DATA REQUIREMENTS RULE AIR QUALITY CHARACTERIZATIONS AND

“ROUND III” SO_2 AREA DESIGNATION RECOMMENDATIONS

AQPSTR 17-01

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Executive Summary

The U.S. Environmental Protection Agency ("USEPA") has promulgated the Data Requirements Rule ("DRR")[1] to support the final phases of implementation of the primary 1-hour sulfur dioxide ("SO_2") National Ambient Air Quality Standard ("NAAQS"). This rulemaking requires regulatory authorities to conduct air quality characterizations (through modeling or monitoring) of facilities with annual emissions meeting or exceeding 2,000 tons (based upon the most recent year of available data) or, alternatively, establishing federally enforceable source emission requirements that will limit a facility's emissions to a level below this threshold.

The Illinois Environmental Protection Agency ("Illinois EPA") has conducted dispersion modeling to characterize air quality around five facilities – Kincaid Generation (Kincaid, IL), Rain CII Carbon (Robinson, IL), Midwest Generation (Waukegan, IL), Dynegy Midwest Generation (Baldwin, IL), Prairie State Generating Company (Lively Grove, IL) – and is continuing to conduct modeling to characterize air quality in the additional area around U.S. Steel Corporation (Granite City, IL) and Gateway Energy & Coke Company (Granite City, IL). The Illinois EPA will also provide Primary Quality Assurance Organization oversight responsibilities for an ambient monitoring program operated by two other facilities – Archer Daniels Midland Company (Decatur, IL) and Tate & Lyle Ingredients Americas (Decatur, IL) – which have been included in the Illinois EPA's 2017 Monitoring Plan. The procedures and results described in this document are provided to USEPA in fulfillment of Illinois EPA's obligations under the DRR. Based upon the DRR dispersion modeling results, the Illinois EPA is recommending designations of attainment of the 1-hour SO_2 NAAQS for the areas surrounding all facilities for which modeling has been completed. For the U.S. Steel/Gateway Energy study area in Madison County, the Illinois EPA is currently providing an area designation recommendation of unclassifiable pending resolution of uncertainties associated with model inputs.

[1] Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS); Final Rule, Federal Register, Vol. 80, No. 162, August 21, 2015, p. 51052-51088.

1.0 Introduction/Background

The 1-hour SO_2 NAAQS implementation process is on a court-approved schedule[2] for completion of area designations by USEPA in three rounds: the first round, which is now completed, was due by July 2, 2016; the second round is due by December 31, 2017; and the final round is due by December 31, 2020. In the court-approved agreement containing that schedule, USEPA indicated that it would designate two additional groups of areas by the July 2, 2016, deadline. These include areas that had newly monitored violations of the NAAQS and areas "that contain any stationary source that according to the EPA's Air Markets Database either emitted more than 16,000 tons of SO_2 in 2012 or emitted more than 2,600 tons of SO_2 and had an emission rate of at least 0.45 pounds SO_2/mmbtu in 2012 that has not been announced (as of March 2, 2015) for retirement."[3] Illinois had five facilities that met the criteria established in the court order – Hennepin Power Station (Putnam County), Newton Power Station (Jasper County), Joppa Steam Coal Power Plant (Massac County), Marion Power Station (Williamson County), and the Wood River Power Station (Madison County). USEPA has finalized the area designations for these five facilities under the first round of the schedule.

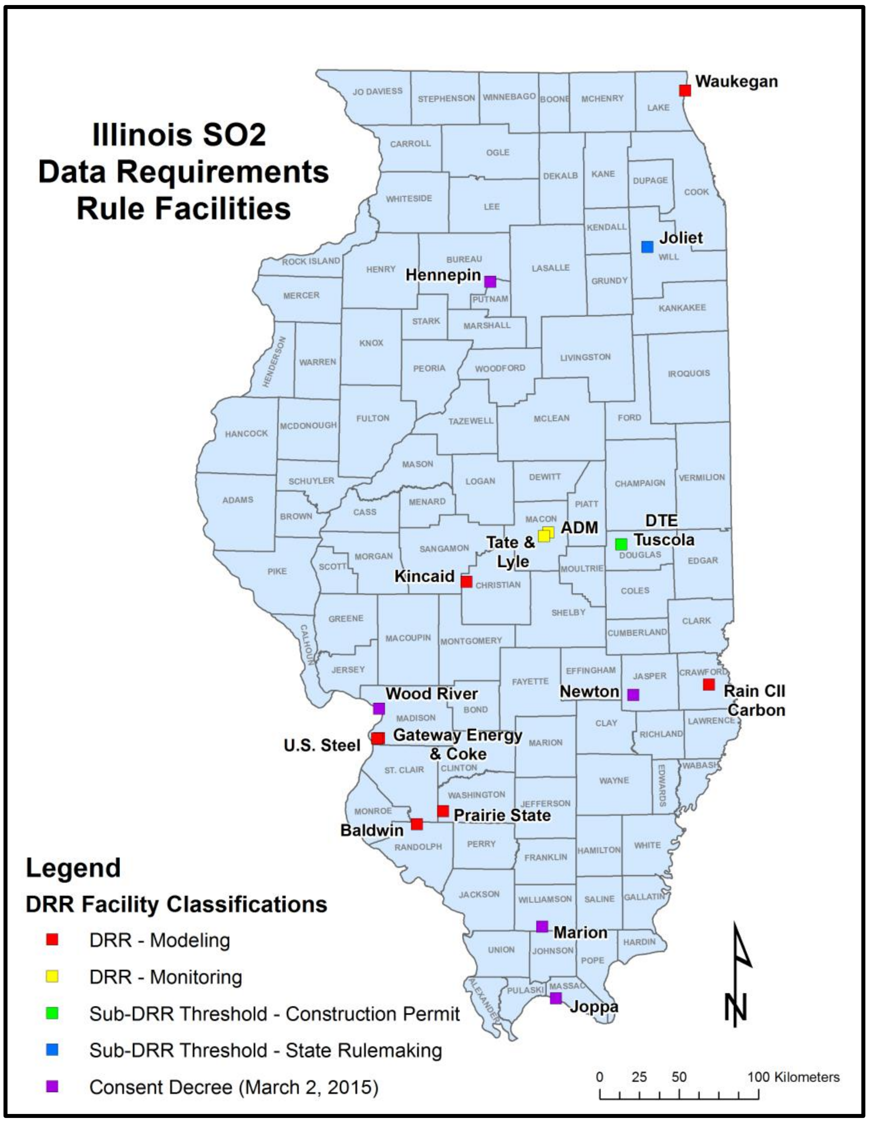
The final implementation phases of the 1-hour SO_2 NAAQS incorporate the December 31, 2017, and December 31, 2020, deadlines agreed to in the March 2, 2015, court order and the closely-linked requirements specified in the DRR. The DRR directs air regulatory authorities to characterize current air quality around sources that emitted greater than 2,000 tons per year ("tpy") in the most recent year for which data was available. Based upon the criteria and conditions set forth in the rule, the Illinois EPA has characterized air quality around five facilities using dispersion modeling – Kincaid Generation (Kincaid, IL), Rain CII Carbon (Robinson, IL), Midwest Generation (Waukegan, IL), Dynegy Midwest Generation (Baldwin, IL), and Prairie State Generating Company (Lively Grove, IL). The Illinois EPA is also continuing to conduct modeling to characterize air quality in the area around the "single source" consisting of U.S. Steel Corporation and Gateway Energy & Coke Company (Granite City, IL). As the modeling in this area is still ongoing due to uncertainties associated with model inputs, the area is not further addressed in this document. For two additional facilities – Archer Daniels Midland Company (Decatur, IL) and Tate & Lyle Ingredients Americas (Decatur, IL) – air quality will be characterized through ambient monitoring that commenced prior to January 1, 2017, and will continue for at least three years.

These facilities are a subset of those that were required to be identified to USEPA in January 2016.[4] The locations of these facilities are shown on the map provided in Figure 1. Thus, the air quality characterization of DRR facilities, through monitoring and modeling as identified in this document, will inform and facilitate the area designations process for the second and third rounds of the schedule (March 2, 2015, court order, Sierra Club v. McCarthy). The Illinois EPA was required to

[2] Sierra Club v. McCarthy, No. 3-13-cv-3953 (SI) (N.D. Cal. Mar. 2, 2015).
[3] March 20, 2015, Memorandum from Janet G. McCabe, Acting Assistant Administrator (USEPA) to Lisa Bonnett, Director, Illinois Environmental Protection Agency.
[4] January 12, 2016, letter to Dr. Susan Hedman, Regional Administrator, USEPA Region V, from Lisa Bonnett, Director, Illinois Environmental Protection Agency.

submit a modeling protocol[5] ("Protocol") to U.S. EPA by July 1, 2016, for each facility to be modeled under the DRR. That protocol, together with comments received from U.S. EPA regarding the protocol, were followed in the analyses performed. By that same date required for protocol submission, the Illinois EPA provided information in its annual monitoring plan on planned monitors at those facilities that will be characterized through ambient monitoring under the DRR.

Figure 1
Statewide Map Showing Locations of DRR - Listed Facilities



[5] Sulfur Dioxide Air Quality Characterization Protocol: Facilities Warranting Evaluation Under the Data Requirements Rule, AQPSTR 16-08, Illinois Environmental Protection Agency, June 30, 2016.

2.0 Facility Selection

Based upon company-reported actual SO_2 emissions for calendar year 2014, which was the most recent year of certified emissions data available to the Illinois EPA at the time of DRR facility notification to USEPA in January 2016, 15 facilities which exceeded the emissions threshold of 2,000 tons per year were identified for inclusion in the air quality characterization process. As identified earlier, the U.S. Steel Corporation – Granite City Works and Gateway Energy & Coke Company LLC facilities ("U.S. Steel Study Area") are regarded as a "single source" under Clean Air Act Title V permitting, and collectively reported emissions that exceeded the threshold. On January 12, 2016, the Illinois EPA submitted to USEPA Region V a list of facilities for SO_2 air quality characterization, as required under the DRR. It is noteworthy that the DRR stipulates the following: "due to the overlap between the criteria for inclusion of sources in this final rule and those in the March 2015 consent decree, all of the sources identified in the March 2015 consent decree should also be included on the January 2016 list of sources required for characterization under this rule." Thus, the DRR list includes the five electrical generating stations that were modeled under Phase 2 (Illinois Power Generating Company – Newton; Dynegy Midwest Generation LLC – Wood River; Electric Energy, Inc. – Joppa; Dynegy Midwest Generation LLC – Hennepin; Southern Illinois Power Cooperative – Marion), but which will not be further addressed in this document.

Additionally, the Midwest Generation LLC – Joliet electrical generating station was modeled in conjunction with the Phase 1 Lemont nonattainment area analysis, though not part of the Lemont nonattainment area. In the R15-21 rulemaking adopted by the Illinois Pollution Control Board and submitted to USEPA as a State Implementation Plan ("SIP") revision, the three units at this facility cannot combust coal on and after December 31, 2016.[6] The conversion from coal combustion to natural gas combustion (with fuel oil backup in the event of natural gas curtailment) will reduce this facility's SO_2 emissions to well below 2,000 tons per year, and thus obviate the need for additional air quality characterization.

