Easting	Northing				
1-Hour							
Maximum of the Three Year Average of the 4^{th} Highest (99^{th} Percentile) Daily 1-Hour Maximum Concentrations (ug/m^3):				**112.0**	**27.0**	**139.0**	**196**

Notes:
1. Model simulations conducted using AERMOD over a three-year meteorological dataset (MKG Airport Surface/Green Bay Upper Air).
2. A background concentration of 27 ug/m^3 (10.3 ppb) was provided by the MDEQ-AQD.

ATTACHMENT A

CONTINUOUS EMISSIONS MONITORING DATA AND DISPERSION MODELING INPUT/OUTPUT FILES (DVD-ROM)

ATTACHMENT B

SUMMARY OF CEMS MISSING HOURLY SO_2 AND/OR FLOW DATA DURING THE 2012-2014 PERIOD (MODELED HOURLY VALUES BASED ON THE STANDARD 40 CFR PART 75, SUBPART D, MISSING DATA SUBSTITUTION PROCEDURES)

Missing Data Substitution Hours

Plant: J.H. CAMPBELL

Report Period: 01/01/2012 00:00 Through 12/31/2014 23:59

Source: CAMP12 **Units:** PPM

Parameter: SO2PPM

Date	Hour	Avg Value	MC	Load Range	PMA	QA Hours
06/03/2012	06	65.9	6	2	99.9	8747
06/03/2012	07	65.9	6	2	99.8	8746
09/25/2012	11	152.8	6	8	99.9	8748
01/30/2013	14	236.5	6	7	100.0	8756
02/11/2013	09	192.8	6	7	99.9	8755
03/15/2013	06	173.9	6	3	99.9	8754
03/15/2013	07	173.9	6	3	99.9	8753
03/15/2013	08	173.9	6	3	99.9	8752
10/18/2013	11	172.5	6	7	99.9	8754
10/18/2013	12	172.5	6	7	99.9	8753
03/05/2014	12	224.7	6	9	99.9	8754
03/05/2014	13	224.7	6	9	99.9	8753
03/05/2014	14	224.7	6	9	99.9	8752
03/05/2014	15	224.7	6	9	99.9	8751
03/05/2014	16	224.7	6	9	99.9	8750
03/05/2014	17	224.7	6	9	99.9	8749
03/05/2014	18	224.7	6	9	99.9	8748
03/05/2014	19	224.7	6	8	99.9	8747
03/05/2014	20	224.7	6	8	99.8	8746
03/05/2014	21	224.7	6	8	99.8	8745
03/05/2014	22	224.7	6	6	99.8	8744
03/05/2014	23	224.7	6	4	99.8	8743
03/06/2014	00	224.7	6	4	99.8	8742
03/06/2014	01	224.7	6	4	99.8	8741
03/06/2014	02	224.7	6	5	99.8	8740
03/06/2014	03	224.7	6	5	99.8	8739
03/06/2014	04	224.7	6	4	99.7	8738
03/06/2014	05	224.7	6	4	99.7	8737
03/06/2014	06	224.7	6	7	99.7	8736
05/19/2014	10	162.8	6	8	99.7	8738
12/11/2014	12	299.2	6	9	99.8	8739
12/11/2014	13	299.2	6	9	99.7	8738

Number of Missing Hours for CAMP12 SO2PPM: 32

Total Number of Missing Hours for CAMP12: 32

Grand Total Number of Missing Hours: 32

Missing Data Substitution Hours

Plant: J.H. CAMPBELL

Report Period: 01/01/2012 00:00 Through 12/31/2014 23:59

Source: CAMP3A **Units:** SCFH

Parameter: FLOWA

Date	Hour	Avg Value	MC	Load Range	PMA	QA Hours
06/21/2012	04	59127000	11	10	100.0	8759
06/21/2012	05	59127000	11	10	100.0	8758
06/21/2012	08	59121000	11	10	100.0	8757
06/21/2012	09	59121000	11	10	100.0	8756
07/17/2013	17	60262000	11	10	99.9	8755
07/17/2013	18	60262000	11	10	99.9	8754
07/17/2013	19	60262000	11	10	99.9	8753
07/17/2013	20	60262000	11	10	99.9	8752
07/17/2013	21	60262000	11	10	99.9	8751
07/17/2013	22	60262000	11	10	99.9	8750
07/17/2013	23	60262000	11	10	99.9	8749
07/18/2013	00	60262000	11	10	99.9	8748
05/19/2014	17	45256000	11	7	99.9	8751
05/19/2014	18	47531000	11	8	99.9	8750

Number of Missing Hours for CAMP3A FLOWA: 14

Source: CAMP3A **Units:** PPM

Parameter: SO2A

Date	Hour	Avg Value	MC	Load Range	PMA	QA Hours
09/17/2012	09	282.6	6	0	100.0	8758
05/01/2013	09	205.5	6	0	100.0	8758
05/01/2013	10	205.5	6	0	100.0	8757
12/18/2013	09	171.2	6	0	100.0	8757
03/07/2014	13	193.8	6	0	100.0	8756
03/07/2014	14	193.8	6	0	99.9	8755
03/07/2014	15	193.8	6	0	99.9	8754
03/07/2014	16	193.8	6	0	99.9	8753
03/07/2014	17	193.8	6	0	99.9	8752
03/07/2014	18	193.8	6	0	99.9	8751
03/07/2014	19	193.8	6	0	99.9	8750
03/07/2014	20	193.8	6	0	99.9	8749
03/07/2014	21	193.8	6	0	99.9	8748
03/07/2014	22	193.8	6	0	99.9	8747
03/07/2014	23	193.8	6	0	99.8	8746
03/08/2014	00	193.8	6	0	99.8	8745
03/08/2014	01	193.8	6	0	99.8	8744
03/08/2014	02	193.8	6	0	99.8	8743
03/08/2014	03	193.8	6	0	99.8	8742
03/08/2014	04	193.8	6	0	99.8	8741
03/08/2014	05	193.8	6	0	99.8	8740
03/08/2014	06	193.8	6	0	99.8	8739
03/08/2014	07	193.8	6	0	99.7	8738
03/08/2014	08	193.8	6	0	99.7	8737

Missing Data Substitution Hours

Plant: J.H. CAMPBELL

Report Period: 01/01/2012 00:00 Through 12/31/2014 23:59

Source: CAMP3A **Units:** PPM

Parameter: SO2A

Date	Hour	Avg Value	MC	Load Range	PMA	QA Hours
03/08/2014	09	193.8	6	0	99.7	8736
03/08/2014	10	193.8	6	0	99.7	8735
03/08/2014	11	193.8	6	0	99.7	8734
12/03/2014	09	156.3	6	0	99.7	8735
12/03/2014	10	156.3	6	0	99.7	8734
12/03/2014	11	156.3	6	0	99.7	8733
12/03/2014	12	156.3	6	0	99.7	8732
12/03/2014	13	156.3	6	0	99.7	8731
12/03/2014	14	156.3	6	0	99.7	8730
12/03/2014	15	156.3	6	0	99.6	8729
12/03/2014	16	156.3	6	0	99.6	8728
12/03/2014	17	156.3	6	0	99.6	8727
12/03/2014	18	156.3	6	0	99.6	8726
12/03/2014	19	156.3	6	0	99.6	8725
12/03/2014	20	156.3	6	0	99.6	8724
12/03/2014	21	156.3	6	0	99.6	8723
12/03/2014	22	156.3	6	0	99.6	8722
12/03/2014	23	156.3	6	0	99.6	8721

Number of Missing Hours for CAMP3A SO2A: 42

Total Number of Missing Hours for CAMP3A: 56

Source: CAMP3B **Units:** PPM

Parameter: SO2B

Date	Hour	Avg Value	MC	Load Range	PMA	QA Hours
05/01/2012	04	9.7	6	0	100.0	8759
09/09/2013	08	274.5	6	0	100.0	8759
12/18/2013	11	185.6	6	0	100.0	8758

Number of Missing Hours for CAMP3B SO2B: 3

Total Number of Missing Hours for CAMP3B: 3

Grand Total Number of Missing Hours: 59

This page left intentionally blank.

Outstate Michigan 1-Hour SO_2 NAAQS Designations
For Specified Large SO_2 Sources (Round 1 Sources)

DTE Energy Belle River & St. Clair Power Plants
East China Township, Michigan
Dispersion Modeling Protocol
July 10, 2015

Introduction

The United States Environmental Protection Agency (EPA) promulgated a revised primary sulfur dioxide (SO_2) national ambient air quality standard (NAAQS) in June 2010. The averaging time for this new NAAQS is 1 hour, which is much shorter than the previous primary NAAQS averaging period, 24 hours. The new NAAQS is the 99th percentile maximum daily 1-hour average, averaged over the most recent three years of monitoring data. The level of the new SO_2 NAAQS (75 ppb) is much lower than the previous 24-hour SO_2 NAAQS (140 ppb). EPA is requiring states to determine whether areas within their borders meet or exceed this new NAAQS to provide designation recommendations to EPA.

Initially, EPA recommended that states use dispersion modeling for identifying locations where this NAAQS is not met. However, there was an outcry to this proposal from many state air quality agencies and other affected parties. EPA decided to proceed designating new nonattainment areas where at least one SO_2 monitoring site violates this NAAQS with the last 3 years of monitoring data. Michigan has been working with source operators that contribute to this monitored violation in Wayne County, and will soon submit their state implementation plan (SIP) for EPA to review. However, EPA decided to delay designations for other portions of the country.

In response to a lawsuit that was brought against EPA by the Sierra Club, and others, to force EPA to designate other areas on an expedited schedule, the parties settled and additional NAAQS designations are being undertaken. The judge issued the settlement order finalizing the agreed upon details on March 2, 2015. The next phase where SO_2 NAAQS designations must be finalized by July 2016 includes areas around 68 large SO_2 sources listed in the settlement agreement between the parties. **This dispersion modeling protocol describes the methodology that will be used to determine whether this revised NAAQS is met in St. Clair County, Michigan, where DTE Energy's Belle River and St. Clair Power Plants are located. Both of these plants are listed in the table of sources meeting the criteria of large SO_2 source in the settlement document.**

Facility Description

Belle River and St. Clair power plants are located in St. Clair County, along the St. Clair River about three miles north of Marine City in East China Township (Part of Belle River Power Plant is actually located in China Township). Belle River Power Plant (BRPP) is directly west of St. Clair Power Plant (SCPP) which is along the west shore of the St. Clair River which forms the international border between Michigan and Ontario.

BRPP is a coal-fired power plant with two coal-fired units, five diesel generators and three combustion turbine generators. The two main units (each rated at 697 MW gross) at this plant burn low-sulfur western (sub-bituminous) coal, with distillate oil as an ignition fuel. Both Unit 1 and Unit 2 are, equipped with large electrostatic precipitators (ESPs), plus each boiler has been retrofitted with low-NO_x burners and over-fired air (OFA) to reduce NO_x emissions. This facility meets its SO_2 air permit limit (1.2 lbs/MMBtu) by firing sub-bituminous coal with an emission rate well below its emission limit.

Also, BRPP has five (2.75 MW) diesel generators located southeast of the main power buildings, next to areas used for coal storage; close to the middle of the power plant site. Figure 1 illustrates the location of these structures at BRPP, with the main power block and coal handling enclosed conveyors in the background.

There are three large (82.4 MW each) combustion turbine generators (CTGs) at BRPP. These units were installed in 1999. They, exclusively, fire pipeline quality natural gas. In addition, four identical CTGs are located east of the BRPP main units. These generators are owned and operated by DTE Energy Services (DTE East China CTGs). Figure 2 is a recent aerial photograph of the BRPP site with labels showing the location of these point sources.

SCPP has seven coal-fired units, one natural gas-fired CTG (CTG 11-1) and two 2.75MW diesel generators (DG 12-1 & 12-2). Units 1 through 4 were built in the early 1950s. Each one of these units was originally designed to produce, approximately, 164 MW of power using bituminous coal. The current nominal rating for each of these units is 150 MW. Units 1 to 4, originally, had their own separate 250-foot tall stack. Air quality monitoring sites near SCPP measured very high SO_2 levels in the early 1970s. Therefore, new ESPs were installed, and a much taller stack was built to eliminate the previous building downwash problem. Wind tunnel studies indicated that the replacement stack needed to be just under 600-feet tall to eliminate the building downwash situation at this power plant. The replacement stack contains the gas flow from each of these four units in its own separate inner stack. A key aspect of the BRPP air permit that was finalized in 1978 was changing the type of coal used at SCPP. Rather than, exclusively, using bituminous coal, all operating units at SCPP were required to burn a blend of sub-bituminous and bituminous coals to meet the statewide 1 percent sulfur-in-fuel limit (1.67 lbs SO_2/MMBtu).