Lastly, the DTE Tuscola LLC facility (Tuscola, IL) also appeared on the DRR list because it had reported SO_2 emissions of 9,677 tons in 2014. This cogeneration facility has since ceased burning coal in its boilers. In Illinois Construction Permit #15060039, the coal-firing capability of the three boilers is permanently eliminated, as clearly stipulated in Condition 1.1.5 c: "Beginning January 30, 2016, natural gas, propane, and fuel gas . . . shall be the only fuels fired in the affected boilers." As a result of the reduced SO_2 emissions, the DTE Tuscola LLC facility was not evaluated for air quality despite appearing on the DRR list.

[6] 35 Illinois Administrative Code 225.296(b)

3.0 Air Quality Characterization: Dispersion Modeling

3.1 General Modeling Methodology

Dispersion modeling performed by the Illinois EPA conforms to regulatory procedures described in *The Guideline on Air Quality Models*[7] and recommended practices identified in the draft *SO_2 NAAQS Designations Modeling Technical Assistance Document*[8] ("TAD"). The AERMOD modeling system (which includes the AERMOD dispersion model, the AERMAP terrain preprocessor, and the AERMINUTE and AERMET meteorological preprocessors) were used to simulate ambient impacts from the DRR facilities. AERMOD is the preferred software for use in regulatory applications, and is particularly suitable for this specific set of air quality analyses given the terrain, stack to structure relationships, dispersion environment, and available meteorological data. AERMOD (version 15181) was run exclusively in the regulatory default mode. The most recent three years (2013-2015) of meteorological data determined to be representative of a facility's airshed were used in combination with surface characteristics data obtained from AERSURFACE (version 13016) for simulating the area's planetary boundary layer turbulence structure.

Illinois EPA staff prepared detailed site characterizations of each DRR facility to support development of specific AERMOD inputs. Building-induced plume downwash was addressed for all discretely modeled stacks and flares that were within the zone of influence of nearby buildings. The Illinois EPA used USEPA's Building Profile Input Program with PRIME algorithm (BPIPPRM, dated 04274) to determine building parameters to model building wake effects. A relatively standard approach to receptor network design, consisting of discrete fenceline receptors (spaced at approximately 50-meter intervals) and a gridded receptor array extending outward to as much as 26 kilometers from the facility, was integral to each area-specific analysis.

3.1.1 Modeling Domains and Emission Source Inventories

Modeling domains were developed based upon the guidance provided in the draft modeling TAD and the professional judgment of Illinois EPA modeling staff. These domains reflect the following considerations: 1) the locations of the DRR-listed facility and potentially significant "near-field" SO_2 emission sources, 2) stack heights, emission rates, and related plume release characteristics, 3) the location and likely extent of significant concentration gradients of nearby sources, and 4) receptor coverage and density that is sufficient to adequately capture and resolve model-predicted maximum SO_2 concentrations. The modeling domains represent the geographic extent of possible emission source inclusion, and are circular constructs with radii ranging in size from 15-50 kilometers. These domains are centered on the respective DRR facilities, with the exception of the combined domain that includes the Dynegy Midwest Generation – Baldwin power plant and the Prairie State Generating

[7] 40 CFR Part 51, Appendix W.
[8] SO_2 NAAQS Designations Modeling Technical Assistance Document (draft), February 2016, USEPA (OAR/OAQPS/AQAD), Research Triangle Park, NC.

Company power plant. Since areas of significant impact are not expected to occur at distances representing the furthest extent of the modeling domains, all of the receptor networks are of smaller geographic coverage than the full modeling domains.

The Illinois EPA had formally requested and received hourly-specific emission rates and stack parameter data for 2012-2015 from both DRR and selected background facilities to best represent ambient loadings in the study area and to obtain the best possible time-resolved estimates for modeling years 2013-2015. Depending upon source and stack monitoring requirements, hourly-specific data may not have been available for certain process sources. In the absence of such data, estimates were derived from production information (including fuel usage/throughput quantities), reported operational periods, stack test information, and/or other data sources.

The Illinois EPA has relied upon annual emission reports and other information in its Integrated Comprehensive Environmental Management System ("ICEMAN") statewide database to supplement the information provided in response to the DRR data requests. Some data has been provided by USEPA and the Indiana Department of Environmental Management ("IDEM") in response to specific requests.

Most sources modeled represent point sources, including flares, but for some of the facilities, selected releases are represented as volume sources. Point source stack configurations are typically vertical with unobstructed releases, but there are some stacks with "raincaps," and other stacks that represent horizontal releases. For the latter, each source's exit velocity was adjusted in the manner recommended in the *AERMOD Implementation Guide.*[9] This guidance document specifically indicates that the "user should input the actual stack diameter and exit temperature but set the exit velocity to a nominally low value, such as 0.001 m/s." Flares were modeled with adjusted release parameters, consistent with current modeling guidance. The adjusted parameters include fixed values for temperature (1273 degrees Kelvin) and exit velocity (20 meters/second) and modified values for release height and diameter. The *AERSCREEN User's Guide*[10] provides the equation for calculating the effective flare height:

$$H_{sl} = H_s + 4.56 \times 10^{-3} (H_r/4.1868)^{0.478}$$

where,

H_{sl} = effective flare height (meters)
H_s = stack height above ground (meters)
H_r = total heat release rate (Joules/second)

[9] AERMOD Implementation Guide. 2009. U.S. Environmental Protection Agency, Research Triangle Park, NC.
[10] AERSCREEN User's Guide. EPA-454/B-11-001. U.S. Environmental Protection Agency, Research Triangle Park, NC.

The screening modeling documentation also provides the equation for calculating the effective diameter for the flare:

$$D = 9.88 \text{ x } 10^{-4} \text{ x } [HR \text{ x } (1\text{-}HL)]^{0.5}$$

where,

D = effective stack diameter (meters)
HR = heat release rate (calories/second)
HL = heat loss fraction [used default value of 0.55]

3.1.2 Terrain Processing (AERMAP)

Procedures for selecting and processing terrain data are provided by the *User's Guide for the AERMOD Terrain Preprocessor* (AERMAP),[11] and the March 2011 *AERMAP User's Guide Addendum* (version 11103).[12]

Selection of terrain data corresponds to the geographic areas represented by the modeling domains. U.S. Geological Survey ("USGS") National Elevation Dataset ("NED") input data was used for all DRR modeling. The latest NED data were obtained in TIFF format directly from the USGS for the individual study areas. This data format is compatible for use with AERMAP. The final NED TIFF files have a resolution of one arc second (30 meters) and the data is stored in a Geographic (latitude/longitude) coordinate system based on the North American Datum of 1983 ("NAD83"). Conversions from latitude/longitude to Universal Transverse Mercator ("UTM") coordinates take place within AERMAP using the UTMGEO program. NADCON conversion software (version 2.1) is incorporated to calculate datum shifts, where necessary. AERMAP (version 11103) was run within the BEEST for Windows software. Elevations from the NED data were determined for all sources and structures, and both elevations and representative hill heights were determined for receptors. This data was subsequently input to AERMOD.

3.1.3 Meteorological Data (AERSURFACE/AERMINUTE/AERMET)

3.1.3.1 Meteorological Data Selection

Procedures for selecting and developing meteorological data have been provided in the draft document *Regional Meteorological Data Processing Protocol, EPA Region 5 and States*.[13] Within this document, content pertaining to selection criteria for surface meteorological data addresses the representativeness of meteorological data collection sites to the emission source/receptor impact area.

[11] User's Guide for the AERMOD Terrain Preprocessor (AERMAP). EPA-454/B-03-003, October 2004. U.S. Environmental Protection Agency, Research Triangle Park, NC.
[12] Addendum – User's Guide for the AERMOD Terrain Preprocessor (AERMAP). EPA-454/B-03-003 (October, 2004). U.S. Environmental Protection Agency, Research Triangle Park, NC.
[13] Draft – Regional Meteorological Data Processing Protocol. EPA Region 5 and States. August 2014.

There are two criteria to be considered: 1) the suitability of meteorological data for the study area, and 2) the actual similarity of surface conditions and surroundings at the emission source/receptor impact area compared to the location of the meteorological instrumentation tower. The closest National Weather Service ("NWS") surface meteorological data station was believed to be the most acceptable for most modeling domains. Similarly, upper air data for processing with surface meteorological data was chosen on the basis of regional representativeness.

3.1.3.2 Meteorological Data Preprocessing

Procedures for processing meteorological data are provided in the *2004 User's Guide for the AERMOD Meteorological Preprocessor* (AERMET)[14] and in the 2014 AERMET User's Guide Addendum.[15] AERMET (version 15181) processes raw meteorological data to produce higher order data that can be read by the AERMOD model. The first two stages of processing the raw data involve QA/QC of the meteorological data and then correlating the surface data with upper air data. While standard NWS surface data include meteorological data records recorded near the beginning of each hour, additional wind speed and wind direction data recorded at one-minute intervals were also included in the development of higher order meteorological data. Automated Surface Observing System ("ASOS") one-minute wind data obtained for NWS surface stations were processed using AERMINUTE (version 15272), as specified in the companion *AERMINUTE User's Instructions*.[16,17] A third and final stage reads the merged surface and upper air data file and processes surface characteristics data at the tower site for final generation of meteorological files to be read into the AERMOD modeling runs.

The surface conditions data are provided through another preprocessor called AERSURFACE, and processing was conducted consistent with documentation in the *AERSURFACE User's Guide*.[18] In response to comments received from USEPA regarding the Illinois EPA's modeling protocol document, the Illinois EPA clarified that the AERSURFACE processing conducted for the DRR used 1992 land cover data and not 2011 National Land Cover Data. AERSURFACE is a tool using land cover data around the meteorological tower site to principally determine surface roughness by wind sector. A wind sector is defined by a wedge shaped area extending from the tower out to one kilometer, but not exceeding 30 degrees in angular width. The total circular area had no more than 12 sectors. Two other parameters, Bowen ratio and albedo, are determined more on a regional basis, but also based on land cover. All three factors can change with the seasons, as well as on a monthly basis. Meteorological conditions vary from year to year, resulting in periods that can be abnormally

[14] User's Guide for the AERMOD Meteorological Preprocessor (AERMET). 2004. EPA-454/B-03-002. U.S. Environmental Protection Agency, Research Triangle Park, NC.
[15] Addendum – User's Guide for the AERMOD Meteorological Preprocessor (AERMET). EPA-454/B-03-002 (November, 2014). U.S. Environmental Protection Agency, Research Triangle Park, NC.
[16] AERMINUTE User's Instructions (Draft). 2011. U.S. Environmental Protection Agency, Research Triangle Park, NC.
[17] AERMINUTE User's Instructions. 2014. U.S. Environmental Protection Agency, Research Triangle Park, NC.
[18] Revised – AERSURFACE User's Guide (Revised January 16, 2013). EPA-454/B-08-001 (January, 2008). U.S. Environmental Protection Agency, Research Triangle Park, NC.

dry one year, and wet the following year, or simply exhibiting average conditions. In augmenting Stage 3 parameters to accommodate monthly variability, the Illinois EPA has calculated values for albedo, Bowen ratio, and surface roughness on a monthly basis in order to provide greater temporal resolution in the characterization of surface moisture and in capturing the influence of snow cover. Thus, AERSURFACE has been run in a monthly format for wet, dry, and average moisture conditions for both snow cover and no snow cover.

Determinations regarding snow cover are based upon Local Climatological Data ("LCD") from the National Weather Service surface collecting station. The LCD indicates which individual days had snow cover and the snow depth for that particular day. Days with greater than a trace amount of snow are considered to have snow cover. The fraction of days per month with snow cover were multiplied by the value for snow cover applicable to albedo and surface roughness values. This approach was also implemented for values involving no snow cover. The computed values were added and then divided by the number of days in a particular month. The end result was an averaged value for each month for regional albedo and surface roughness by wind sector. These calculations were produced through a spreadsheet, as are the ones described below.

With regard to moisture levels, the determination of a "wet" or "dry" recent year has been made based upon what was known about precipitation records over historical periods of time that might range over 50 or more years. Generally, an average for each month was calculated over 30 years of data. A dry month is considered to be that month where the monthly total was at or below 0.6 times the average. A wet month would be a month where the monthly total of precipitation would be at or over 1.2 times the average. Months within 0.6 to 1.2 times the average precipitation were considered to be normal or average. These ratios were determined from guidelines set forth in the AERSURFACE User's Guide. According to this document, a dry month can be considered to be that month where the monthly precipitation total falls under the lower 30th percentile of monthly records. A wet month can be a month where the monthly total of precipitation would be above the upper 30th percentile of monthly records. An average month would fall in between the lower and upper 30th percentiles. Months evaluated as being "dry" used the Bowen ratio that was determined for a "dry" month from the AERSURFACE runs. Likewise, "wet" and "average" months determined from the LCD data were linked to corresponding output in the AERSURFACE runs. For winter months, after the evaluation of monthly moisture is made, the Bowen Ratio is additionally averaged for days of snow cover in the same way as albedo.

In general, typical monthly values for albedo can be affected by the presence of snow but not by moisture. Similarly, surface roughness can be influenced by snow, but not by moisture. Monthly values for Bowen ratio can be influenced by snow cover and moisture.

Surface meteorological data used by AERMET were obtained from multiple sources. Hourly surface meteorological data records are read by AERMET that include all the necessary elements for meteorological data processing, including wind direction and wind speed. Wind data taken at hourly intervals may not always portray wind conditions for the entire hour, which can be variable in nature compared to more stable meteorological properties not susceptible to wide-ranging changes. Wind data that portray calm conditions for particular hours are not usable for modeling purposes, and must be passed over by AERMOD when modeling is being performed. In order to better represent actual wind conditions at the meteorological tower, wind data of one-minute duration were obtained for the same meteorological tower but in a different formatted meteorological file, and processed using AERMINUTE. These data were subsequently integrated into the AERMET meteorological data processing to produce final hourly wind records that more closely approach actual conditions at the meteorological tower, with fewer calm wind conditions. This allows AERMOD to apply more hours of meteorology and thereby process more pollutant concentration values when generating final output.

As a guard against excessively high concentrations that could be produced in very light wind conditions, a minimum threshold of 0.5 meters/second in processing meteorological data for use in AERMOD was applied so that no wind speeds lower than this would be used for determining concentrations.[19] This threshold was specifically applied to the one-minute wind data.

3.1.4 Model Implementation (AERMOD)

AERMOD (AMS/EPA Regulatory Model) is the preferred Gaussian plume dispersion model for steady state air pollutant modeling, and the Illinois EPA has relied upon AERMOD (version 15181) and companion User Guide documentation[20] and recent Addendum[21] in developing its air quality characterizations and designation recommendations for the areas surrounding the DRR facilities. Regulatory default options were implemented, consistent with established practices for use of AERMOD in regulatory applications.

3.1.4.1 Dispersion Environment (Rural/Urban Determination)

The urban or rural dispersion regime of emissions sources is a critical parameter in properly characterizing dispersion in the boundary layer. Generally, urban areas cause higher rates of dispersion because of increased turbulence and buoyancy, the result of higher surface roughness and enhanced thermal buoyancy from urban heat island effects. The manner in which emissions disperse downwind from short stacks as compared to tall stacks can differ substantially between urban and rural environments due to significant differences in land use and surface roughness features.

The recommended methodology for making a rural or urban determination for a study area, or more localized application, is outlined in Section 7.2.3 (c, d, e) of 40 CFR Part 51 Appendix W, as well as in the AERMOD Implementation Guide (p. 14-16). These documents reference two methodologies

[19] Use of ASOS meteorological data in AERMOD dispersion modeling. Tyler Fox Memorandum dated March 8, 2013. U.S. Environmental Protection Agency, Research Triangle Park, NC.
[20] User's Guide for the AMS/EPA Regulatory Model – AERMOD. 2004. EPA-454/B-03-001. U.S. Environmental Protection Agency, Research Triangle Park, NC.
[21] Addendum – User's Guide for the AMS/EPA Regulatory Model – AERMOD. 2014. EPA-454/B-03-001 (September, 2004). U.S. Environmental Protection Agency, Research Triangle Park, NC.

as acceptable approaches for making the urban/rural determination. The first approach is the land use type method described by Auer.[22] The second recommended approach is to use population density.

Auer's methodology recommends categorizing an area as urban or rural based on existing land use types. In contrast with the 1992 land use data relied upon for AERSURFACE processing, the Auer's analysis was conducted using 2011 National Land Cover Data. The Auer's method bases the urban/rural determination on predominant land use types within a study area (for an individual facility, typically a three-kilometer radius is considered sufficient). If 50% of the study area is comprised of urban land use types, then the source lying within this area should be modeled as urban. If land use in the study area is less than 50% urban, then the rural option is recommended. Table 1 identifies the land use types that signify urban and rural land use per Auer's study.

Table 1
Auer's Land Use Classification Scheme

Type Identifier	Description/Use	Urban or Rural
I1	Heavy Industrial	Urban
I2	Light-Moderate Industrial	Urban
C1	Commercial	Urban
R2/R3	Compact Residential	Urban
R1	Common Residential	Rural
R4	Estate Residential	Rural
A1	Metropolitan Natural Areas	Rural
A2	Agricultural/Crops	Rural
A3	Undeveloped Land (Wild Grasses)	Rural
A4	Undeveloped Rural (Heavily Wooded)	Rural
A5	Water Surfaces (Rivers, Lakes)	Rural

The population density method uses a threshold of 750 people per square kilometer, based on census data, as the determinant of urban or rural. If the population is higher than 750 per square kilometer (usually in a three-kilometer radius around a source) within the study area, then it is likely an urban environment. This method is not considered as robust as an Auer's land use analysis.

For purposes of the DRR air quality modeling, an Auer's land use analysis was performed on the full extent of each modeling domain, as well as on the subdomain areas comprising a three-kilometer radius centered on each facility or facility grouping (U.S. Steel/Gateway Energy & Coke Company). These analyses were conducted using the 2011 National Land Cover Data ("NLCD") database. The data were obtained from the Multi-Resolution Land Characteristics Consortium, or MRLC (www.mrlc.gov/nlcd2011.php). The NLCD 2011 database categorizes land cover into 20 different

[22] Auer, Jr., A.H. (1978). Correlation of Land Use and Cover with Meteorological Anomalies. Journal of Applied Meteorology, 17(5), 636-643.

types at a 30-meter grid cell resolution. These categories were further refined and allocated as indicated in Table 2 to match the 12 land use categories referenced in Auer's classification scheme.

Table 2
Land Cover Mapping from NLCD to Auer's Classifications

Code	NLCD 2011 Description	Auer's Code	Auer's Classification
11	Open Water	A5	Rural
21	Developed, Open Space	A1/R4	Rural
22	Developed, Low Intensity	R1	Rural
23	Developed, Medium Intensity	R2/R3	Urban
24	Developed, High Intensity	I1/I2/C1	Urban
31	Barren Land (Rock/Sand/Clay)	A3	Rural
41	Deciduous Forest	A4	Rural
42	Evergreen Forest	A4	Rural
43	Mixed Forest	A4	Rural
52	Shrub/Scrub	A4	Rural
71	Grassland/Herbaceous	A3	Rural
81	Pasture/Hay	A3	Rural
82	Cultivated Crops	A2	Rural
90	Wood Wetlands	A4	Rural
95	Emergent Herbaceous Wetlands	A3	Rural

Illinois EPA has been utilizing Geographic Information System software to extract, tabulate, and map the percentages of urban and rural land cover per Auer's classification scheme for the modeling study areas and for the DRR facility-centered near-field areas with radii of three kilometers.

3.1.4.2 Monitored Background

Modeling for the air quality characterizations and area designation recommendations was based upon design values of cumulative concentrations from discretely modeled sources and monitored background concentrations. The hourly by season background concentrations were input to AERMOD using the "BACKGRND" keyword and "SEASHR" parameter on the Source Pathway in the model runstream file. Full implementation of this option requires that the "BACKUNIT" keyword and "BGunits" parameter option of micrograms per cubic meter ("UG/M3") be specified, while also indicating the "SrcIDs" of "ALL" and "BACKGROUND" with the "SRCGROUP" keyword. There are 24 separate "SEASHR" values input for each of the four seasons, for a total of 96 monitored concentrations. Each of these values represents a three-year average (2013-2015) of the second highest hourly concentration (for each hour of the day) for each season. AERMOD reads these values from the runstream file and then incorporates into the final predicted concentration the background value corresponding to the season and hour modeled.

In the USEPA memorandum from Stephen D. Page entitled *Guidance Concerning the Implementation of the 1-hour SO_2 NAAQS for the Prevention of Significant Deterioration Program,*[23] the text addressing the use of monitored background concentrations in combination with modeled concentrations for comparison to the NAAQS is non-prescriptive on the topic. It does state that a conservative approach that would "add the overall highest hourly background SO_2 concentration from a representative monitor to the modeled design value" could be "applied without further justification." Illinois EPA will apply a methodology that derives from the USEPA memorandum by Tyler Fox entitled, *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard.*[24] In reference to combining modeled results and monitored background to determine compliance, the narrative states that "an appropriate methodology for incorporating background concentrations in the cumulative impact assessment" for the one-hour SO_2 standard "would be to use multiyear averages" of the 99th-percentile "of the available background concentrations by season and hour-of-day." An associated footnote succinctly states the monitored values to be used: "For 1-hour SO_2 analyses, use the 2nd-highest value for each season and hour-of-day combination or the 4th-highest value for hour-of-day only." The seasonal, hourly-averaged 2013-2015 SO_2 background values for the DRR modeling analyses were developed for monitors in East St. Louis, Nilwood, and Oglesby. These background values are provided in Appendix B.