SCPP Unit 5 is a cyclone boiler that came on-line in 1957. It has been in extended cold standby mode since 1980. It will not be modeled in this impact assessment. SCPP Unit 6 is a coal-fired unit, rated at 350 MW. It began operation in 1959. This unit was designed to operate using bituminous coal, but currently uses a blend of sub-bituminous and bituminous coals. It has large electrostatic precipitators (ESPs) and has been retrofitted with low-NO_x burners and OFA to reduce NO_x emissions. SCPP Unit 6 has a 425-foot tall stack which is below its GEP formula height. Therefore, it is affected by building downwash from the SCPP main unit structures. SCPP Unit 7 is the newest of the main units at this power plant. It began operating in 1967. This unit was also designed to operate on bituminous coal, but currently uses a blend of sub-bituminous and bituminous coals. It has electrostatic precipitators (ESPs) for particulate matter control, and has been retrofitted with low-NO_x burners and OFA to reduce NO_x emissions. This unit's stack is 600 feet above grade. The SCPP site is illustrated in Figure 3.

Table 1-A lists the actual SO_2 emissions from point sources at both of these large power plants from the last three operating years (2012-2014). It clearly shows that nearly all of the SO_2 is emitted by the eight operating coal-fired units at these facilities for the three years which will be analyzed to project actual SO_2 concentrations around the site.

Table 1-A

Actual Belle River & St. Clair PP SO_2 Emissions (2012-2014)

	2012 (tons)	2013 (tons)	2014 (tons)
Belle River PP			
Unit 1	13,127	10,752	11,691
Unit 2	11,741	14,034	12,775
Auxiliary Boiler Stack	0.05	0.04	0.00
Diesel Gen No. 11-1	0.01	0.00	0.00
Diesel Gen No. 11-2	0.01	0.00	0.00
Diesel Gen No. 11-3	0.02	0.00	0.00
Diesel Gen No. 11-4	0.02	0.00	0.00
Diesel Gen No. 11-5	0.02	0.00	0.00
CTG No. 12-1	0.19	0.27	0.21
CTG No. 12-2	0.16	0.32	0.25
CTG No. 13-1	0.13	0.40	0.28
East China CTG No. 1	0.11	0.07	0.01
East China CTG No. 2	0.11	0.08	0.01
East China CTG No. 3	0.11	0.07	0.01
East China CTG No. 4	0.11	0.04	0.01
St. Clair PP			
Unit 1	2,750	2,336	2,493
Unit 2	2,848	2,329	2,627
Unit 3	2,917	2,580	2,518
Unit 4	3,219	2,746	2,600
Unit 5	0	0	0
Unit 6	5,487	9,477	7,970
Unit 7	10,988	10,643	9,245
CTG No. 11-1	0.00	0.00	0.01
Diesel Gen No. 12-1	0.01	0.00	0.00
Diesel Gen No. 12-2	0.01	0.00	0.00
BR/SC Main Units	53,077	54,897	51,920
BR/SC Other Sources	1.04	1.26	0.77
Site Total	**53,078**	**54,898**	**51,920**

The following table identifies which SO_2 sources will be included in the impact modeling, and those that will be excluded and the reason(s) for this decision.

Table 1-B
Basis for Including or Excluding SO_2 Source from Impact Assessment

Power Plant	SO_2 Source(s)	Include / Exclude	Reason(s)
Belle River	**Unit Nos. 1-2**	**Include**	**Main units with high SO_2 emissions**
Belle River	**Aux. Blrs (N&S)**	**Exclude**	**Infrequent operation, 15 ppm S oil**
Belle River	**DG Nos. 11-(1-5)**	**Exclude**	**Infrequent operation, 15 ppm S oil**
Belle River	**CTG Nos. 12-(1-2)&13-1**	**Exclude**	**Pipeline natural gas, Low annual SO_2**
East China	**CTG Nos. 1-4**	**Exclude**	**Pipeline natural gas, Low annual SO_2**
St. Clair	**Unit Nos. 1-4 & 6-7**	**Include**	**Main units with high SO_2 emissions**
St. Clair	**CTG No. 11-1**	**Exclude**	**Pipeline natural gas, Low annual SO_2**
St. Clair	**DG Nos. 12-(1-2)**	**Exclude**	**Infrequent operation, 15 ppm S oil**

The secured property line for this modeling study is assumed to be the actual property line of the BRPP / SCPP complex. There are a number of non-DTE Energy areas that are adjacent to and run through the site. State Highway, M-29 (River Road), separates SCPP from BRPP. Also, pieces of the BRPP property are owned by non-DTE Energy owners. Along the southern edge of BRPP, there is a sewage treatment facility. There is a small business on the south side of Puttygut Road, along the northern fringe of the BRPP site. The biggest area owned by outsiders is at the intersection of M-29 and Puttygut Road, where a medical complex is located. Also, a railroad runs through the BRPP property. However, no receptors will be placed along this right-of-way, due to the infrequent usage of this railroad link for outside rail traffic.

The SCPP site has a 6-foot high cyclone fence around all property lines, except for the riverfront, where coal is offloaded. The main power buildings at BRPP are surrounded by a 6-foot high cyclone fence as well as the material handling areas. However, the portion of the site east of King Road, and south of Puttygut Road do not have security fence lines. These sections of BRPP's property have a number of "No trespassing" signs, approximately, every 200 yards, to address unauthorized access. For this modeling study, I assume that these provide adequate site protection. Receptors are placed along and outside of these respective property lines. The primary AERMOD run will only include off-site receptors. However, a separate model run will include receptors along the western and northern edges of BRPP's property, outside of the fence line around the main units and nearby supporting structures to verify that peak predicted SO_2 impacts are outside of the property line.

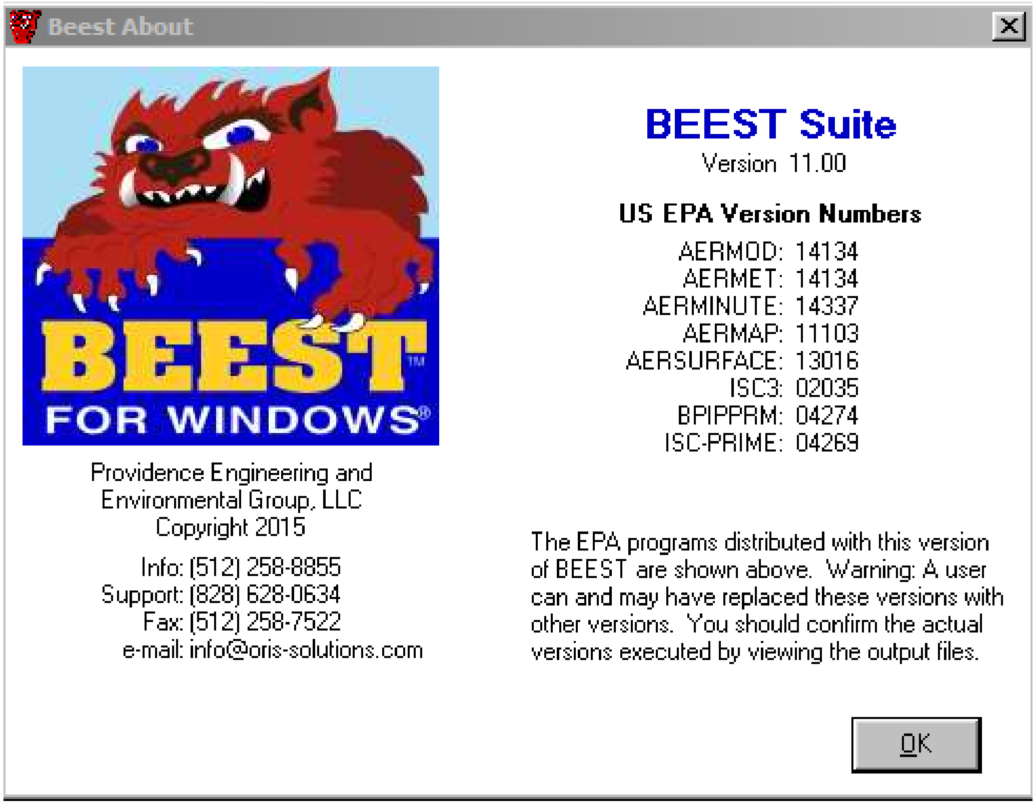
DTE Energy staff will make the 1-hour SO_2 AERMOD runs to simulate what peak 1-hour average concentrations would have been measured had one or more monitoring sites been actively measuring the air quality near these power plants. Our best estimate of the date for the modeling to be completed is by July 17, which is about three weeks after the draft schedule submittal date (June 26). There are a couple of very important concerns (i.e., appropriate background SO_2 concentrations and Canadian SO_2 source impacts) that will make it much more difficult to avoid double-counting impacts. This may require additional time to accurately assess the current air quality around these DTE Energy power plants.

DTE Energy remains concerned that the dispersion modeling methodology overestimates actual SO_2 concentrations, especially regarding use of a 99^{th} percentile background concentration for all modeled hours and surface meteorological data from Oakland County International Airport, in Waterford. DTE Energy may request to locate SO_2 and meteorological monitors at appropriately sited locations to provide straightforward data regarding the attainment status of this area for the 1-hour SO_2 NAAQS. We realize that allowing this option would delay St. Clair County's designation, but we feel that a number of background and Canadian source complications make the modeling option biased high. This could result in designating this area nonattainment when actual air quality meets the NAAQS, and force the State to develop a SIP when measured SO_2 levels are below the NAAQS.

Model Selection

AERSCREEN will **not** be run to predict maximum ground-level 1-hour average SO_2 impacts for each key source at BRPP and SCPP. It is a foregone conclusion that the maximum predicted impacts from nearly all relevant SO_2 sources will be above the 1-hour SO_2 significant impact level (SIL). Therefore, this step is less critical than the refined model analysis that will use the most recent version of AERMOD.

The version of AERMOD and its support files is shown in the following picture:



Point source and building tables are provided to identify which structures are nearby from a building downwash perspective and list allowable SO_2 emission rates for the relevant power plant sources. Table 2 identifies the key structures at these two power plants, and lists which buildings are nearby each relevant SO_2 source. Data are included for the SO_2 sources included in the impact assessment as well as the auxiliary boiler at BRPP and the diesel generators at SCPP.

Emissions Characterization

DTE Energy will model SO_2 impacts from BRPP and SCPP using **actual** emission data. Hourly SO_2 data from our CEMS will be formatted for use in AERMOD for all eight coal-fired units modeled. Monitored hourly stack exit temperature and exit velocity data for these units will also be utilized in the modeling analysis to predict source impacts from these units. Emission data from 2012 through 2014 will be utilized to mesh with the most recent 3-year meteorological data set.

Source Description

The detailed plant description is provided in the Introduction Section of this modeling protocol, including the justification for including only the main units from both of these DTE Energy power plants. Table 3 and Table 4 list the UTM coordinates for the large SO_2 sources that will be modeled as well as the structure data (height, tiers, corners or tank center/diameter details). The latest version of BPIP (Version dated 04274) will be used to develop building height and width values for each 10-degree wind direction category used in AERMOD.

The area surrounding these power plants is predominantly rural with: large residential properties, a city park, Belle River flood plain and the St. Clair River dominating the area around these facilities. There are a few industrial facilities on the Michigan side and also across the St. Clair River, in Canada, but the site is considered rural in the upcoming dispersion modeling runs.

Background Concentration

Identifying a representative background SO_2 concentration for this site is a very difficult task. The closest SO_2 monitor is located in Port Huron, approximately, 13 miles north of these two power plants. BRPP is directly upwind of this monitor with wind directions of 191 degrees. SCPP's main units are upwind of it with a wind direction from 185 degrees. This monitor just completed obtaining three full years of SO_2 data at the end of 2014, with a design concentration of 69 ppb. The highest 1-hour SO_2 concentrations have usually been measured with winds from the south, where BRPP, SCPP and a Canadian refinery on the south side of Sarnia are upwind of this monitor.