3.1.4.3 Model Execution and Output Evaluation

When using modeling, the one-hour primary SO_2 NAAQS is attained when the highest five-year average of the fourth high maximum daily one-hour average concentration (by receptor) is less than or equal to 75 ppb. Since AERMOD generates output concentrations in micrograms per cubic meter, in order to assure ease of comparison of model output to the NAAQS, the level of the standard (75 ppb) was converted to micrograms per cubic meter based on the ideal gas law at standard temperature (68 degrees Fahrenheit) and pressure (1 atmosphere), as follows:

$$\text{Concentration } (\mu g/m^3) = [SO_2 \text{ Molecular Weight x Concentration (ppm)}] / 0.02445$$

$$= [(64) \text{ x } (0.075)]/(0.02445)$$

$$= 196.32\ \mu g/m^3$$

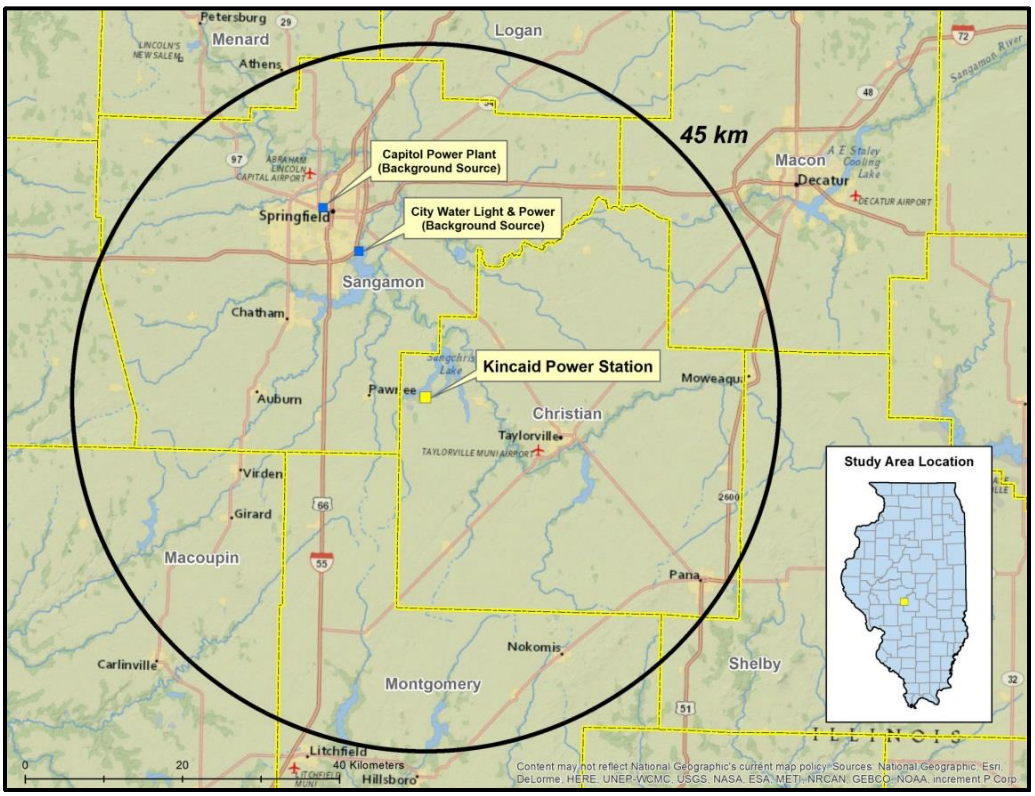
[23] Guidance Concerning the Implementation of the 1-hour SO_2 NAAQS for the Prevention of Significant Deterioration Program. Stephen D. Page memorandum dated August 23, 2010, Research Triangle Park, NC.
[24] Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO2 National Ambient Air Quality Standard. Tyler Fox memorandum dated March 1, 2011. U.S. Environmental Protection Agency, Research Triangle Park, NC.

3.2 Facility-Specific Modeling Assessments

3.2.1 Kincaid Generation LLC

Kincaid Generation LLC (Kincaid) operates an electrical power generating station approximately four miles west of the town of Kincaid, along the southern end of Sangchris Lake in northwestern Christian County (see Figure 2). The facility produces electricity from two coal-fired cyclone boilers with nominal capacities of 6,634 and 6,406 mmBtu/hour. SO_2 emissions are controlled through dry sorbent injection of either trona (sodium carbonate) or sodium bicarbonate in conjunction with electrostatic precipitators, with the controlled emissions subsequently routed to a single common stack. A natural gas-fired auxiliary boiler, with a nominal capacity of 175 mmBtu/hour, is used to provide heat to the plant and to generate steam during certain startups of the coal-fired boilers.

Figure 2
Kincaid Generation Study Area



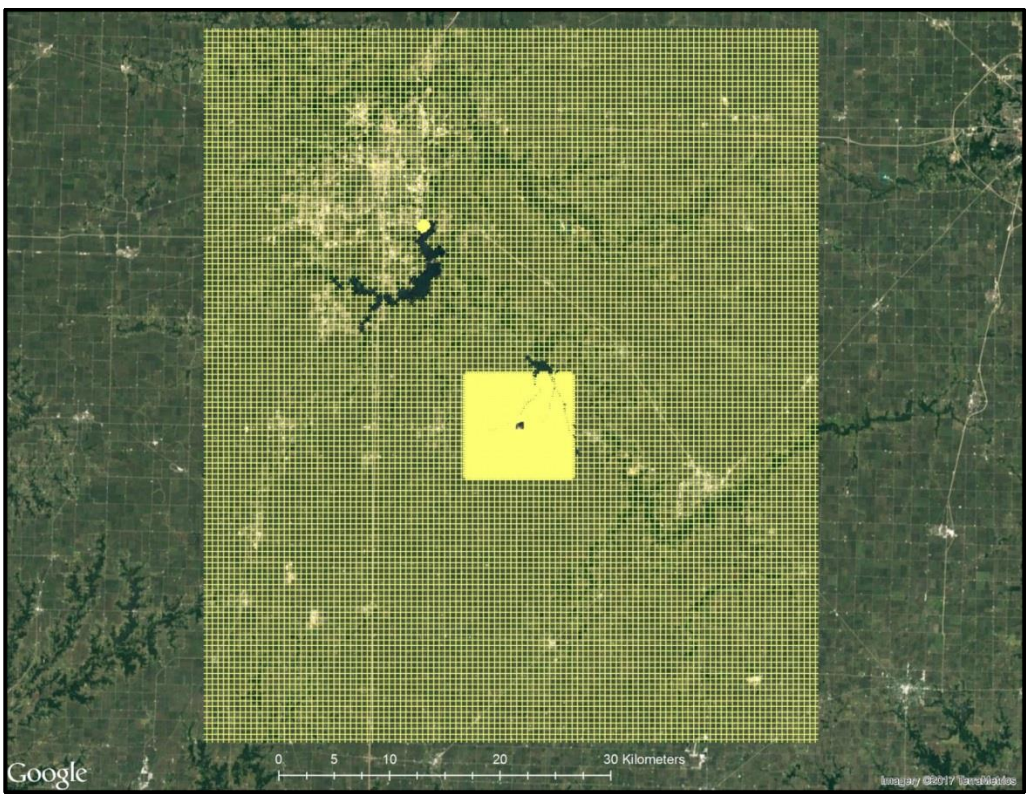
3.2.1.1 Modeling Domain and Receptor Network

The air quality characterization of the Kincaid facility and surrounding area used a modeling domain centered on Kincaid's main boiler stack and include regional emissions sources within a 45-kilometer radius of that centroid. The study area terrain is best characterized as flat to gently rolling. Only two facilities, located in adjoining Sangamon County – City of Springfield's City Water Light & Power Station ("CWLP") and Illinois Secretary of State's Capital Power Plant ("CPP") – were discretely modeled along with the Kincaid sources. The CWLP power plant is approximately 21 kilometers northwest of the Kincaid power plant. The CPP facility, which provides steam to the Capitol complex for heating and air conditioning, is located approximately 29 kilometers northwest of the Kincaid power plant. Site-specific information for all of these facilities had been previously obtained from information requests or permit-related activity, and this information has been updated and augmented more recently in response to the needs of the DRR modeling effort. To ensure adequate capture of predicted maximums near the DRR facility, as well as for the two background sources, the receptor network created has the following spacing densities:

- 50 meters along the fenceline (Kincaid, CWLP, CPP)
- 100 meters from the Kincaid fenceline out to a distance of approximately four kilometers
- 500 meters from four kilometers out to a distance of approximately 26 kilometers from Kincaid.

The Kincaid Study Area receptor network consists of 22,409 receptors, and covers large portions of Christian and Sangamon Counties, and the northeast section of Macoupin County (See Figure 3). Per the recommendation of the TAD, receptors were not placed on large bodies of water (Lake Springfield and Sangchris Lake).

Figure 3
Receptor Grid – Kincaid Study Area



3.2.1.2 Auer's Analysis (Urban/Rural Environment)

An Auer's analysis, as discussed in Section 3.1.4.1, was applied to the Kincaid Study Area. The 45-kilometer radius study area and a three-kilometer near-field ring, centered on the main stack at Kincaid, were evaluated for determining whether the areas are predominantly urban or rural land cover environments. The results of the Auer's analysis are presented in Figures 4 and 5 and Table 3.

Figure 4
Land Cover in the Kincaid Study Area (Urban vs. Rural)

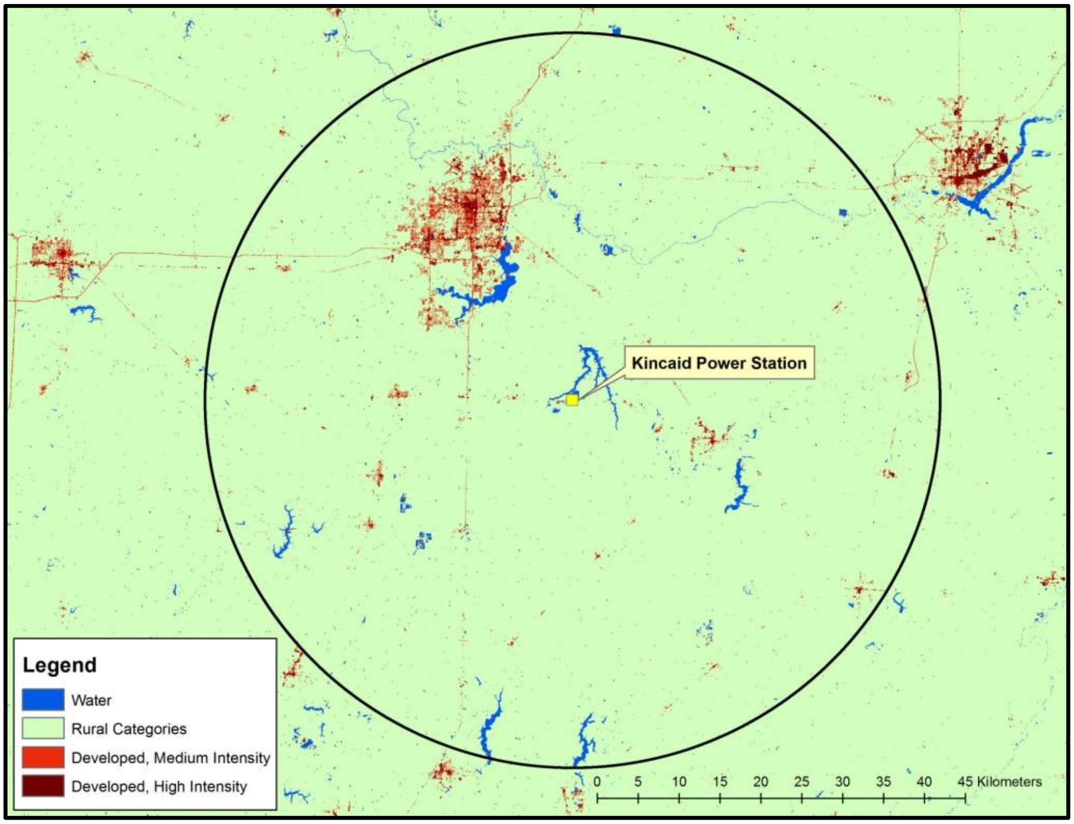


Figure 5
Land Cover within a Three-Kilometer Radius of Kincaid Generation (Urban vs. Rural)

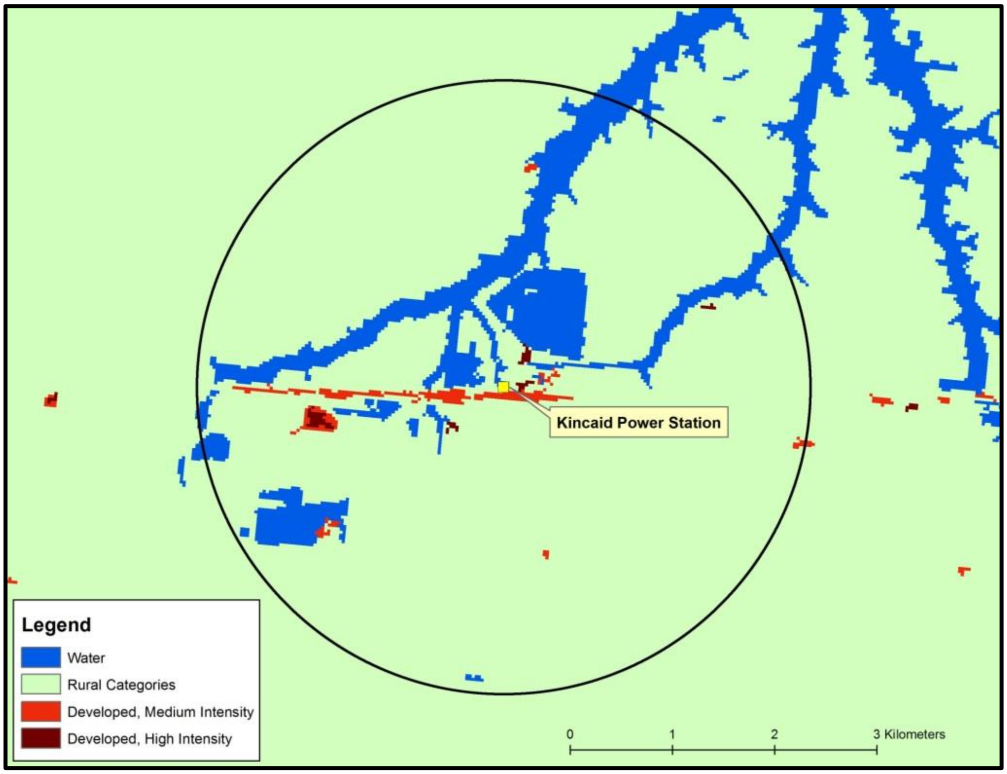


Table 3

Land Cover Percentages by Auer's Category for a Three-Kilometer Radius Area and for the Modeling Domain (45-Kilometer Radius) – Kincaid Study Area

Kincaid Study Area Auer's Analysis				Auer's 3 km Ring			Study Area 45 km Ring		
NLCD Value	**NLCD 2011 Description**	**Auer's Code**	**Auer's Class**	**Cell Count**	**Percentage**	**Totals**	**Cell Count**	**Percentage**	**Totals**
23	Developed, Medium Intensity	R2/R3	**Urban**	323	1.01%	**1.23%**	96,746	1.34%	**1.65%**
24	Developed, High Intensity	I1/I2/C1		72	0.23%		21,880	0.30%	
11	Open Water	A5	**Rural**	3,422	10.70%	**98.77%**	71,820	1.00%	**98.35%**
21	Developed, Open Space	A1/R4		786	2.46%		311,290	4.33%	
22	Developed, Low Intensity	R1		848	2.65%		289,462	4.02%	
31	Barren Land (Rock/Sand/Clay)	A3		42	0.13%		2,838	0.04%	
41	Deciduous Forest	A4		3,148	9.84%		489,066	6.80%	
42	Evergreen Forest	A4		0	0.00%		121	0.00%	
43	Mixed Forest	A4		0	0.00%		9	0.00%	
52	Shrub/Scrub	A4		0	0.00%		301	0.00%	
71	Grassland/Herbaceous	A3		292	0.91%		11,867	0.16%	
81	Pasture/Hay	A3		1,044	3.26%		337,121	4.68%	
82	Cultivated Crops	A2		21,990	68.73%		5,508,283	76.53%	
90	Wood Wetlands	A4		17	0.05%		55,369	0.77%	
95	Emergent Herbaceous Wetlands	A3		9	0.03%		1,033	0.01%	
Analysis based on 30 meter by 30 meter raster cells extracted for each area.			***Total***	***31,993***	***100.00%***	***100.00%***	***7,197,206***	***100.00%***	***100.00%***

The Auer's analysis indicates that the study area and the near-field are both at least 98% rural; therefore Illinois EPA has implemented the rural option to all emissions sources in the modeling domain.

3.2.1.3 Emissions

As described in Section 3.1.1, USEPA modeling guidance recommends the use of actual emissions (in contrast to allowable emissions) in generating model output to represent air quality in the study area. Illinois EPA has acquired the best available emissions data for the three facilities modeled and has used hourly-specific emission rates obtained from continuous emissions monitoring or, alternatively, developed an hourly apportionment of daily emission rates.

Dynegy Midwest Generation Inc. ("DMG") is the current owner of the Kincaid Generation LLC facility. The company provided hourly-specific SO_2 emission rates for Boiler #1, Boiler #2, and the Auxiliary Boiler for calendar years 2012-2015. Total actual emissions reported by the facility for years 2013-2015 are provided in Table 4, together with those emissions reported for the CWLP and CPP plants.

The magnitude of CWLP's 2014 emissions (1,203 tons) was approximately 43% of that of Kincaid Generation's emissions (2,818 tons). Despite this, the potential for plume interaction that would result in significant ground level impacts provides a sufficient basis for inclusion of this facility in the modeling analysis. This utility operates two cyclone boilers (Dallman Units #31, #32; each nominally rated at 882 mmBtu/hour), a tangentially-fired boiler (Dallman Unit #33; nominally rated at 2,120 mmBtu/hour), and a pulverized coal-fired boiler (Dallman Unit #4; maximum rated capacity 2,440 mmBtu/hour). All of these boilers have the capability to fire natural gas as a startup fuel. SO_2 emissions are controlled through flue gas desulfurization. The utility can also operate three distillate oil-fired engines that power electrical generators. These engine-generators generally function as a source of backup power to meet various on-site needs for electricity in the event of disruptions in the facility's internal power system. Hourly-specific SO_2 emission rates for calendar years 2012-2015 were provided by CWLP staff for the coal-fired boilers. Emissions and operating hours for the engines and backup generators during this timeframe were deemed too low and intermittent to be applicable to the form of the 1-hour SO_2 standard for this analysis. Consequently, they were not included in the model

The CPP power plant is comprised of three coal-fired traveling grate stoker boilers (each rated at 68.3 mmBtu/hour) and two gas-fired boilers (each rated at 140 mmBtu/hour) with distillate fuel oil backup. The gas-fired boilers are used primarily as a backup for the coal-fired boilers. CPP staff provided daily boiler consumption rates of coal and natural gas and developed daily SO_2 emission rates from these fuel usage rates for each day for calendar years 2013-2015. The daily emission rates have been adjusted by Illinois EPA staff to hourly rates assuming uniform operation as the most appropriate approach for temporal allocation of the data.

Table 4
Facility Actual Emissions – Kincaid Study Area

Company I.D.	Facility Name	SO_2 Emissions (tons per year)		
		2013	**2014**	**2015**
021814AAB	Kincaid Generation, LLC	10,259.4	2,818.4	2,366.3
167120AAO	CWLP	1,174.7	1,209.5	820.9
167120ADP	CPP	298.5	289.0	229.2
Total Emissions	**All Facilities**	**11,732.6**	**4,317.8**	**3,416.3**

Please refer to Appendix A for a complete listing of all emission sources modeled in the Kincaid study area, and associated locational data, stack release parameters, and emission rate profiles.

3.2.1.4 Meteorology

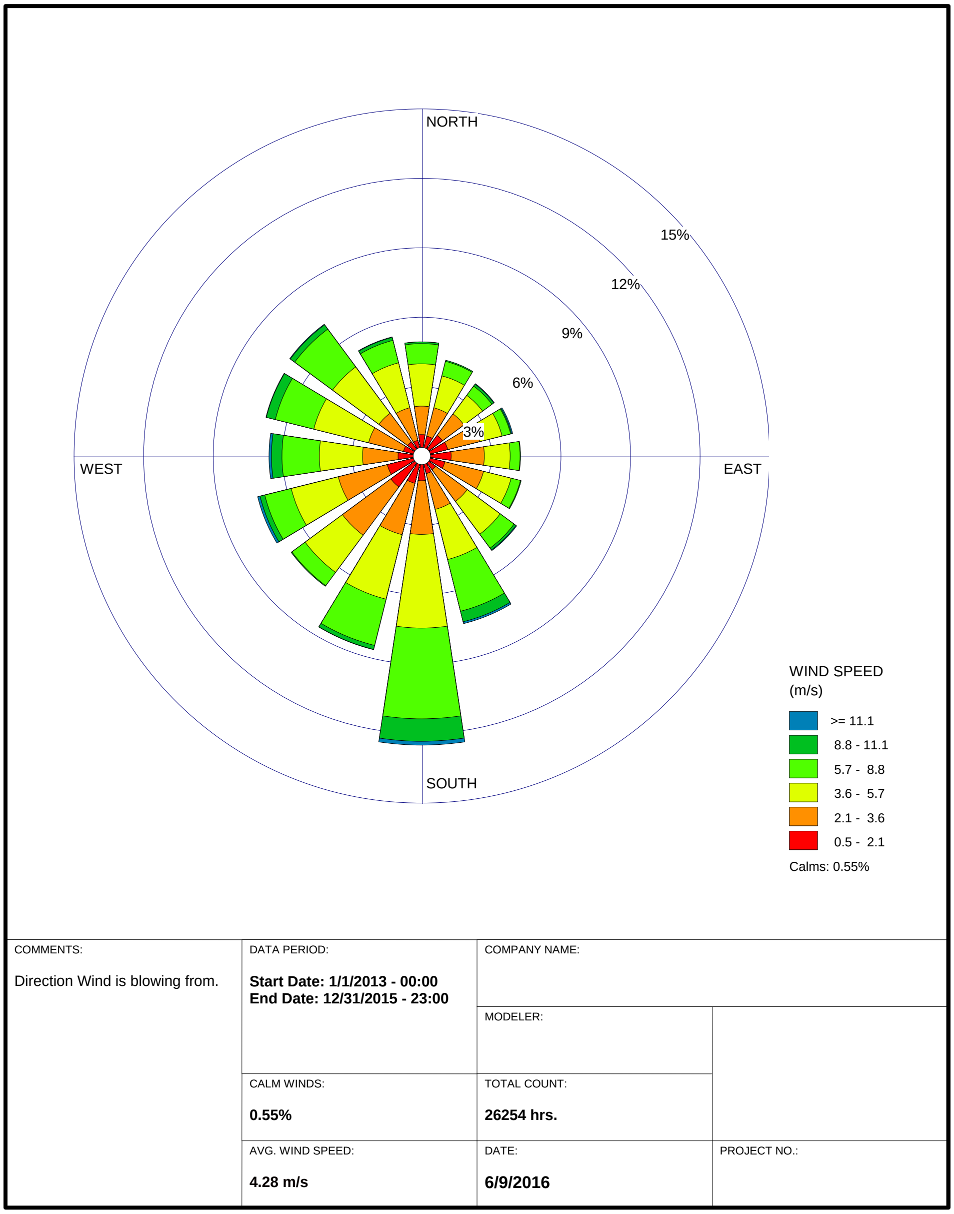
The meteorological data site selection and processing discussed in Section 3.1.3 was applied to the Kincaid Study Area. The SO_2 TAD recommends using the three most recent years of meteorology for modeling applicable to the SO_2 air quality characterization process. In this case, data for meteorological years 2013-2015 were available. This time period aligns with the three years of hourly emissions data that were input to the model. This temporal linkage of emissions and meteorology in the model provides the best approximation of real-world impacts that would occur during that time period, should a monitor have been present.