The other Michigan SO_2 sources that will be included in the AERMOD runs are: Cargill Salt (in St. Clair south of the monitor) and E.B. Eddy Paper (north of the monitor). The, tentative, procedure to calculate a background concentration would be to eliminate any high SO_2 values when a modeled source is upwind of the monitor, and use the 99th percentile SO_2 value based on the rest of the 2012-2014 data set. However, this would result in an extremely high background value of 64 ppb. These "other" high SO_2 observations occur when the wind direction at the Port Huron monitor is measuring winds from the east-southeast (105^o). There is a second refinery on the south side of Sarnia that is upwind of the monitor with this wind direction. Somehow, the impact of these Canadian sources needs to be quantified, but at their real location, 12 miles north of the DTE Energy operating power plants, and **not** directly across the St. Clair River! Figures 4A through 4D illustrate the MDEQ's Port Huron monitoring site and the Canadian refinery sources' locations with respect to this monitor.

DTE Energy proposes to use the following technique to appropriately estimate the impact of the modeled and SO_2 sources not modeled:

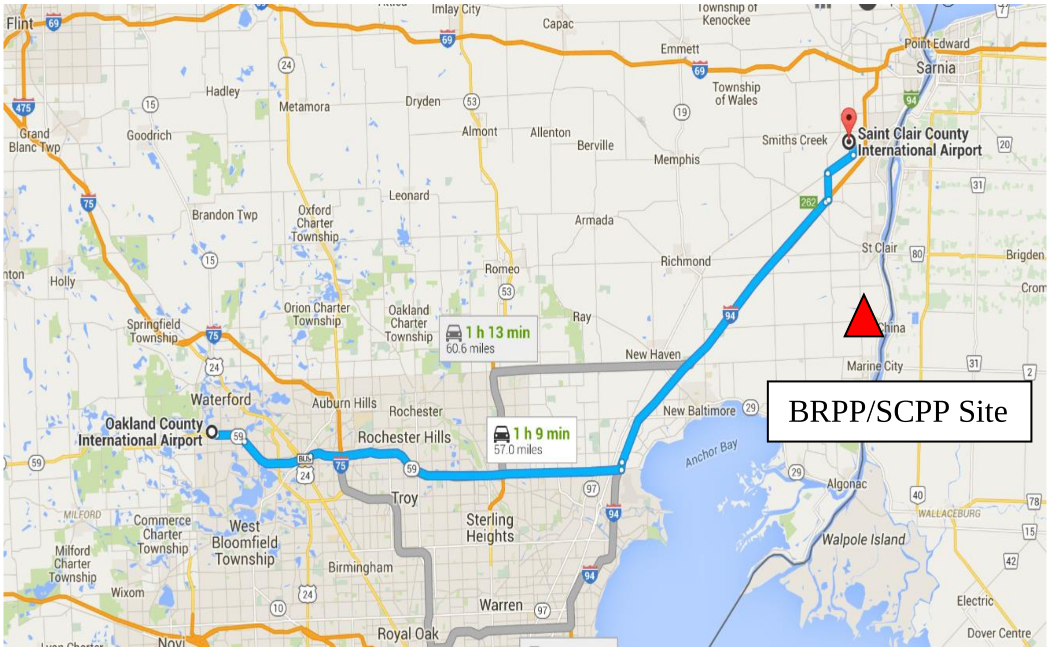
- Calculate the 99th percentile SO_2 concentration at the Port Huron monitor using data only when winds are **not** impacted by any of the Michigan and Ontario sources identified, above. This would use 2012-2014 data when winds are, generally, from the west at the Port Huron monitor. MDEQ staff informed me that a value of 15 ppb was calculated using the SO_2 data only when winds are coming from the west.

Meteorology

The most representative, readily available, meteorological data set for this 1-hour SO_2 NAAQS designation analysis is the 2012-2014 data set, with surface data from the St. Clair County International Airport (Port Huron). However, EPA Region V staff are concerned that there are too many hours with calm winds, approximately 25 percent of the hours. Therefore, MDEQ has proposed to incorporate surface data from Oakland County International Airport (Pontiac) that has 1-minute wind data, and calm winds less than 2 percent of the time. Upper air data from White Lake Township will be used in this impact assessment.

However, DTE Energy staff remains concerned that Oakland County International Airport is too far away from the BRPP/SCPP site to be representative. Not only is Oakland County International Airport farther away from the power plants than St. Clair International Airport (77 kilometers versus 15kilometers),it is too far west to account for the influence that Lake St. Clair and Lake Huron have on the flow patterns around the power plant site. This is especially an issue when synoptic scale winds are light, and mesoscale effects from these large lakes influence the wind speed and direction near their shorelines. These conditions are, generally, when the highest impacts are predicted from sources with tall stacks, which applies to all of the units at BRPP and SCPP. The following graphic shows the two possible meteorological data sites with the BRPP/SCPP site indicated by a triangle. We believe that air quality monitoring data near the site is the most appropriate methodology for designating these areas close to large SO_2 sources, rather than relying on modeling using weather data from a site that may not adequately represent the meteorology at the plant site.

<u>**Location of BRPP/SCPP Site and Two NWS Meteorological Data Sites**</u>



<u>Modeling Domain</u>

The receptor grid modeled will follow MDEQ guidance for receptors around a large point source. The receptor grid includes:

- Property line receptor grid with 50-meter receptor separation
- Rectangular grid with 50-meter receptor separation out to 500 meters beyond the property line
- Rectangular grid with 100-meter receptor separation out to 4 kilometers beyond the property line
- Rectangular grid with 250-meter receptor separation out to 10 kilometers beyond the property line

Note, that receptors over the following areas will not be included in the impact analysis:

- DTE Energy BRPP / SCPP property
- Canadian waters and land
- US waters (i.e., St. Clair River & Belle River)
- Landfills (Range Road north of BRPP)
- On roadways (i.e., M-29 & other local roads
- On modeled SO_2 source secured property

Receptor elevation data will be used in the analysis. A separate AERMOD run will be performed to identify whether receptors outside of the fenced in part of the BRPP site would be expected to measure peak 1-hour SO_2 impacts higher than those predicted off-site.

Off-Site Emission Inventory

The MDEQ has identified two additional SO_2 sources that should be modeled. They are Cargill Salt in St. Clair and E.B. Eddy Paper in Port Huron. These two sources will be included in the AERMOD impact assessment using their actual emission rate (provided by MDEQ).

Also, the Lambton Generating Station is located across the St. Clair River from BRPP and SCPP, in Ontario. However, this large coal-fired generating station burned coal for the last time in 2013. It did have wet flue gas desulfurization operational on its coal-fired units, prior to eliminating coal from its fuel mix. The following citation from the Ontario Power Generation (OPG) web site summarizes their reduction in coal use at their large thermal generating stations:

> "Lambton GS and Nanticoke GS stopped using coal as fuel in 2013. These stations served Ontario for more than 40 years, providing reliable electricity when it was needed most. Two units at Lambton and four units at Nanticoke are being preserved so that they are available in future to be converted to alternate fuels if required."

Therefore, Lambton Generating Station likely had some impact at the Port Huron monitor, especially in 2012, but it will not contribute any amount in the foreseeable future. **This adds further support for possibly installing new, properly sited, SO_2 monitors to determine the current air quality; rather than relying on Port Huron monitoring data that had impacts from a large, and now retired SO_2 source.**

Table 2

Outstate Michigan 1-Hour SO_2 NAAQS Designations
For Specified Large SO_2 Sources (Round 1 Sources)

DTE Energy Belle River & St. Clair Power Plants

Belle River Power Plant - Buildings That May Cause Main Unit / Aux Boiler Stack Downwash

Belle River Power Plant Structure	Unit No.	Important Structure Data: Base Elevation (feet)	Height (feet)	Length (feet)	Width (feet)	Diameter (feet)	Minimum Distance to Unit 1 Stk (feet)	Minimum Distance to Unit 2 Stk (feet)	Minimum Distance to Aux Blr Stk (feet)	Structure Influential Distance (feet)	Stacks Within Structure Wake Zone
Boiler House	1	591.5	262.5	193.3	176	NA	360	425	87	880	U1, U2, Aux
Combustion Air Duct Roof	1	591.5	241.2	107	46	NA	312	412	132	535	U1, U2, Aux
Coal Conveyor Gallery Roof (N)	1	591.5	236.5	43	27	NA	346	406	104	270	Aux
Coal Conveyor Gallery Roof (NW)	1	591.5	236.5	43	27	NA	346	394	57	270	Aux
Coal Conveyor Gallery Roof (NE)	1	591.5	210.3	46	31.8	NA	351	539	251	159	None
Coal Conveyor Gallery Roof (E)	1	591.5	193.5	155.2	31.8	NA	384	560	250	159	None
Coal Conveyor Gallery Roof (W)	1	591.5	193.5	155.2	32	NA	409	416	57	160	Aux
Coal Conv Gallery Roof (N Edge)	1	591.5	174	43	46	NA	321	500	208	215	Aux
Boiler House	2	591.5	262.5	193.3	176	NA	440	360	43	880	U1, U2, Aux
Combustion Air Duct Roof	2	591.5	255	107	46	NA	410	315	96	535	U1, U2, Aux
Coal Conveyor Gallery Roof (N)	2	591.5	236.5	43	27	NA	356	340	53	285	Aux
Coal Conveyor Gallery Roof (NE)	2	591.5	236.5	63	30	NA	365	346	14	285	Aux
Coal Conveyor Gallery Roof (NW)	2	591.5	193.5	43	27	NA	510	318	210	215	Aux
Coal Conveyor Gallery Roof (E)	2	591.5	193.5	153.8	31.8	NA	390	425	13	159	Aux
Coal Conveyor Gallery Roof (W)	2	591.5	193.5	201	33.8	NA	560	375	206	169	None
Fan Room Roof (Turbine Bdg)	1	591.5	134	193	56.5	NA	600	646	233	670	U1, U2, Aux
Turbine Building	1	591.5	110.5	259	150.3	NA	495	532	145	552	U1, U2, Aux
Fan Room Roof (Turbine Bdg)	2	591.5	134	193	58	NA	646	600	220	670	U1, U2, Aux
Turbine Building	2	591.5	110.5	255	150.3	NA	532	495	145	552	U1, U2, Aux
Auxiliary Area (NE Section)	1 & 2	591.5	236.5	47.3	33	NA	362	369	12	350	Aux
Auxiliary Area (NW Section)	1 & 2	591.5	236.5	66.3	37	NA	362	330	10	350	U2, Aux
Auxiliary Area (Between Blr Hses)	1 & 2	591.5	193.5	153.8	70	NA	391	387	0	350	Aux
Auxiliary Area (Between Turb Bdgs)	1 & 2	591.5	110.5	153.5	70	NA	513	510	144	350	Aux
HVAC Fan Room	1	591.5	72.7	139	72	NA	360	560	310	360	U1, Aux
HVAC Fan Room	2	591.5	72.7	139	72	NA	560	360	261	360	U2, Aux
Service Building	NA	591.5	31.8	183.2	261	NA	672	510	280	159	None
Administration Building	NA	591.5	28	120	96	NA	838	728	402	140	None
Electrostatic Precipitator	1	591.5	90	291	117	NA	95	204	195	450	U1, U2, Aux
Electrostatic Precipitator	2	591.5	90	291	117	NA	204	95	186	450	U1, U2, Aux
Bottom & Fly Ash Bdg. /Collector	1	590.5	124	NA	NA	40	144	218	526	200	U1
Bottom & Fly Ash Bdg. /Collector	2	590.5	124	NA	NA	40	222	142	517	200	U2
Economizer / Mill Rejects Building	1 & 2	590.5	116	NA	NA	28	416	466	794	140	None
Breaker House 3-TH-7	1 & 2	590	173	83	68	NA	835	1160	1055	340	None
Transfer House 3-TH-8	1 & 2	590	74.1	73	34	NA	945	1260	1090	170	None
Transfer House 3-TH-9	1 & 2	590	67	90	70	NA	778	1084	1165	335	None
Fuel Oil Storage Tank	1 & 2	590	32	NA	NA	80	356	658	542	160	None
Warehouse	NA	591.6	35	201	101	NA	1263	1156	828	175	None
Condensate Storage Tanks (2)	1 & 2	591	30	NA	NA	46	624	765	403	150	None
Fire Water Pump House	1 & 2	591	30	75	30	NA	880	1058	700	150	None
Construction Shop	NA	590	30	200	150	NA	1134	813	1000	150	None
Water Storage Tank	NA	591	25	NA	NA	44	904	1096	740	125	None
Changehouse	NA	591.5	25	200	50	NA	1090	1065	680	125	None
Document Control Office	NA	592.3	25	200	80	NA	992	942	564	125	None
Clubhouse / Recreation Building	NA	582	25	200	40	NA	1228	1046	806	125	None
Maintenance Shop	NA	590	25	60	40	NA	1030	709	835	125	None
Chemical Canopy	1 & 2	591.5	24	72	56	NA	605	788	466	120	None
Neutalization Sump Pump House	1 & 2	591.5	20	52	26	NA	526	721	416	100	None
Material Test Lab	1 & 2	591	20	50	30	NA	1046	1175	788	100	None
Switchyard Relay Control House	1 & 2	589	20	70	36	NA	1014	1052	652	100	None
Waste Water Pump House	1 & 2	590	18	58	32	NA	1300	1446	1055	90	None
Fuel Oil / Foam Sump Pump House	1 & 2	591.5	15	56	32	NA	420	684	476	75	None
Gatehouse	NA	591	12	29	29	NA	1033	806	655	60	None

Table 2 (Continued)

Outstate Michigan 1-Hour SO_2 NAAQS Designations
For Specified Large SO_2 Sources (Round 1 Sources)

DTE Energy Belle River & St. Clair Power Plants

St Clair Power Plant - Buildings That May Cause Main Unit Stack Downwash

St Clair Power Plant Structure	Unit No(s).	Important Structure Data: Base Elevation (feet)	Height (feet)	Length (feet)	Width (feet)	Diameter (feet)	Minimum Distance to Unit 1-4 Stk (feet)	Minimum Distance to Unit 6 Stk (feet)	Minimum Distance to Unit 7 Stk (feet)	Minimum Distance to DG 12 Stk (feet)	Structure Influential Distance (feet)	Stacks Within Structure Wake Zone
Boiler House (Middle Section)	1 - 4	585	150.3	482	65	NA	246	215	426	397	752	All
Boiler House (West Section)	1 - 4	585	138.4	458	60	NA	291	258	457	407	692	All
Boiler House (East Section)	1 - 4	585	73.7	458	26	NA	231	200	415	523	368	U1-4 & U6
Boiler House (Middle Section)	5	585	215.8	110.5	62	NA	663	148	337	763	553	U6-7
Boiler House (2nd West Section)	5	585	149.8	110.5	30	NA	680	204	369	748	553	U6-7
Boiler House (1st West Section)	5	585	138	110.5	35	NA	692	226	387	735	553	U6-7
Boiler House (East Section)	5	585	172.1	110.5	25	NA	658	128	325	799	553	U6-7
Boiler House (Scrubber Extension)	5	583	150	100	28	NA	660	107	315	818	500	U6-7
Boiler House (East Section)	6	585	178.2	145	138	NA	755	42	190	858	725	U6-7
Boiler House (West Section)	6	585	138	138	35	NA	784	190	277	842	690	U6-7
Boiler House (East Section)	7	584.5	212.2	150	144	NA	991	156	65	1080	720	U6-7
Boiler House (North Section)	7	584.5	154	53	28	NA	1111	317	197	1154	265	U7
Boiler House (West Section)	6 - 7	584.5	120.8	202	53	NA	911	170	207	967	604	U6-7
Turbine Building	1 - 7	585	106	956	122	NA	311	222	307	260	530	All
ID Fan Building (West)	1 - 4	583	38.5	510	32	NA	224	180	446	537	192	U6
ID Fan Building (East)	1 - 4	583	18	510	21	NA	211	177	441	545	90	None
Electrostatic Precipitator (N Section)	1 - 4	582	80	175	106	NA	441	194	415	741	400	U6
Electrostatic Precipitator (S Section)	1 - 4	582	80	175	106	NA	201	427	658	623	400	U1-4
Electrostatic Precip (N-S Ductwork)	1 - 4	582	100	410	20	NA	216	254	427	750	500	U1-4 & U6-7
Electrostatic Precip (NE-SW Ductwork)	1 - 4	582	100	165	25	NA	25	644	846	628	500	U1-4
Electrostatic Precipitator	6	582	186	106	75	NA	910	146	88	1109	530	U6-7
Electrostatic Precipitator	7	582.5	137	85	26	NA	1006	182	50	1136	425	U6-7
Shops Building (New)	1 - 7	585	71	126.5	62.5	NA	170	680	922	387	355	U1-4
Shops Building (Original)	1 - 7	585	51.3	152	52	NA	191	624	858	369	256	U1-4
Office Building	All	585	47	110	69	NA	252	762	1000	319	235	None

Table 2 (Continued)

Outstate Michigan 1-Hour SO_2 NAAQS Designations For Specified Large SO_2 Sources (Round 1 Sources)

DTE Energy Belle River & St. Clair Power Plants

St Clair Power Plant - Outlying Buildings That May Cause Main Unit Stack Downwash

		Important Structure Data									Structure	Stacks
St Clair	Section of	Base					Minimum Distance to				Influential	Within
Power Plant	Power	Elevation	Height	Length	Width	Diameter	Unit 1-4 Stk	Unit 6 Stk	Unit 7 Stk	DG 12 Stk	Distance	Structure
Structure	Plant	(feet)	(feet)	(feet)	(feet)	(feet)	(feet)	(feet)	(feet)	(feet)	(feet)	Wake Zone
Screen House No. 1	East	582	35	117	69	NA	358	399	594	844	175	None
Screen House No. 2	East	582	25	126	69	NA	635	192	306	989	125	None
Screen House No. 3	East	582	25	57	54	NA	1037	292	122	1283	125	U7
Bottom Ash Polymer Treatment Bdg.	East	582	20	30	30	NA	114	877	1109	531	100	None
South Flyash Silo	East	582	70	NA	NA	40	152	625	855	597	200	U1 - U4
Nitrogen Tank	East	583	20	NA	NA	8	205	634	870	560	40	None
Acid Tank / Caustic Tank	East	582	12	25	15	NA	648	157	389	868	60	None
Slurry Storage Tank	East	583	15	NA	NA	32	794	35	225	1005	75	U6
No. 2 Oil Barge Unloading Station	East	582	12	24	20	NA	834	236	260	1149	60	None
No. 6 Oil Barge Unloading Station	East	582	10	10	10	NA	817	243	285	1145	50	None
South Dewatering Bin (Unit 6)	East	583	60	NA	NA	30	651	126	356	891	150	U6
North Dewatering Bin (Unit 6)	East	583	60	NA	NA	30	690	92	317	921	150	U6
SO2 Building	East	582	40	64	55	NA	906	91	88	1087	200	U6 - U7
South Dewatering Bin (Unit 7)	East	583	60	NA	NA	30	1009	227	32	1221	150	U7
North Dewatering Bin (Unit 7)	East	583	60	NA	NA	30	1044	259	30	1244	150	U7
Transfer House 3TH1	South	583	70	120	50	NA	671	1480	1701	988	250	None
Transfer House 3TH2 (Dock Hopper)	South	583	65	120	88	NA	410	1228	1741	796	325	None
Storage Building (near 3TH1)	South	583	15	12	12	NA	567	1379	1604	896	60	None
Junction House	South	585	30	32	99	NA	358	1113	1339	456	150	None
Coal Breaker House	South	585	100	120	72	NA	424	1124	1345	384	360	None
Fuel Supply Admin Building	South	587	25-35	102	70	NA	519	1164	1398	295	175	None
Electrical Distribution Building	South	580	15	80	36	NA	635	1396	1632	571	75	None
Club House / Rec Building	South	589.5	15	86	35	NA	599	1066	1284	104	75	None
Motorcycle Shed	South	588	15	80	15	NA	571	1090	1303	139	75	None
Combustion Turbine No. 11-1	South	590	24	65	11	NA	668	1094	1329	92	55	None
Gas Compression Building (CTG 11-1)	South	589	15	27	24	NA	691	1161	1396	158	75	None
Diesel Fuel Storage Tanks	South	589	12	38	28	NA	770	1177	1400	158	60	None
Water Pretreatment Plant	South	587	30	72	40	NA	500	931	1158	52	150	DGs
Water Tank	South	589	25	NA	NA	40	500	863	1097	104	125	DGs
Diesel Generator No. 12-1	South	587	12	50	10	NA	627	995	1230	0	60	DGs
Diesel Generator No. 12-2	South	587	12	50	10	NA	627	977	1211	0	60	DGs
No. 2 Fuel Oil Foam & Pumphouse	South	587	15	21	18	NA	1186	1778	2024	801	75	None
Used Oil & No. 6 Oil Tank (N)	South	587	34	NA	NA	90	1177	1710	1914	670	170	None
No. 2 Oil Tank (S)	South	587	34	NA	NA	90	1392	1997	2206	964	170	None
Oil Transfer House	South	589.5	20	35	18	NA	1077	1532	1756	545	100	None
East Tractor House	South	589.5	25	174	56.5	NA	946	1228	1438	290	125	None
Storage Building	South	589.5	30	130	60	NA	1268	1480	1645	603	150	None
Transfer House #1	South	589.5	80	32	25	NA	1315	1666	1848	670	125	None
Transfer House #2	South	588.5	80	31	28	NA	1541	1839	2010	886	155	None
Transfer House #3	South	588.5	80	33	25	NA	1912	2145	2299	1250	125	None
Transfer House #4	South	588.5	80	24	20	NA	2265	2441	2579	1600	100	None
Relay House #1	West	589.5	20	37.3	22	NA	887	717	895	510	100	None
Relay House #2	West	591	12	32	22	NA	1156	824	943	719	60	None
Relay House #3	West	594	20	50	30	NA	1288	635	633	1115	100	None
Hydrogen Tank	North	590	30	NA	NA	10	1338	565	456	1307	50	None
Building Cleaners Office / Gym	North	587	15	162	60	NA	1384	578	393	1413	75	None
Garage	North	587	25	62	50	NA	1470	701	577	1396	125	None
Waste Water Building	North	594	18	98	80	NA	2096	1619	1625	1656	90	None
North Gate House	North	594	10	10	10	NA	1634	987	943	1391	50	None
North Storage Building	North	591	30	110	50	NA	2254	1631	1540	1980	150	None

Table 3

Outstate Michigan 1-Hour SO_2 NAAQS Designations
For Specified Large SO_2 Sources (Round 1 Sources)

DTE Energy Belle River & St. Clair Power Plants

Source Data

Source	Load (%)	Sulfur Dioxide Allowable Emission Rate Short-term (lb/hr)	Notes
Belle River PP Unit 1	100	8,177	Emission limit – 1.2 lbs/MMBtu
Belle River PP Unit 2	100	8,177	Emission limit – 1.2 lbs/MMBtu
Belle River PP Aux Blrs	100	0.00683	15 ppm sulfur oil
Belle River PP DG 11-1	100	4.88×10^{-6}	15 ppm sulfur oil & < 100 hrs/yr
Belle River PP DG 11-2	100	4.88×10^{-6}	15 ppm sulfur oil & < 100 hrs/yr
Belle River PP DG 11-3	100	4.88×10^{-6}	15 ppm sulfur oil & < 100 hrs/yr
Belle River PP DG 11-4	100	4.88×10^{-6}	15 ppm sulfur oil & < 100 hrs/yr
Belle River PP DG 11-5	100	4.88×10^{-6}	15 ppm sulfur oil & < 100 hrs/yr
St. Clair PP Unit 1	100	2,355	State 1.67 lb/MMBtu SO_2 limit
St. Clair PP Unit 2	100	2,355	State 1.67 lb/MMBtu SO_2 limit
St. Clair PP Unit 3	100	2,355	State 1.67 lb/MMBtu SO_2 limit
St. Clair PP Unit 4	100	2,355	State 1.67 lb/MMBtu SO_2 limit
St. Clair PP Unit 6	100	5,187	State 1.67 lb/MMBtu SO_2 limit
St. Clair PP Unit 7	100	7,841	State 1.67 lb/MMBtu SO_2 limit
St. Clair PP DG 12-1	100	4.27×10^{-4}	15 ppm sulfur oil
St. Clair PP DG 12-2	100	4.27×10^{-4}	15 ppm sulfur oil

Note: Belle River PP CTG Nos. 12-1, 12-2 & 13-1 and DTE East China CTG Nos. 1-4 were not modeled since they only combust pipeline-quality natural gas

Table 3 (Continued)

Belle River & St. Clair Power Plant 1-Hour SO_2 Modeling Study
China Township, MI

Stack Parameters

Source	Load (%)	Stack Height (feet)	Stack Inside Diam. (feet)	Stack Exit Gas Flow (acfm)	Stack Exit Velocity (ft/sec)	Stack Exit Temp. (F)	Minimum Property Line Distance: Distance (feet)	Minimum Property Line Distance: Direction
Belle River Unit 1	100	665	25.5	2.76 E6	90	290	1,959	North
Belle River Unit 2	100	665	25.5	2.76 E6	90	290	1,898	North
St. Clair Unit 1-4	100	599	13.32	765,000	91.5	300	216	East
St. Clair Unit 6	100	425	13.3	1.35 E6	161.5	300	266	East
St. Clair Unit 7	100	600	16.0	1.59 E6	132	275	191	East

Notes:

1. Belle River Units 1 & 2 were installed after promulgation of the Good Engineering Practice (GEP) Stack Height Regulations. However, since this impact analysis is to project past actual monitoring SO_2 levels, each unit's actual stack height (665 feet) is modeled.
2. St. Clair Units 1-4 have an actual stack height greater than their GEP formula height. Units 1-4 have a common 599-foot tall outer stack with four separate liners for each unit. These units will be modeled with their actual stack height.
3. St. Clair Unit 7 has a stack height that is above its formula height. However, it was in existence before the GEP stack height regulation was finalized. Therefore, its actual stack height is modeled in this impact analysis.
4. St. Clair Unit 6's stack is below its GEP formula height, and will be modeled at its actual stack height.