The selection of a representative meteorological station for each of the study areas was based on proximity, similarity of terrain/surface roughness, and climatological consistency. For the Kincaid Study Area, the National Climatic Data Center (“NCDC”) NWS surface meteorology from Springfield, Illinois (WBAN No. 93822, 20 miles to the northwest), and coincident upper air observations from Lincoln, Illinois (WBAN No. 04833, 40 miles to the north-northeast), were considered best representative of meteorological conditions within the study area.

The three-year surface wind rose for Abraham Lincoln Capital Airport in Springfield, Illinois, is depicted in Figure 6. The frequency and magnitude of wind speed and direction are defined in terms of where the wind is blowing from, parsed out in sixteen 22.5-degree wind sectors. The predominant wind direction during the three-year time period represented in the modeling is from the south, occurring approximately 12.5% of the time. The highest percentage wind speed range, occurring 31.3% of the time period, was in the 3.6 - 5.7 m/s range.

Figure 6

Abraham Lincoln Capital Airport
Cumulative Annual Wind Rose
2013-2015



3.2.1.5 Background SO_2

The monitored background integration process discussed in Section 3.1.4.2 was applied to the Kincaid Study Area modeling analysis. Illinois EPA incorporated temporally-varying background one-hour concentrations developed from the Nilwood monitor, which is located approximately 22 miles southwest of the study area in northern Macoupin County. This monitor, which is operated and maintained by Illinois EPA, has validated hourly SO_2 concentrations for the three years utilized in this analysis (2013-2015). The values developed for input were based on the 99th percentile monitored concentrations and vary by hour and season. A table of the background SO_2 seasonally and hourly varying values utilized in the Kincaid Study Area modeling is provided in Appendix B.

3.2.1.6 Modeling Results

The AERMOD simulation for the Kincaid Study Area comprised eight stacks, 72 structures, three fencelines, and 22,409 receptors. The model simulated years 2013-2015, taking into account maximum actual emissions expected from the source, in conjunction with meteorology, terrain, and background SO_2 levels to calculate a maximum 99th percentile 1-hour SO_2 concentration for each receptor in the grid. The results presented in Table 5 report the magnitude and geographic location of the highest predicted design value concentration.

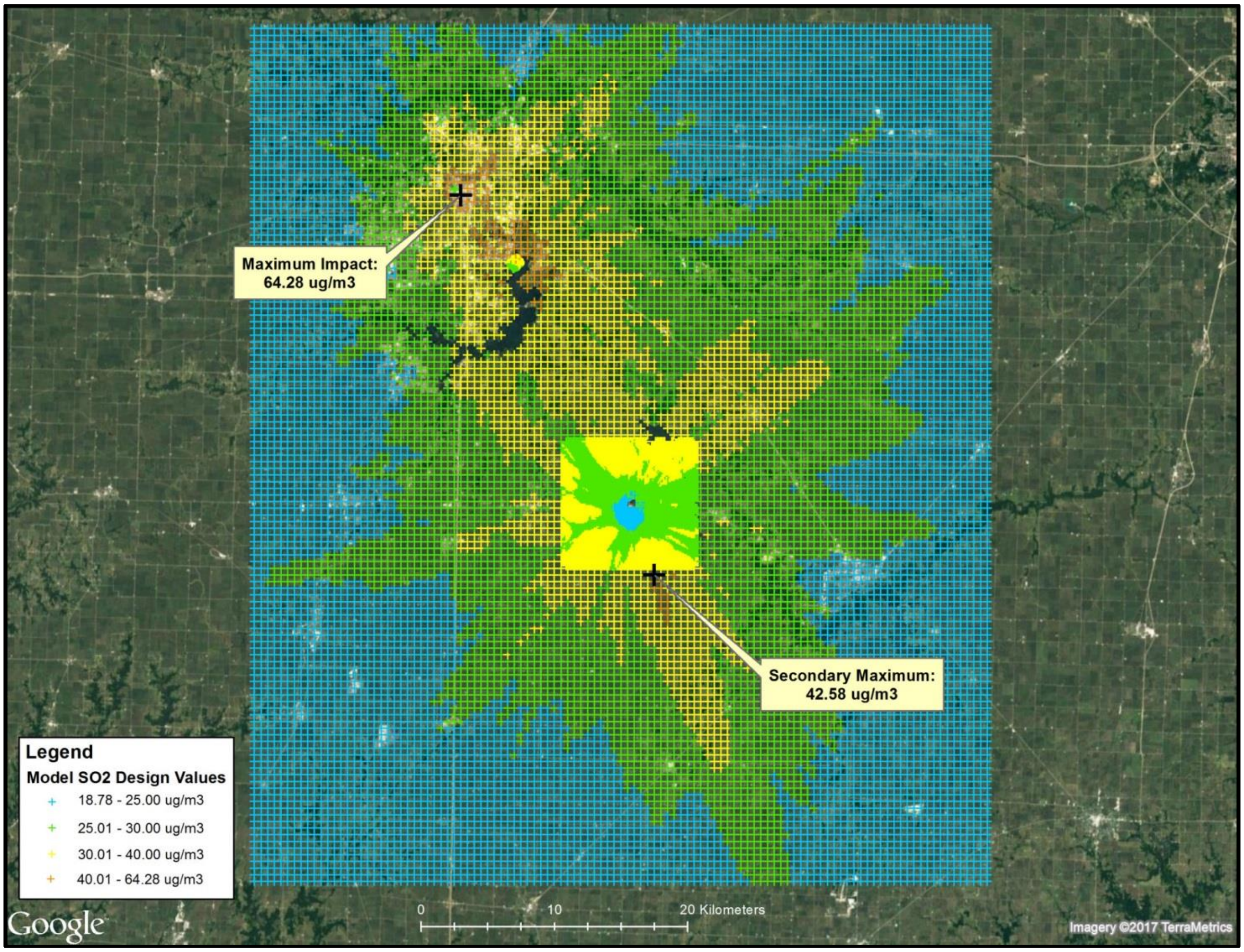
Table 5
Maximum Predicted 99th Percentile 1-Hour SO_2 Design Value Concentration
Kincaid Study Area

Averaging Period	Data Period	Receptor Location (Meters)		SO_2 Concentration ($\mu g/m^3$)	
		East	North	Modeled	NAAQS
99th Percentile 1-Hour Average	2013-2015	273000	4409000	**64.28**	**196.32***

* Equivalent to the 75 ppb standard

The maximum predicted 99th percentile 1-hour average concentration within the modeling domain is **64.28** $\mu g/m^3$, or 24.6 ppb. The maximum occurred within the 500-meter grid 0.6 km southeast of Capital Power Plant in Springfield, IL. The maximum concentration downwind of the Kincaid station is **42.58** $\mu g/m^3$, or 16.3 ppb. The color coded contour map in Figure 7 depicts maximum predicted concentrations for each receptor in the study area and indicates the location of the predicted maximum.

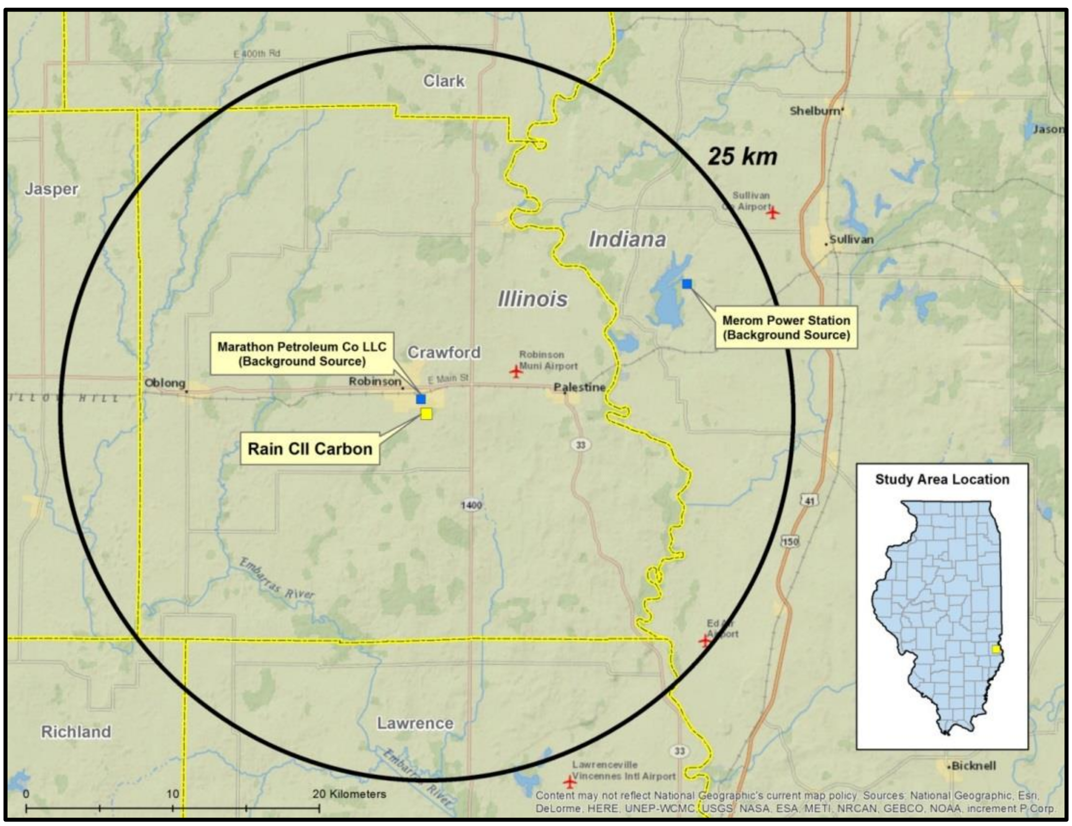
Figure 7
Maximum Predicted 99th Percentile 1-Hour SO_2 Concentrations – Kincaid Study Area



3.2.2 Rain CII Carbon LLC

Rain CII Carbon, LLC (now Rain Carbon Inc.) owns and operates a petroleum coke calcining facility southeast of Robinson, Illinois, in eastern Crawford County, and within approximately seven to eight miles of the Illinois-Indiana state line. As shown in Figure 8, the plant is located near the southeast edge of town and is bounded to the north by the Marathon Petroleum Company, LLC oil refinery ("Marathon"). The facility has two calcining lines, each processing green petroleum coke through separate countercurrent, inclined rotary kilns (each rated at 50 mmBtu/hour) and rotary coolers. The permitted green coke feed capacity of each kiln is 28 tons per hour. The combustion of volatile gases from the green coke feed and the consumption (approximately 20%) of some of the green coke provide the primary source of heat for the calcining process. The calcined coke flows by gravity from the kiln into the cooler where it is quenched by a water spray to lower the coke temperature. Each calcining line has an associated pyroscrubber and baghouse. Separate exhaust stacks service the kilns and the coolers. The rotary kilns are considered to be the only significant sources of SO_2 emissions at this facility.