Table 4

Belle River & St. Clair Power Plant 1-Hour SO_2 Modeling Study
China Township, MI

Modeling Input Parameters

Refined Modeling Inputs
Source Emission & Stack Data

		Stack				SO2 Max	Stack	Stack	Stack	
		Base	Stack	Stack Coordinates (NAD83)		Emission	Inside	Exit	Exit	
Belle River PP		Elevation	Height	UTME	UTMN	Rate	Diameter	Temperature	Velocity	Stack
Stack Data	Source No.	(feet)	(feet)	(m)	(m)	(lbs/hour)	(feet)	(deg F)	(ft/sec)	Orientation
Unit 1 Stack	1	591.5	665	377804	4736933	8177	25.5	290	90	Vertical
Unit 2 Stack	2	591.5	665	377713	4736972	8177	25.5	290	90	Vertical
Aux Boiler Stack	Aux. Boiler	591.5	268.5	377706	4736849	209.1	9.0	350	20	Vertical
DG 11-1	DG 11-1	590	20	378133	4736554.5	19.9	2.67	770	68.45	Vertical
DG 11-2	DG 11-2	590	20	378133	4736545.5	19.9	2.67	770	68.45	Vertical
DG 11-3	DG 11-3	590	20	378133	4736537.5	19.9	2.67	770	68.45	Vertical
DG 11-4	DG 11-4	590	20	378133	4736528.5	19.9	2.67	770	68.45	Vertical
DG 11-5	DG 11-5	590	20	378133	4736519.5	19.9	2.67	770	68.45	Vertical
		Stack				SO2 Max	Stack	Stack	Stack	
		Base	Stack	Stack Coordinates (NAD83)		Emission	Inside	Exit	Exit	
St Clair PP		Elevation	Height	UTME	UTMN	Rate	Diameter	Temperature	Velocity	Stack
Stack Data	Source No.	(feet)	(feet)	(m)	(m)	(lbs/hour)	(feet)	(deg F)	(ft/sec)	Orientation
Unit 1 - 4 Stack	1	583	599	379538	4735415	2355	13.32	300	91.5	Vertical
Unit 1 - 4 Stack	2	583	599	379538	4735415	2355	13.32	305	105.1	Vertical
Unit 1 - 4 Stack	3	583	599	379538	4735415	2355	13.32	300	99.3	Vertical
Unit 1 - 4 Stack	4	583	599	379538	4735415	2355	13.32	305	90.9	Vertical
Unit 6 Stack	6	583	425	379597	4735659	5187	13.3	300	161.5	Vertical
Unit 7 Stack	7	583	600	379629	4735718	7841	16.0	275	132	Vertical
DG 12-1	DG 12-1	589	20	379347	4735464	28.5	2.67	770	68.45	Vertical
DG 12-2	DG 12-2	589	20	379349	4735471	28.5	2.67	770	68.45	Vertical

Table 4 (Continued)

Belle River & St. Clair Power Plant 1-Hour SO_2 Modeling Study
China Township, MI

Modeling Input Parameters

Refined Modeling Inputs
Building Data

Building Influence Model: BPIP (Version 8.80, dated 04112)

Belle River Power Plant - Critical Buildings Affecting Main Unit / Aux Boiler / Diesel Gen Stack Downwash

Belle River Power Plant Structure	Unit No.	Base Elevation (feet)	Height (feet)	Corner 1 UTME (m)	Corner 1 UTMN (m)	Corner 2 UTME (m)	Corner 2 UTMN (m)	Corner 3 UTME (m)	Corner 3 UTMN (m)	Corner 4 UTME (m)	Corner 4 UTMN (m)
Boiler House	1	591.5	262.5	377713	4736795	377733	4736845	377788	4736823	377768	4736773
Boiler House	2	591.5	262.5	377622	4736830	377641	4736882	377696	4736860	377676	4736810
Combustion Air Duct Roof	2	591.5	255	377653	4736877	377658	4736890	377691	4736877	377686	4736864
Combustion Air Duct Roof	1	591.5	241.2	377745	4736840	377750	4736853	377780	4736841	377775	4736828
Coal Conveyor Gallery Roof (North)	1	591.5	236.5	377775	4736828	377778	4736836	377790	4736831	377787	4736823
North Aux Area & West U1 / East U2	1 & 2 & Aux	591.5	236.5	377686	4736864	377691	4736877	377710	4736869	377708	4736864
				377748	4736848	377745	4736840	377733	4736845	377731	4736841
				377694	4736856	377696	4736860				
Coal Conveyor Gallery Roof (NE)	1	591.5	210.3	377785	4736817	377790	4736830	377800	4736826	377795	4736813
Coal Conveyor Gallery Roof (East)	1	591.5	193.5	377768	4736773	377785	4736817	377795	4736813	377777	4736769
Coal Conveyor Gallery Roof (West)	2	591.5	193.5	377614	4736834	377637	4736893	377644	4736891	377622	4736831
Auxiliary Area (Between Boilers)	Aux.	591.5	193.5	377676	4736810	377694	4736856	377731	4736841	377713	4736795
Turbine Bdg (Fan Room Roof)	1	591.5	134	377697	4736751	377703	4736767	377756	4736747	377750	4736731
Turbine Bdg (Fan Room Roof)	2	591.5	134	377607	4736786	377613	4736802	377666	4736782	377660	4736766
Turbine Building	1 & 2 & Aux	591.5	110.5	377598	4736790	377614	4736834	377777	4736769	377760	4736727
HVAC Fan Room	1	591.5	72.7	377784	4736786	377800	4736826	377821	4736819	377805	4736779
HVAC Fan Room	2	591.5	72.7	377600	4736858	377615	4736900	377636	4736893	377621	4736851
Service Building	1 & 2 & Aux	591.5	31.8	377523	4736817	377542	4736870	377617	4736843	377598	4736790
Administration Building	1 & 2 & Aux	591.5	28	377554	4736768	377565	4736795	377599	4736781	377587	4736754
Bottom & Fly Ash Bdg. /Collector	1	590.5	124	Center = 377807E, 4736997N, Diameter = 40 feet							
Bottom & Fly Ash Bdg. /Collector	2	590.5	124	Center = 377761E, 4737016N, Diameter = 40 feet							
Electrostatic Precipitator	1	591.5	90	377740	4736891	377752	4736925	377835	4736895	377823	4736861
Electrostatic Precipitator	2	591.5	90	377650	4736925	377662	4736959	377745	4736929	377733	4736895
Diesel Gen No. 11-1 (Main Bdg.)	DG 11-1	590	12	378134	4736553	378134	4736556	378148	4736556	378148	4736553
Diesel Gen No. 11-1 (Silencer)	DG 11-1	590	17	378134	4736553.7	378134	4736555.3	378142	4736555.3	378142	4736553.7
Diesel Gen No. 11-2 (Main Bdg.)	DG 11-2	590	12	378134	4736544	378134	4736547	378148	4736547	378148	4736544
Diesel Gen No. 11-2 (Silencer)	DG 11-2	590	17	378134	4736544.7	378134	4736546.3	378142	4736546.3	378142	4736544.7
Diesel Gen No. 11-3 (Main Bdg.)	DG 11-3	590	12	378134	4736536	378134	4736539	378148	4736539	378148	4736536
Diesel Gen No. 11-3 (Silencer)	DG 11-3	590	17	378134	4736536.7	378134	4736538.3	378142	4736538.3	378142	4736536.7
Diesel Gen No. 11-4 (Main Bdg.)	DG 11-4	590	12	378134	4736527	378134	4736530	378148	4736530	378148	4736527
Diesel Gen No. 11-4 (Silencer)	DG 11-4	590	17	378134	4736527.7	378134	4736529.3	378142	4736529.3	378142	4736527.7
Diesel Gen No. 11-5 (Main Bdg.)	DG 11-5	590	12	378134	4736518	378134	4736521	378148	4736521	378148	4736518
Diesel Gen No. 11-5 (Silencer)	DG 11-5	590	17	378134	4736518.7	378134	4736520.3	378142	4736520.3	378142	4736518.7
Stack Data											
Unit 1 Stack	1	591.5	665	377804	4736933						
Unit 2 Stack	2	591.5	665	377713	4736972						
Auxiliary Boiler Stack	Aux. Boiler	591.5	268.5	377706	4736849						
Diesel Gen No. 11-1	DG 11-1	590	20	378133	4736554.5						
Diesel Gen No. 11-2	DG 11-2	590	20	378133	4736545.5						
Diesel Gen No. 11-3	DG 11-3	590	20	378133	4736537.5						
Diesel Gen No. 11-4	DG 11-4	590	20	378133	4736528.5						
Diesel Gen No. 11-5	DG 11-5	590	20	378133	4736519.5						

Table 4 (Continued)

Belle River & St. Clair Power Plant 1-Hour SO_2 Modeling Study
China Township, MI

St Clair Power Plant - Critical Buildings Affecting Main Unit / Diesel Generator Stack Downwash

St Clair Power Plant Structure	Unit No.	Base Elevation (feet)	Height (feet)	Corner 1(or 5) UTME (m)	Corner 1(or 5) UTMN (m)	Corner 2(or 6) UTME (m)	Corner 2(or 6) UTMN (m)	Corner 3(or 7) UTME (m)	Corner 3(or 7) UTMN (m)	Corner 4(or 8) UTME (m)	Corner 4(or 8) UTMN (m)
Boiler House (Middle Section)	5	585	215.8	379526	4735622	379535	4735654	379553	4735649	379544	4735617
Boiler House (East Section)	7	584.5	212.2	379562	4735722	379572	4735755	379576	4735754	379577	4735758
				379617	4735747	379605	4735705	379565	4735716	379566	4735720
Electrostatic Precipitator	6	582	186	379635	4735670	379641	4735692	379672	4735683	379666	4735661
Boiler House (East Section)	6	585	178.2	379536	4735654	379548	4735694	379582	4735684	379580	4735678
				379588	4735676	379580	4735647	379572	4735649	379570	4735643
Boiler House (East Section)	5	585	172.1	379544	4735617	379553	4735649	379560	4735647	379551	4735615
Boiler House (North Section)	7	584.5	154	379555	4735756	379557	4735764	379577	4735758	379576	4735754
				379572	4735755	379571	4735752				
Boiler House (Middle Section)	1 - 4	585	150.3	379469	4735486	379471	4735493	379489	4735489	379527	4735623
				379546	4735618	379508	4735484	379501	4735486	379499	4735479
Boiler House (Scrubber Extension)	5	583	150	379552	4735616	379560	4735646	379568	4735644	379560	4735615
Boiler House (2nd West Section)	5	585	149.8	379517	4735625	379526	4735657	379535	4735654	379526	4735622
Boiler House (West Section)	1 - 4	585	138.4	379471	4735493	379509	4735628	379527	4735623	379489	4735489
Boiler House (1st West Section)	5	585	138	379509	4735628	379518	4735660	379528	4735657	379517	4735625
Boiler House (West Section)	6	585	138	379526	4735657	379538	4735697	379548	4735694	379536	4735654
Electrostatic Precipitator	7	582.5	137	379614	4735712	379621	4735737	379629	4735735	379622	4735710
Boiler House (West Section)	6 - 7	584.5	120.8	379538	4735697	379555	4735756	379571	4735752	379562	379722
				379566	4735721	379557	4735692				
Turbine Building	1 - 7	585	106	379431	4735488	379511	4735772	379547	4735762	379467	4735478
Upper Interface Blr Hse to ESP	7	583	100	379608	4735713	379615	4735739	379621	4735737	379614	4735711
Electrostatic Precip (N-S Duct Run)	1 - 4		100	379584	4735462	379615	4735582	379621	4735581	379590	4735461
Electrostatic Precip (NE-SW Duct Run)	1 - 4		100	379539	4735423	379584	4735462	379586	4735461	379586	4735455
Electrostatic Precipitator (South)	1 - 4		80	379543	4735476	379558	4735527	379590	4735517	379575	4735466
Electrostatic Precipitator (North)	1 - 4		80	379563	4735547	379578	4735597	379609	4735588	379594	4735538
Boiler House (East Section)	1 - 4	585	73.7	379508	4735484	379546	4735618	379554	4735616	379516	4735482
Shops Building (South Section)	1 - 7	585	71	379462	4735459	379467	4735478	379504	4735467	379499	4735449
South Flyash Silo	1 - 7	582	70	Center = 379536E, 4735462N & Diameter = 40 feet (12.2m)							
Lower Interface Blr Hse to ESP	7	583	61.4	379604	4735701	379617	4735747	379623	4735745	379610	4735699
South Ash Dewatering Bin	6	583	60	Center = 379581E, 4735595N & Diameter = 30 feet (9.14m)							
North Ash Dewatering Bin	6	583	60	Center = 379586E, 4735614N & Diameter = 30 feet (9.14m)							
South Ash Dewatering Bin	7	583	60	Center = 379641E, 4735700N & Diameter = 30 feet (9.14m)							
North Ash Dewatering Bin	7	583	60	Center = 379644E, 4735713N & Diameter = 30 feet (9.14m)							
Shops Building (North Section)	1 - 7	585	51.3	379467	4735478	379469	4735486	379499	4735479	379501	4735486
				379516	4735482	379512	4735467				
Office Building (North Section)	1 - 7	585	46.7	379446	4735441	379458	4735480	379467	4735478	379462	4735459
				379469	4753457	379462	4735434				
SO2 Building	6 - 7	583	40	379595	4735674	379600	4735691	379617	4735685	379612	4735667
Water Pretreatment Plant	1 - 7	587	30	379356	4735458	379359	4735470	379380	4735463	379377	4735451
Screen House #3	7	582	25	379662	4735704	379667	4735721	379681	4735713	379676	4735696
Water Tank	1 - 7	589	25	Center = 379381E, 4735481N & Diameter = 40 feet (12.2m)							
Office Building (South Section)	1 - 7	585	18.5	379439	4735431	379449	4735464	379453	4735463	379446	4735441
				379462	4735434	379459	4735425				
Slurry Storage Tank	1 - 7	583	15	Center = 379602E, 4735649N & Diameter = 32 feet (9.75m)							
Diesel Generator	12-1	589	12	379333	4735465	379334	4735468	379348	4735464	379347	4735461
Diesel Generator	12-2	589	12	379335	4735472	379336	4735475	379350	4735471	379349	4735468
Stack Data											
Unit 1 - 4 Stack	1 - 4	583	599	379538	4735415						
Unit 6 Stack	6	583	423.5	379597	4735659						
Unit 7 Stack	7	583	599	379629	4735718						
DG 12-1	DG 12-1	589	20	379347	4735464						
DG 12-2	DG 12-2	589	20	379349	4735471						

Note: Other buildings in the area are not modeled because the proposed source's stacks are outside of the wake zone of these structures.

Table 4 (Continued)

Belle River & St. Clair Power Plant 1-Hour SO_2 Modeling Study
China Township, MI

Modeling Input Parameters

Refined Model: AERMOD (BEE-Line Version 11.00, dated 14134)

Model Options:
- Terrain elevations considered - Yes
- Dispersion coefficients - Rural
- Default wind exponents - Yes
- Default vertical temperature gradients - Yes
- Emissions scaled - No
- Final plume rise - Yes
- Stack tip downwash - Yes
- Buoyancy induced dispersion - Yes
- Calm processing routine - Yes
- Regulatory default option - Yes
- Type of pollutant – SO_2

Meteorological Data:
- Surface – Oakland County International Airport (PTK)
- Upper Air – White Lake NWS Office (DTX)
- Dates – 2012-2014
- Anemometer height – 10 m

Receptor Grid (Property Line Grid / Innermost Grid)
- Grid Type: Rectangular
- Fence Line Rec.: Yes
- Grid: 50 m spacing at fence line & outside of the fence line out to 500 m beyond the property line

Receptor Grid (2^{nd} Grid)
- Grid Type: Rectangular
- Grid: 100 m spacing outside of Innermost Grid to 4 km from the property line

Receptor Grid (3^{rd} Grid)
- Grid Type: Rectangular
- Grid: 250 m spacing outside of the 2nd Grid to 10 km from the property line

Figure 1

Belle River Power Plant
Diesel Generators 11-1 through 11-5
With Main Units in the Background

Figure 2

Belle River Power Plant

Aerial Photograph from 2006

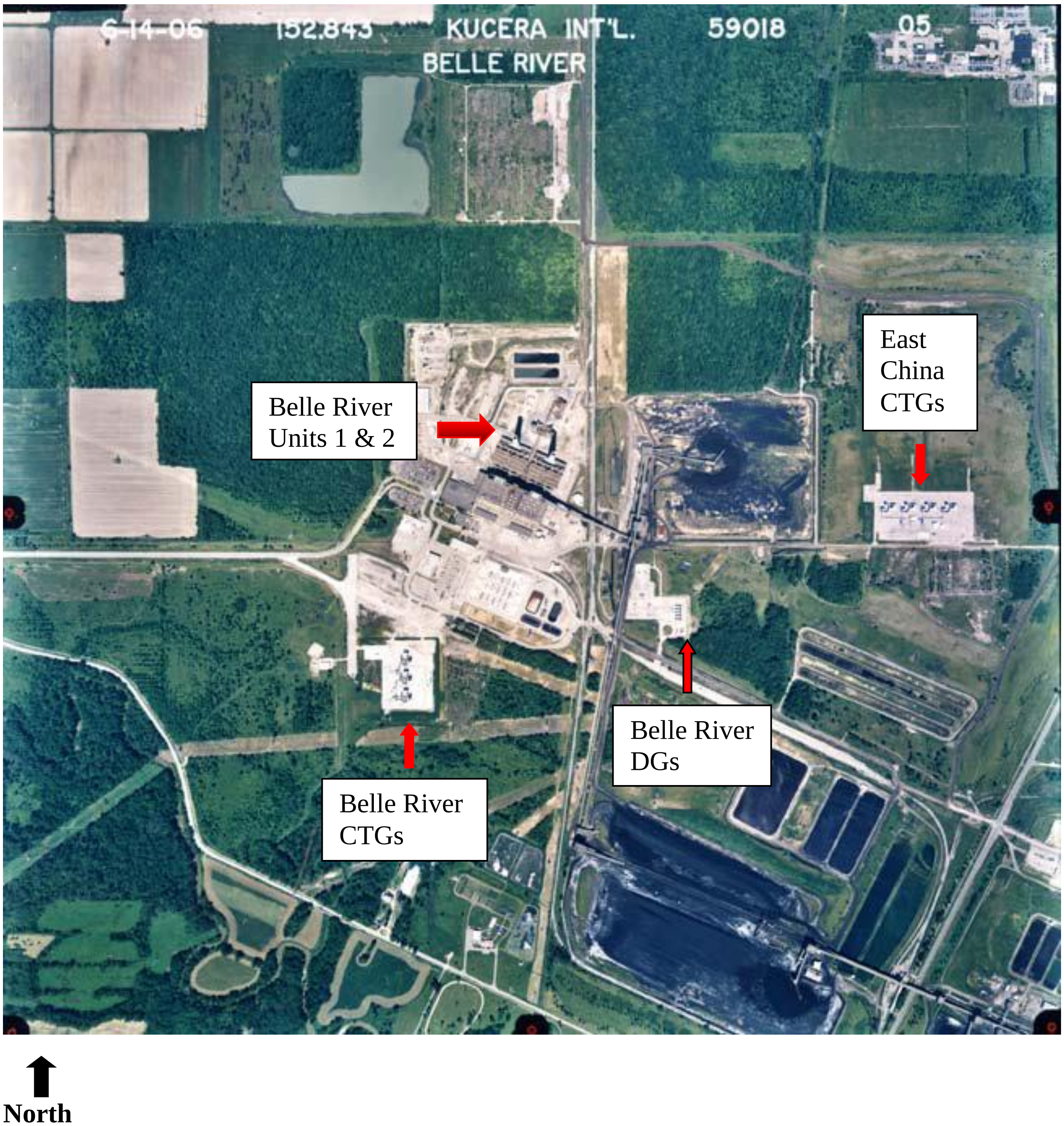


Figure 3

St. Clair Power Plant

Aerial Photograph from 2006

Figure 4A

Belle River & St. Clair Power Plant 1-Hour SO_2 Modeling Study
China Township, MI

Port Huron Monitoring Site

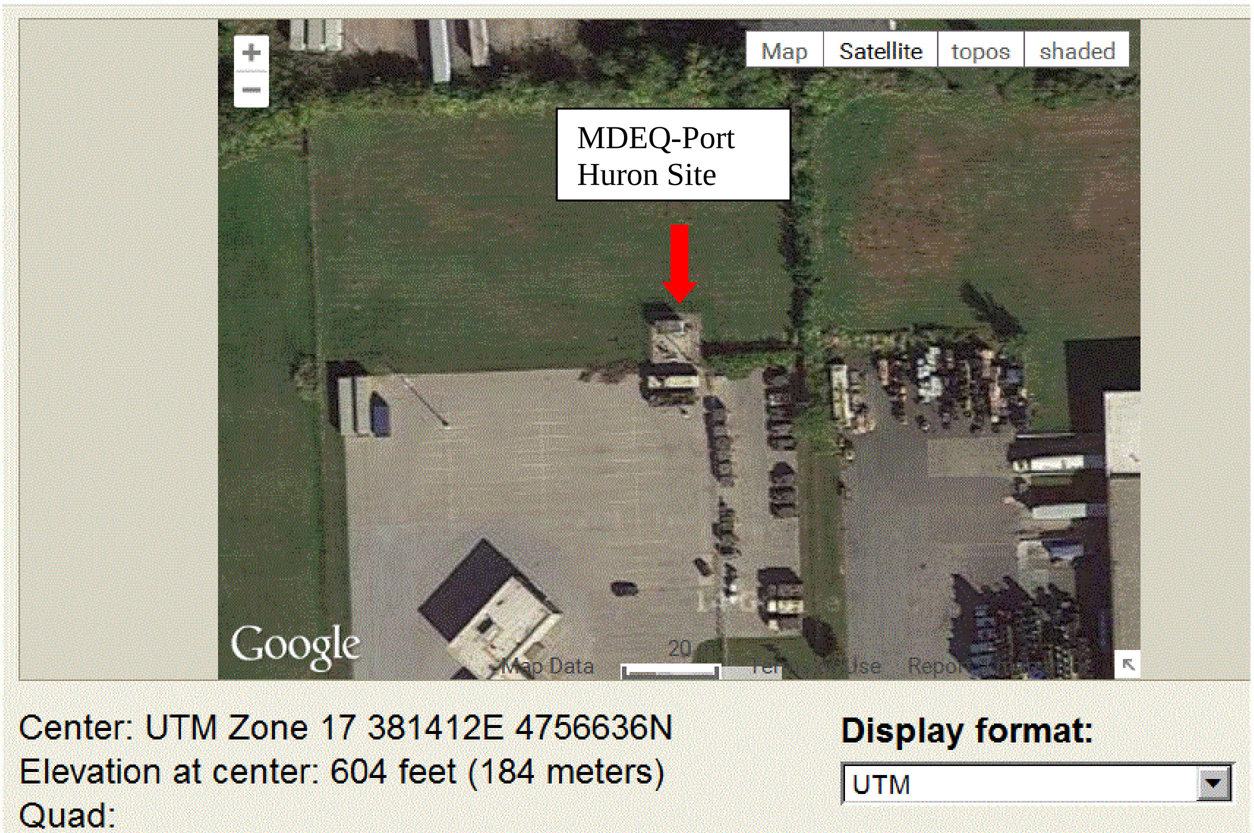


Figure 4B

Belle River & St. Clair Power Plant 1-Hour SO_2 Modeling Study
China Township, MI