Figure 8
Rain CII Carbon Study Area



3.2.2.1 Modeling Domain and Receptor Network

The modeling domain circumscribes an area of 25-kilometer radius centered on Rain CII Carbon's southernmost kiln stack and includes any potentially significant regional emission sources. This domain includes two background facilities that have been discretely modeled – Marathon, and the Hoosier Energy – Merom ("Merom") electrical power generating station across the Illinois-Indiana border in Sullivan County, Indiana. Data to support the modeling of the Rain CII Carbon facility has been compiled from separate information requests to the company (July 29, 2010; January 5, 2016), from internally generated information, and from the Illinois EPA's ICEMAN database. The Illinois EPA's modeling of the Rain CII Carbon facility used a single flow rate for Kiln #1 and a separate single flow rate for Kiln #2, because as the company has indicated, it "does not and cannot monitor stack flow rate on a continuous basis due to high stack temperatures." Updated information necessary to model the Marathon refinery has been obtained over the past several years, and most notably within recent months. Stack location coordinates, certain stack release parameter information, and direction-specific building downwash inputs were obtained from an air quality analysis conducted by Marathon as part of an enforcement action settlement with the Illinois Attorney General and the Illinois EPA.[24,25] The Indiana Department of Environmental Management (IDEM) has provided hourly-specific emission rates, exhaust temperatures, and exit velocities for the two boilers at Merom, as well as stack height, stack diameter, and direction-specific downwash inputs in support of modeling this background source.

To ensure adequate capture of predicted maximums near the DRR facility, the receptor network includes fenceline receptors for both the Rain CII Carbon and Marathon facilities, as well as dense near-field receptor arrays. The receptor network for the study area is as follows:

- 50 meters along the fenceline (Rain CII Carbon and Marathon)
- 100 meter grid from the Rain CII Carbon/Marathon fencelines out to a distance of approximately four kilometers
- 500 meter grid from four kilometers out to a distance of approximately 10 kilometers from Rain CII Carbon.

The Rain CII Carbon Study Area receptor network (see Figure 9) consists of 12,615 receptors, and is contained entirely in Crawford County. The study area terrain is best characterized as flat to gently rolling.

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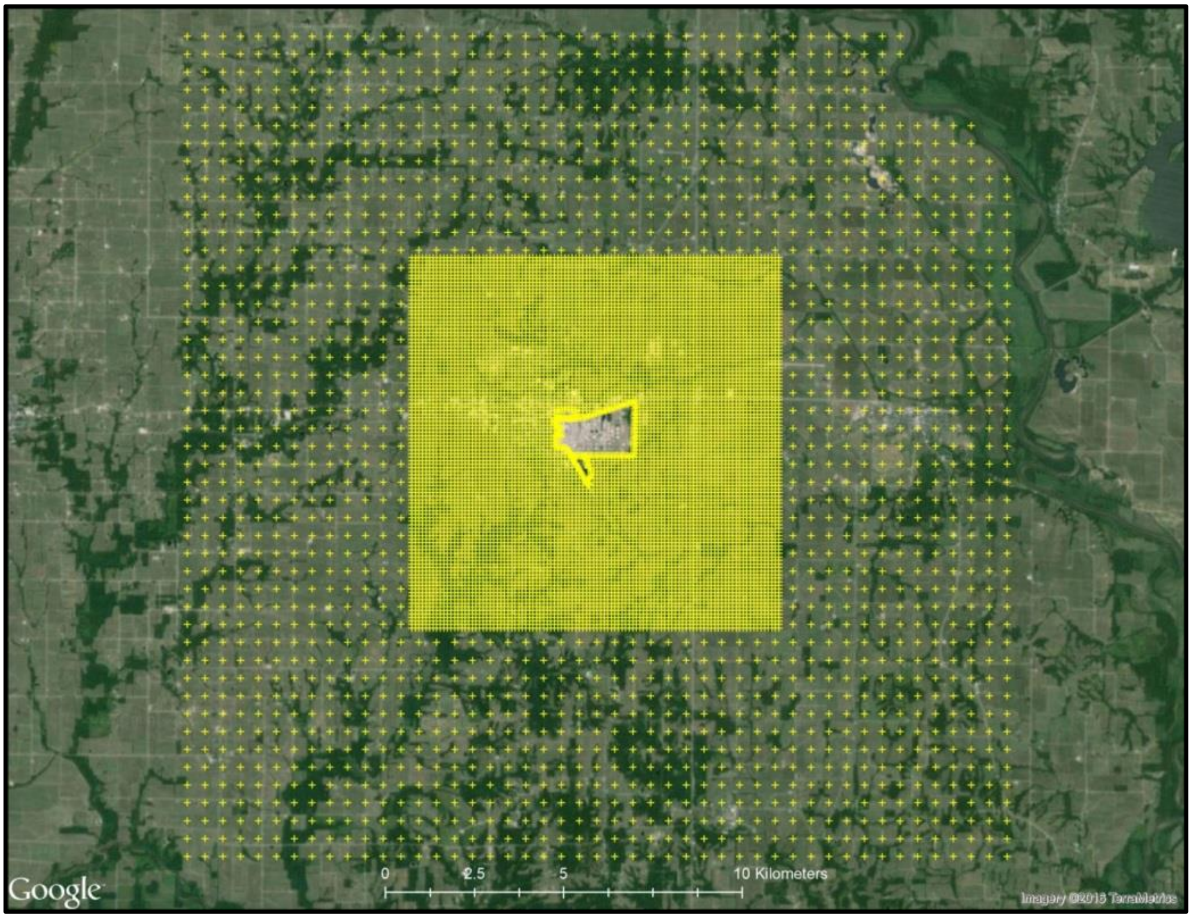
[24]DRAFT 1-Hr SO_2 National Ambient Air Quality Standards Analysis and Ambient Monitoring Siting Analysis for Marathon Robinson Petroleum Refinery in Robinson, Illinois, RTP Environmental Associates, Inc., January 2015.

[25]1-Hr SO_2 National Ambient Air Quality Standards Analysis for Marathon Refinery in Robinson, Illinois, RTP Environmental Associates, Inc., February 9, 2015.

Figure 9
Receptor Grid – Rain CII Carbon Study Area



3.2.2.2 Auer's Analysis (Urban/Rural Environment)

The 25-kilometer radius study area and three kilometer near-field ring, centered on the southernmost kiln stack at Rain CII Carbon, were evaluated for determining whether this area represents an urban or rural dispersion regime. The results of the Auer's analysis are presented in Figures 10 and 11 and Table 6.

Figure 10
Land Cover in the Rain CII Carbon Study Area (Urban vs. Rural)

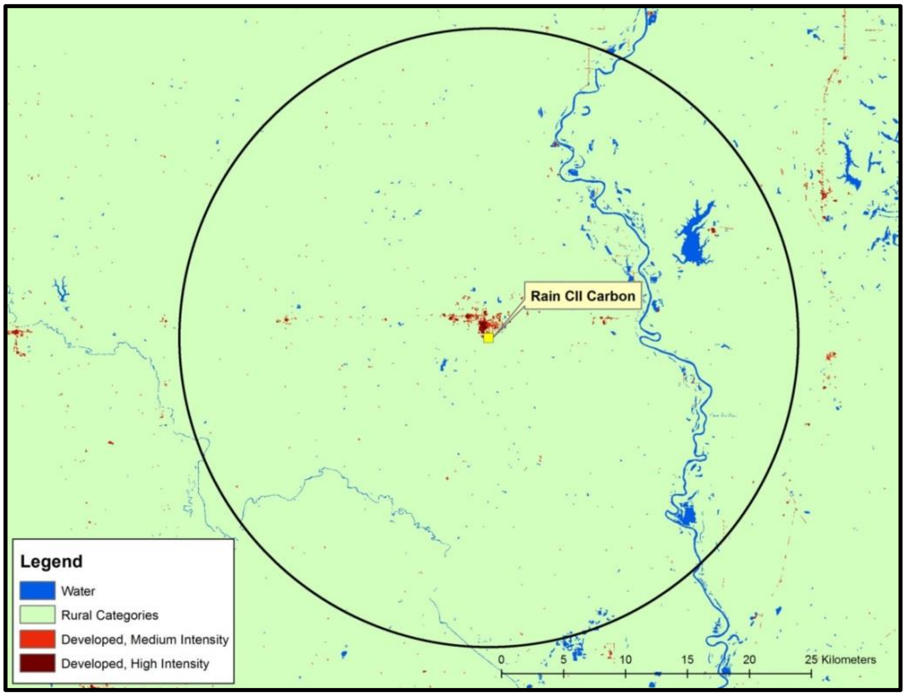


Figure 11
Land Cover within a Three-Kilometer Radius of Rain CII Carbon (Urban vs. Rural)

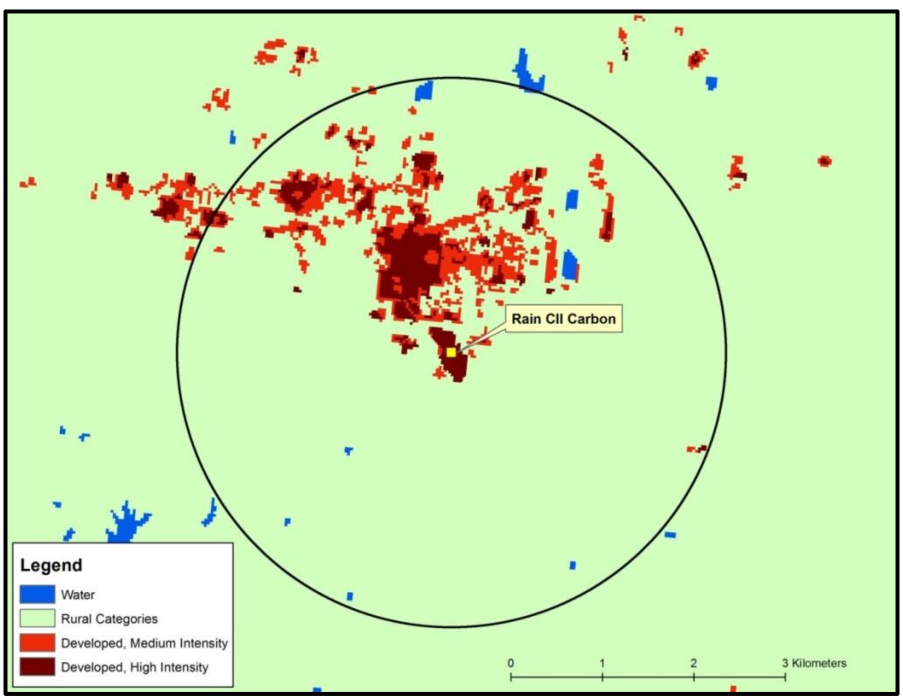


Table 6

Land Cover Percentages by Auer's Category for a Three-Kilometer Radius Area and for the Modeling Domain (25-Kilometer Radius) – Rain CII Carbon Study Area

Rain CII Carbon Study Area Auer's Analysis				Auer's 3 km Ring			Study Area 25 km Ring		
NLCD Value	NLCD 2011 Description	Auer's Code	Auer's Class	Cell Count	Percentage	Totals	Cell Count	Percentage	Totals
23	Developed, Medium Intensity	R2/R3	Urban	1,844	5.75%	9.30%	4,788	0.22%	0.29%
24	Developed, High Intensity	I1/I2/C1		1,135	3.54%		1,620	0.07%	
11	Open Water	A5	Rural	141	0.44%	90.70%	34,091	1.53%	99.71%
21	Developed, Open Space	A1/R4		3,552	11.09%		131,273	5.90%	
22	Developed, Low Intensity	R1		4,753	14.83%		22,657	1.02%	
31	Barren Land (Rock/Sand/Clay)	A3		0	0.00%		601	0.03%	
41	Deciduous Forest	A4		4,206	13.13%		388,606	17.46%	
42	Evergreen Forest	A4		0	0.00%		240	0.01%	
43	Mixed Forest	A4		0	0.00%		0	0.00%	
52	Shrub/Scrub	A4		0	0.00%		75	0.00%	
71	Grassland/Herbaceous	A3		457	1.43%		11,709	0.53%	
81	Pasture/Hay	A3		1,023	3.19%		93,478	4.20%	
82	Cultivated Crops	A2		14,818	46.24%		1,490,126	66.97%	
90	Wood Wetlands	A4		114	0.36%		43,642	1.96%	
95	Emergent Herbaceous Wetlands	A3		0	0.00%		2,286	0.10%	
Analysis based on 30 meter by 30 meter raster cells extracted for each area.			*Total*	*32,043*	*100.00%*	*100.00%*	*2,225,192*	*100.00%*	*100.00%*

The Auer's analysis indicates that the study area is at least 99% rural and the three-kilometer near-field is approximately 90% rural. Based upon these results, the dispersion regime was treated as rural.