Canadian Refinery East-southeast of Port Huron Monitor

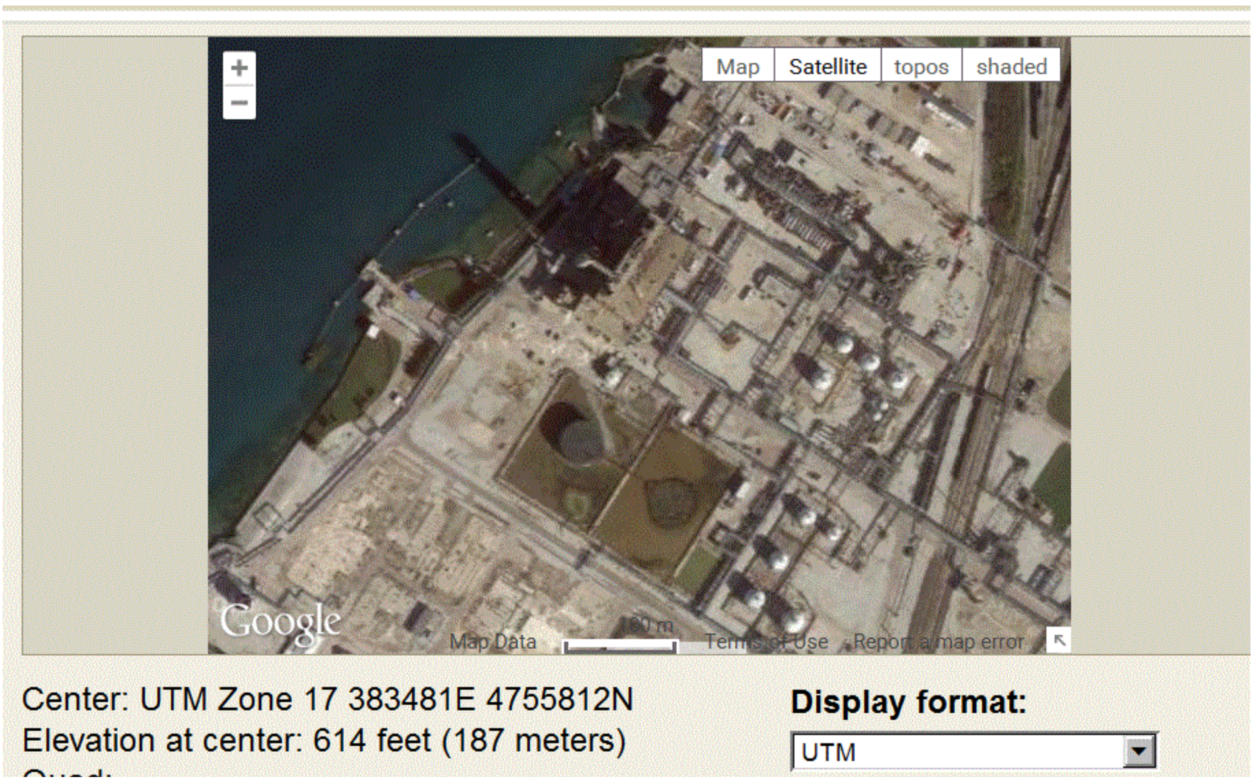


Figure 4C

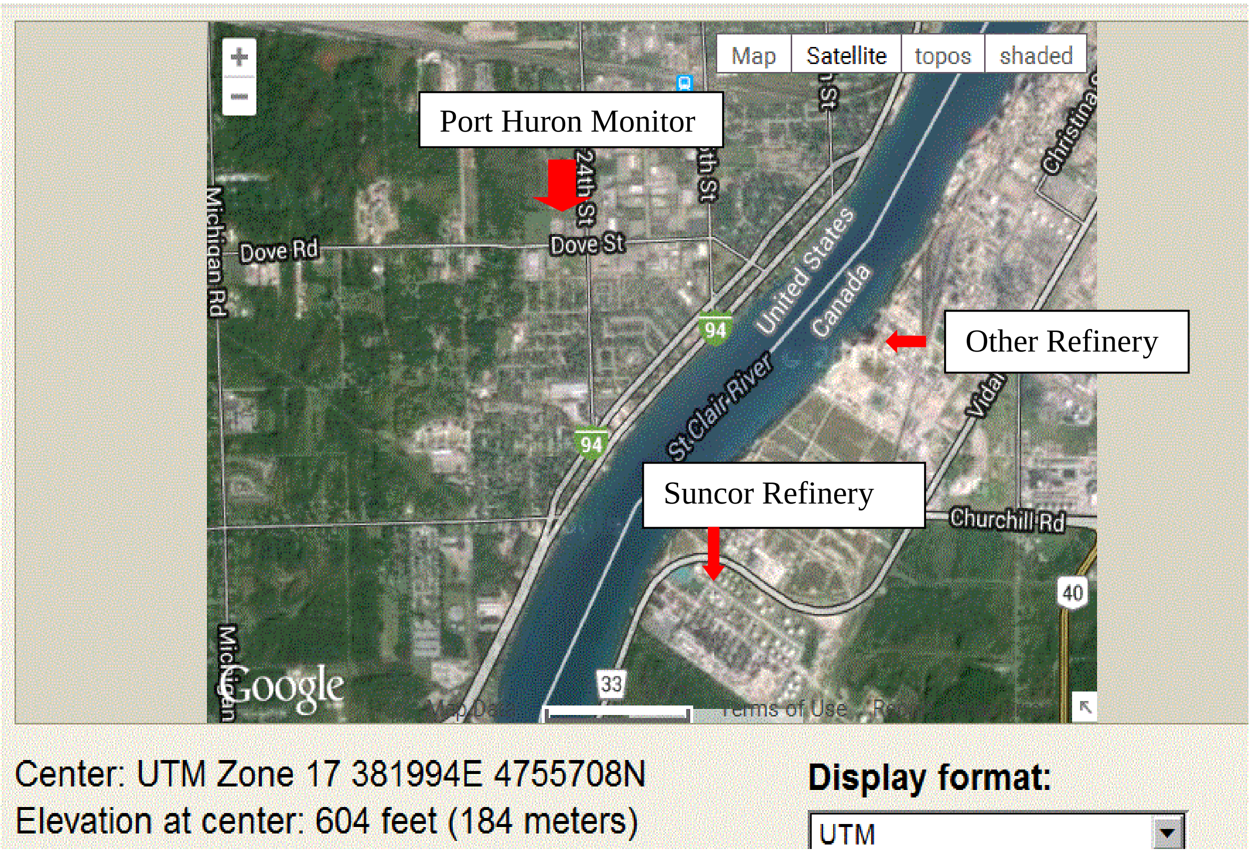
Belle River & St. Clair Power Plant 1-Hour SO_2 Modeling Study
China Township, MI

Canadian Refinery (Suncor) South-southeast of Port Huron Monitor

Figure 4D

Belle River & St. Clair Power Plant 1-Hour SO_2 Modeling Study
China Township, MI

Port Huron Monitor & Nearby Canadian Refineries



Belle River / St. Clair PP 1-hour SO_2 Designation Modeling Results

With Pontiac Surface Meteorological Data

August 10, 2015

AERMOD Modeling Assumptions

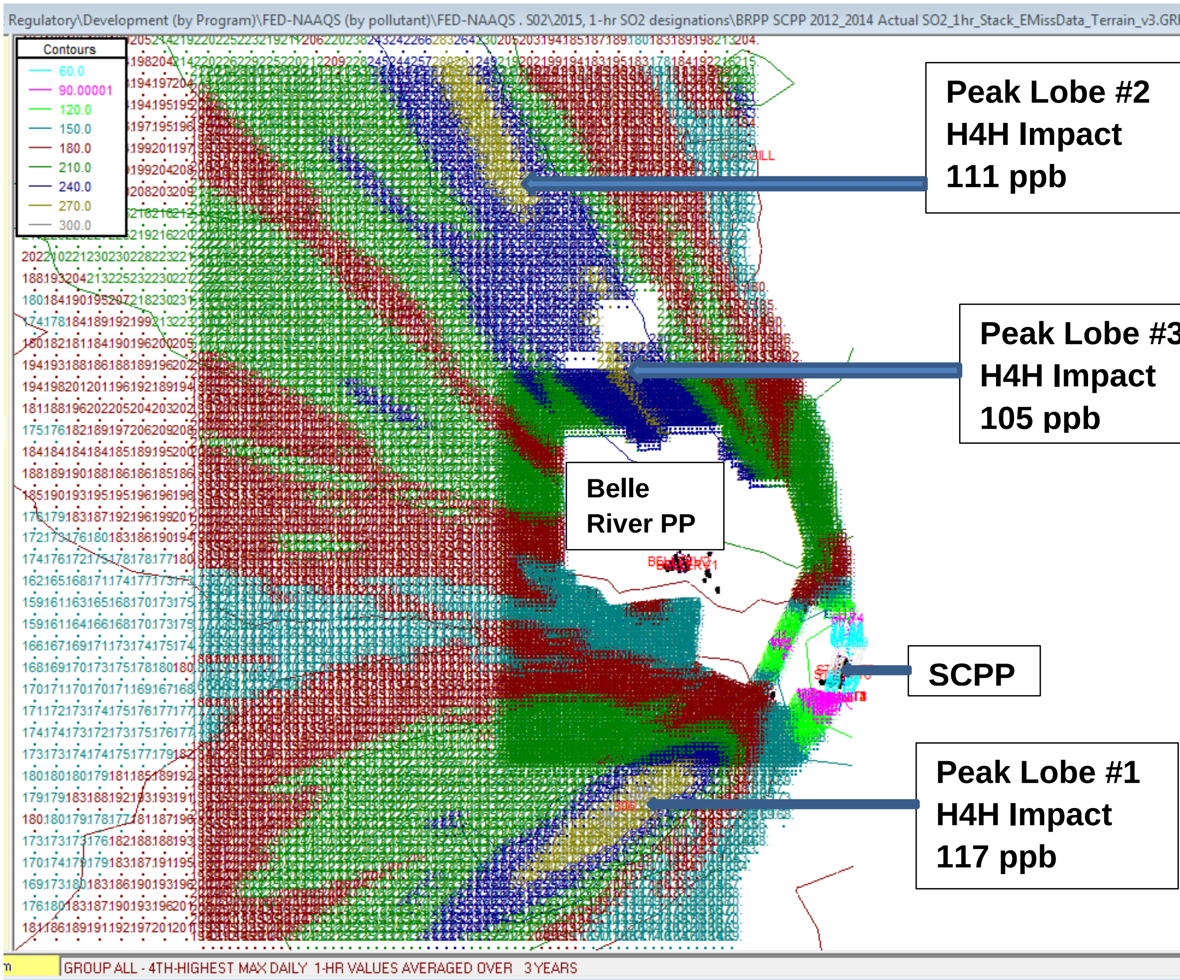
- Use actual 2012-2014 CEMS data (SO_2, Exit temperature, Exit velocity) for all Belle River PP & St. Clair PP main units
- Did not model smaller SO_2 source impacts (CTGs, DGs, Aux Blrs)
- Used 2012-2014 meteorological data from Oakland County International Airport (Pontiac) instead of closer site (Port Huron)
- Only predict impacts where monitors could be located
    - No receptors in Canada, over water, over landfills, within secured plant property (used property lines not fence lines)
- Modeled impacts from two other "nearby" SO_2 sources (Cargill Salt & E B Eddy Paper Company)
- Included actual source and receptor elevations
- Used most recent version of AERMOD (14134)
- Estimated background SO_2 concentration – 15 ppb

Figure 1

99th Max Daily 1-hour SO_2 Impacts- All Belle River & St. Clair PP Units

Pontiac Surface Met Data

(Not Including Background Concentration)



At the peak combined impact receptor, the SO_2 sources' H4H impact is:

SO_2 Source	Impact (ug/m^3) / (ppb)
BRPP-Units 1&2	60.3 / 23
SCPP-Unit 1	26.9 / 10.3
SCPP-Unit 2	21.6 / 8.2
SCPP-Unit 3	24.7 / 9.4
SCPP-Unit 4	39.7 / 15.2
SCPP Unit 6	117 / 44.6
SCPP-Unit 7	79.8 / 30.4
SCPP-Total	305 / 116.4
Cargill Salt Inc.	21.39 / 8.2
E B Eddy Paper Inc.	17.8 / 6.8

Total = 306.14 ug/m^3 / 116.8 ppb

NAAQS = 75 ppb

Belle River / St. Clair PP 1-hour SO_2 Designation Modeling Results

With Port Huron Surface Meteorological Data

August 10, 2015

AERMOD Modeling Assumptions

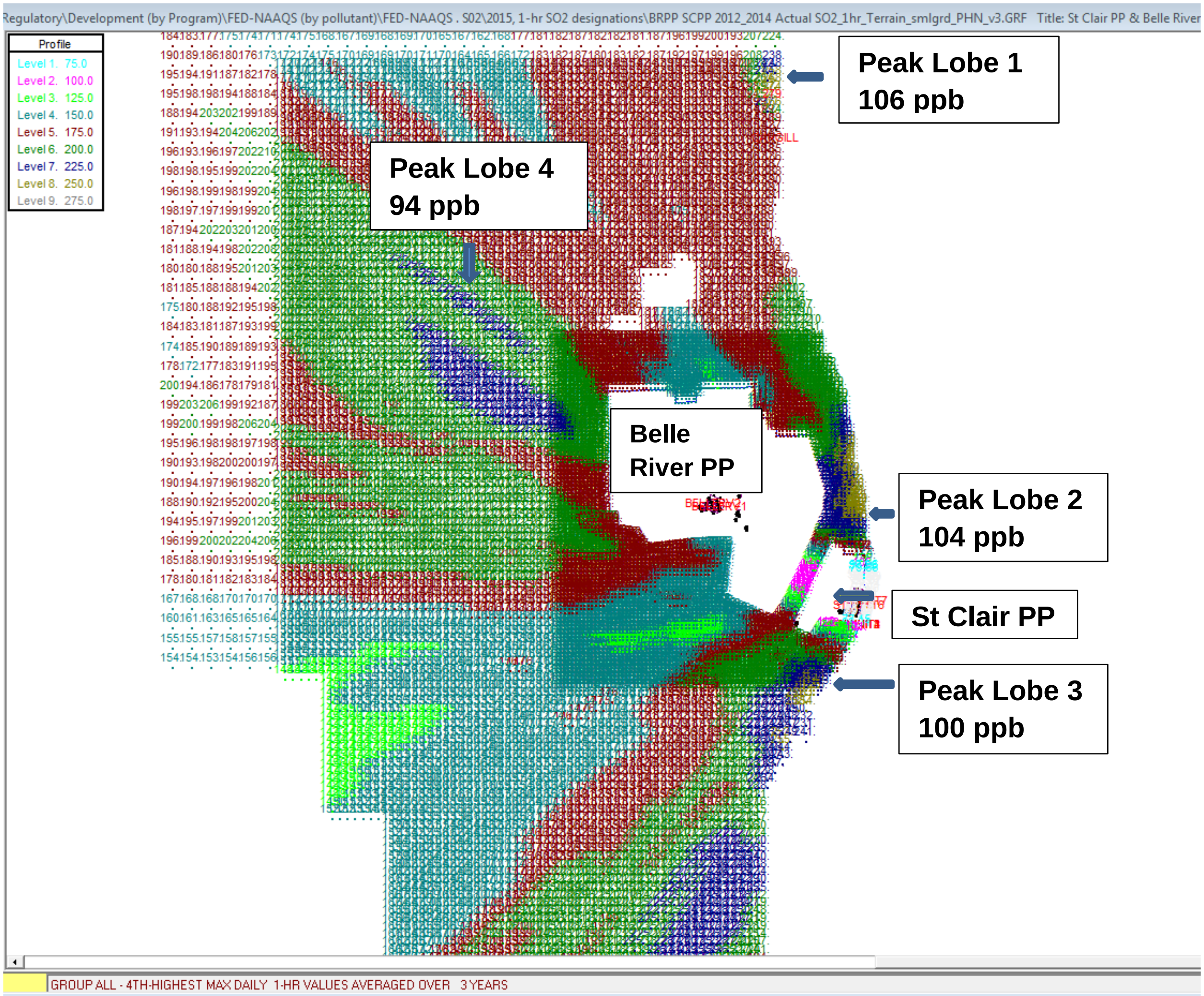
- Use actual 2012-2014 CEMS data (SO_2, Exit temperature, Exit velocity) for all Belle River PP & St. Clair PP main units
- Did not model smaller SO_2 source impacts (CTGs, DGs, Aux Blrs)
- Used 2012-2014 meteorological data from St. Clair County International Airport (Port Huron) instead of EPA preferred site (Pontiac)
- Only predict impacts where monitors could be located
    - No receptors in Canada, over water, over landfills, within secured plant property (used property lines not fence lines)
- Modeled impacts from two other "nearby" SO_2 sources (Cargill Salt & E B Eddy Paper Company)
- Included actual source and receptor elevations
- Used most recent version of AERMOD (14134)
- Estimated background SO_2 concentration – 15 ppb

Figure 2

99th Max Daily 1-hour SO_2 Impacts- All Belle River & St. Clair PP Units

Port Huron Surface Met Data

(Not Including Background Concentration)



At the peak combined impact receptor, the SO_2 sources' H4H impact is:

SO_2 Source	Impact (ug/m^3) / (ppb)
BRPP Units 1 & 2	77.5 / 29.6
SCPP Total	169 / 64.5
Cargill Salt Inc.	128 / 48.9
E B Eddy Paper Inc.	17.32 / 6.61

Total = 279 ug/m^3 / 106.5 ppb

NAAQS = 75 ppb

H4H Impacts Using Pontiac Versus Port Huron Meteorological Data

Introduction:

There are challenges predicting the magnitude and location of the 99th percentile SO_2 impacts from these large SO_2 sources. This prediction is important for two main reasons:

1. Understanding how each source contributes to the highest combined 1-hour SO_2 impacts is important for reduction strategy development. Accurately predicting the location and magnitude of high SO_2 impacts is essential to develop the most effective strategy to attain the SO_2.NAAQS
2. Modeling predictions of the location of highest 1-hour SO_2 impacts and how often they occur in the AERMOD runs will be used to determine where to site new air quality monitors. Monitor installation is being proposed to provide critical concentration and meteorological data for SO_2 reduction strategy development.

Challenges:

- The magnitude of differences between predicted 99th percentile 1-hour SO_2 impact from the model using Pontiac meteorological data versus Port Huron meteorological data. This discrepancy is very important, especially if the results using Pontiac data are used in the official area designation, and subsequent SIP development.
  - The predicted 99th percentile 1-hour SO_2 impact from these large SO_2 sources is 10 ppb higher when Pontiac meteorological data are modeled (117 ppb) instead of Port Huron data (106 ppb) – This 10 ppb difference is much higher than when an annual average SO_2 emission rate is modeled (3-4 ppb) between the two meteorological data sets.
  - These predicted impacts do NOT include the background concentration (estimated as 15 ppb by MDEQ-AQD staff)
- There are large differences in the location of predicted peak impact areas from AERMOD using Pontiac meteorological data versus Port Huron meteorological data.
  - Port Huron weather data clearly shows some channeling flow along the St. Clair River <u>during meteorological conditions when the highest 1-hour SO_2 impacts are predicted – The highest predicted 1-hour SO_2 impacts are NOT along the St. Clair River when Pontiac surface data are modeled</u>
  - Lobe 1 using Pontiac data is SSW of SCPP versus N of SCPP using Port Huron data – The 2nd peak lobe along the St. Clair River shown with Port Huron data is more realistic, especially with St. Clair Unit No. 6's (Stack Ht.=425 feet) stack being much more affected by building downwash than the other units (Stack Hts.=599-665 feet)
  - The farther inland high impact lobe with BRPP & SCPP impact is NW of BRPP with Pontiac data versus WNW of BRPP with Port Huron data
- Monitor siting is challenged by the variability of modeled high impact locations between the two meteorological data sets.
  - This high impact location discrepancy could lead to locating new SO_2 monitoring sites in the wrong location, too far inland from the St. Clair River

Improvements:

- Installation of SO_2 monitors and meteorological towers to determine the actual magnitude of high SO_2 values and provide accurate site meteorological flow to improve model predicted location of high impact areas. On-site meteorological data should be acquired, and used to clarify actual power plant site flow during meteorological conditions when the highest 1-hour SO_2 impacts are predicted, and compared to periods when the highest 1-hour average SO_2 concentrations are observed at these critical locations.

- Tentative, SO_2 monitoring sites are:
    - On the west side of River Road (M-29), on the berm just east of East China Township LLC combustion turbine generators (Lobe 2 from Port Huron met data results)
    - At a DTE Energy substation in Marine City (the southern portion of Lobe 3 SSW of SCPP) – This site would provide a much more representative background SO_2 concentration when high SO_2 levels are predicted, or observed at the monitoring site along River Road
    - The following figures (Figures 3-6) illustrate these currently preferred locations
        - Figures 3 and 4 illustrate the monitoring site closest to the peak 99^{th} percentile 1-hour SO_2 impact using Port Huron met data
        - Figures 5 and 6 show the recommended monitoring location next to a DTE Energy substation (Marine City Substation) that is amongst the lobe of high 99^{th} percentile SO_2 impacts southwest of St. Clair Power Plant. This site would help quantify incoming SO_2 levels when high SO_2 may be observed at the other monitoring site.
        - A monitoring site closer to St. Clair Power Plant than the Marine City Substation would be preferred. However, there are no suitable sites in this area that meet EPA's siting criteria for air quality monitoring sites. This area next to the St. Clair River has a number of subdivisions with canals to access the River, with most parcels also having large trees
        - Figure 7 shows the discrepancy between highest 4^{th}-highest (H4H) predicted impacts between the two met data sets. Using Pontiac met data, the orange arrow shows the 1^{st} H4H 1-hour SO_2 impact location southwest of St. Clair Power Plant. The blue and red arrows illustrate nearby locations of the second and third H4H 1-hour SO_2 impact locations with Port Huron met data. The highest H4H 1-hour SO_2 location is in downtown area of the City of St. Clair, just north of Cargill Salt Incorporated using Port Huron data. This location is not suitable for a future air quality monitoring site.

Figure 3

Northwest of St. Clair PP (Along River Road)

Figure 4

Figure 5

South-southwest of St. Clair PP (Between St. Clair River & Belle River)
Just north of Marine City at DTE Energy's Marine City Substation

Figure 6

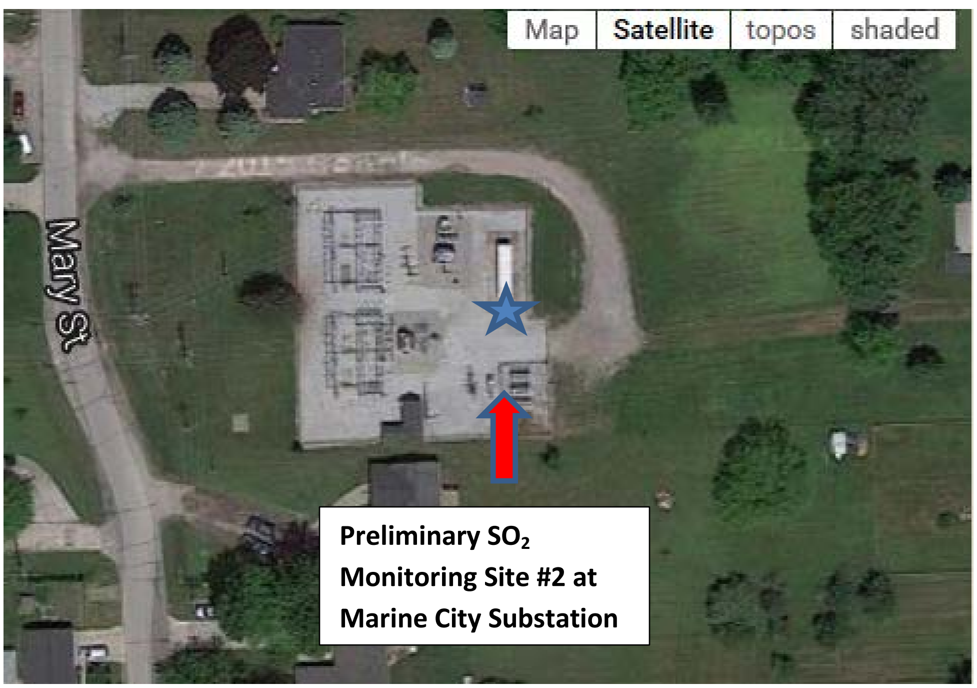


Figure 7 - 99th Max Daily 1-hour SO_2 Impacts – Only St. Clair PP Units