The 2011 NLCD land cover dataset erroneously classified the Rain CII Carbon facility as "Open Water." Due to the relatively small size of this facility, this classification error did not significantly alter the results of the three-kilometer Auer's Analysis. However, the problem was still addressed by using a small 400-meter buffer to extract out all of the misclassified "Open Water" cells that fell within the property boundary of the Rain CII Carbon facility. From this small grid extraction it was determined that 132 cells were misclassified. The Auer's Analysis results were then adjusted by subtracting the 132 cells from the "Open Water" category and adding them to the "Developed, High Intensity" category. This increased the urban land cover percentage from 8.88% to 9.30% for the three-kilometer Auer's Analysis and from 0.28% to 0.29% for the 25-kilometer Auer's Analysis. This very small adjustment did not change the final determination that the Rain CII Carbon Study Area should be modeled as Rural.

3.2.2.3 Emissions

Illinois EPA received hourly emissions data (actual) for all sources modeled for the Rain CII Carbon facility, as well as for the Hoosier Energy - Merom generating station and for most sources from the Marathon Petroleum Company refinery for calendar years 2012-2015. Since the Merom generating station is in the Eastern Time Zone, yet Rain CII Carbon and Marathon are in the Central Time Zone, the hourly inputs for Merom were shifted back one hour in order for all three facilities to be in synchrony. Table 7 provides a summary of the reported actual SO_2 tonnages from these facilities for 2013-2015. In response to an inquiry by USEPA as to why there were significantly lower emissions for Rain CII Carbon in 2015, as compared with years 2013 and 2014, the company informed the Illinois EPA, "The SO_2 emissions were lower due to low customer demands for the year, which led to the plant operating at less than 50% capacity." Upon receipt of the actual hourly emissions data provided by Rain CII Carbon for the two kilns (Protocol totals were based on AER submissions for those calendar years), emissions for 2013-2015 totaled 2,958.93; 3,134.08; and 2,161.40 tons per year as opposed to 5,239.7; 5,429.8; and 2,161.40 tons per year per AERs and Illinois EPA's ICEMAN database. Illinois EPA contacted Rain CII Carbon to obtain an explanation for the discrepancy. Rain CII stated that when the AERs were completed, they had believed that the most reliable method for estimating SO_2 emissions "used hourly emissions data from the most recent stack test and operating hours for each kiln. This method was based on the assumption that stack test conditions represented 'typical' or 'average' operating conditions for the facility. In truth, the data from the stack tests represent operation during high/maximum feed rates. There is ample time during 2013 and 2014 that the kilns were not operating at high/maximum feed rates." Upon responding to the state's data request in January 2016, Rain CII Carbon modified its method of estimating emissions to a more accurate method. The company informed Illinois EPA, "The new method was based on an engineering study that correlated SO_2 emissions with actual operating data, taking into account variations in hourly feed rate and coke sulfur levels. This is in contrast to the previous method that assumed a uniform emission rate for all feed rates and coke sulfur levels."

For Marathon, although the magnitude of the reported facility emissions (approximately 202 tons) for 2014 are much lower than those of Rain CII Carbon, the proximity of the refinery to the Rain CII Carbon facility warranted its inclusion in the modeling analysis. The Hoosier Energy – Merom power plant had reported SO_2 emissions of 3,316 tons in calendar year 2014 and because of the magnitude of the emissions and relative source proximity, its inclusion was also considered necessary.

Table 7
Facility Actual Emissions – Rain CII Carbon Study Area

Company I.D.	Facility Name	SO_2 Emissions (tons per year)		
		2013	2014	2015
033025AAJ	Rain CII Carbon	2,958.9	3,134.1	2,161.4
033808AAB	Marathon Petroleum	218.8	207.1	213.4
1815300005	Merom Generating Station	2,816.2	3,315.9	2,579.4
Total Emissions	**All Facilities**	**5,993.9**	**6,657.1**	**4,954.2**

The Rain CII Carbon hourly emission estimates are based upon a calculation method that takes into account variations in hourly feed rates and coke sulfur levels. The Merom generating station hourly-specific data was provided by IDEM and is presumed to reflect the continuous emissions monitoring data supplied to USEPA's Clean Air Markets Division database. The Illinois EPA had requested hourly-specific information on this facility from USEPA, and the information received was evaluated for potential use in refining the IDEM-supplied data. The Marathon Petroleum Company data for the Fluidized Catalytic Cracking Unit, Sulfur Recovery Units, and 1F1 Crude Atmospheric Heater were obtained from SO_2 continuous emission monitoring. For Marathon's boilers and other heaters, hourly heat input rates in combination with fuel gas emission factors (determined from continuous emission monitoring of H_2S in refinery fuel gas) provided the basis of the hourly emissions. Non-H_2S sulfur data were incorporated into the final estimates. It should be noted that Heater 90F-41 replaced Heater 90F-1 in October 2013. SO_2 emission estimates for flaring reflect the H_2S content of the gases flared and the quantity of gas being flared. Anomalous negative emission rates for Flare #4 during certain hours in 2013 were set to zero. Day-specific operational data were provided for the stationary engines (fire pumps) at Marathon, and together with SO_2 emission rates developed from stack testing data and horsepower ratings, a particular engine's emissions were allocated uniformly across all hours of each specific day of operation.

The following example calculation for the 66F-3 Sulfur Recovery Unit thermal oxidizer (January 1, 2013, hour 01) was provided by Marathon to illustrate the derivation of a lbs/hour emission rate based upon an in-stack parts per million concentration (obtained from hourly averaged analyzer data):

In-stack ppm concentration: 8.1033 ppm

<u>Moles SO_2/hour</u>: (311,190 SCFH SO_2 x 8.1033 ppm SO_2) / (10^6 x 379.5 SCF/lb-mol)

= 0.0066447 lb-mol SO_2/hour

Where 311,190 SCFH is the calculated stack gas rate on a dry basis, and 10^6 is used to determine the decimal fraction of 8.1033 ppmv, i.e. 8.1033 ppm/1,000,000 = 8.1033 x 10^{-6}

<u>Lbs SO_2/hour</u>: (0.0066447 lb-mol SO_2/hour) x (64.06 lb/lb-mole SO2) = 0.4257 lb/hr SO_2

Where 64.06 lb/lb-mole SO_2 is the molar mass of SO_2.

Please refer to Appendix A for a complete listing of all emission sources modeled in the Rain CII Carbon study area, and their associated locational data, stack release parameters, and emission rates.

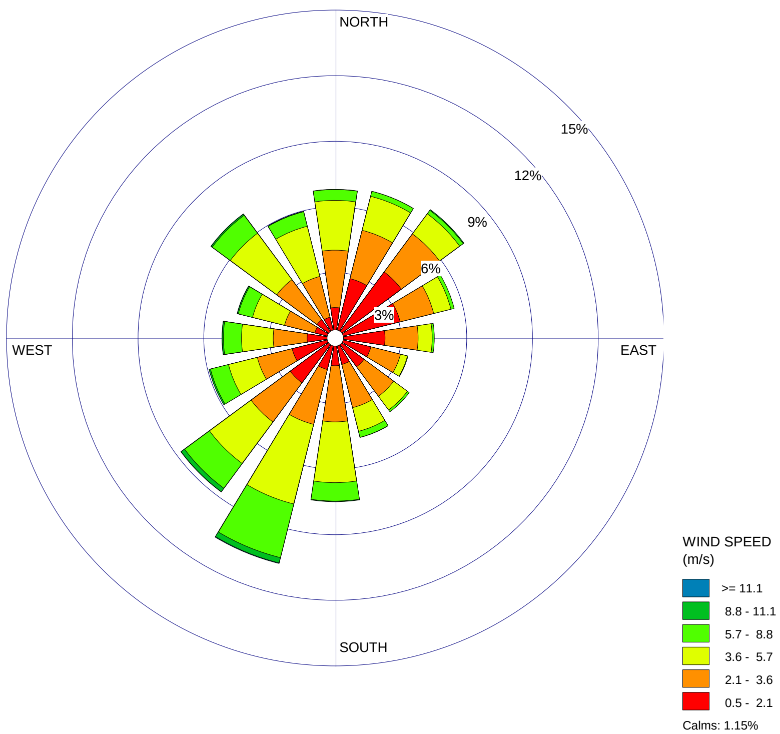
3.2.2.4 Meteorology

As discussed in Section 3.1.3, the meteorological data site selection and processing procedure was applied to the Rain CII Carbon Study Area. NCDC NWS surface meteorology from Evansville, Indiana (WBAN No. 93817, 65 miles to the south-southeast), and coincident upper air observations from Lincoln, Illinois (WBAN No. 04833, 115 miles to the north-northwest), were determined to be best representative of meteorological conditions within the study area.

The three-year surface wind rose for Evansville Regional Airport in Evansville, Indiana, is depicted in Figure 12. The frequency and magnitude of wind speed and direction are defined in terms of where the wind is blowing from, parsed out in sixteen 22.5-degree wind sectors. The predominant wind direction during the three-year time period proposed in the modeling is from the south-

southwest, occurring approximately 10.6% of the time. The highest percentage wind speed range, occurring 31.3% of the time, was in the 2.1 - 3.6 m/s range.

Figure 12
Evansville Regional Airport, Indiana
Cumulative Annual Wind Rose
2013-2015



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
Direction Wind is blowing from.	**Start Date: 1/1/2013 - 00:00** **End Date: 12/31/2015 - 23:00**	MODELER:	
	CALM WINDS: **1.15%**	TOTAL COUNT: **26206 hrs.**	
	AVG. WIND SPEED: **3.28 m/s**	DATE: **6/9/2016**	PROJECT NO.:

3.2.2.5 Background SO_2

The process of incorporating monitored background data as discussed in Section 3.1.4.2 was applied in the Rain CII Carbon Study Area modeling analysis. Illinois EPA incorporated temporally-varying background one-hour concentrations developed from the Nilwood monitor, which is located approximately 115 miles west-northwest of the study area in northern Macoupin County. The monitor, which is operated and maintained by Illinois EPA, has validated hourly SO_2 concentrations for the three years proposed to be utilized in this analysis (2013-2015). The values developed for input are based on the 99^{th} percentile monitored concentrations and vary by hour and season. A table of the proposed background SO_2 seasonally and hourly varying values used in the Rain CII Carbon Study Area modeling is provided in Appendix B.

3.2.2.6 Modeling Results

The AERMOD simulation for the Rain CII Study Area comprised 58 stacks, 262 structures, two fencelines, and 12,615 receptors. The model simulated year 2013-2015, while taking into account maximum actual emissions expected from the source, in conjunction with meteorology, terrain, and background SO_2 levels to calculate a maximum 99^{th} percentile 1-hour SO_2 concentration for each receptor in the grid. The results presented in Table 8 report the magnitude and geographic location of the highest predicted design value concentration.

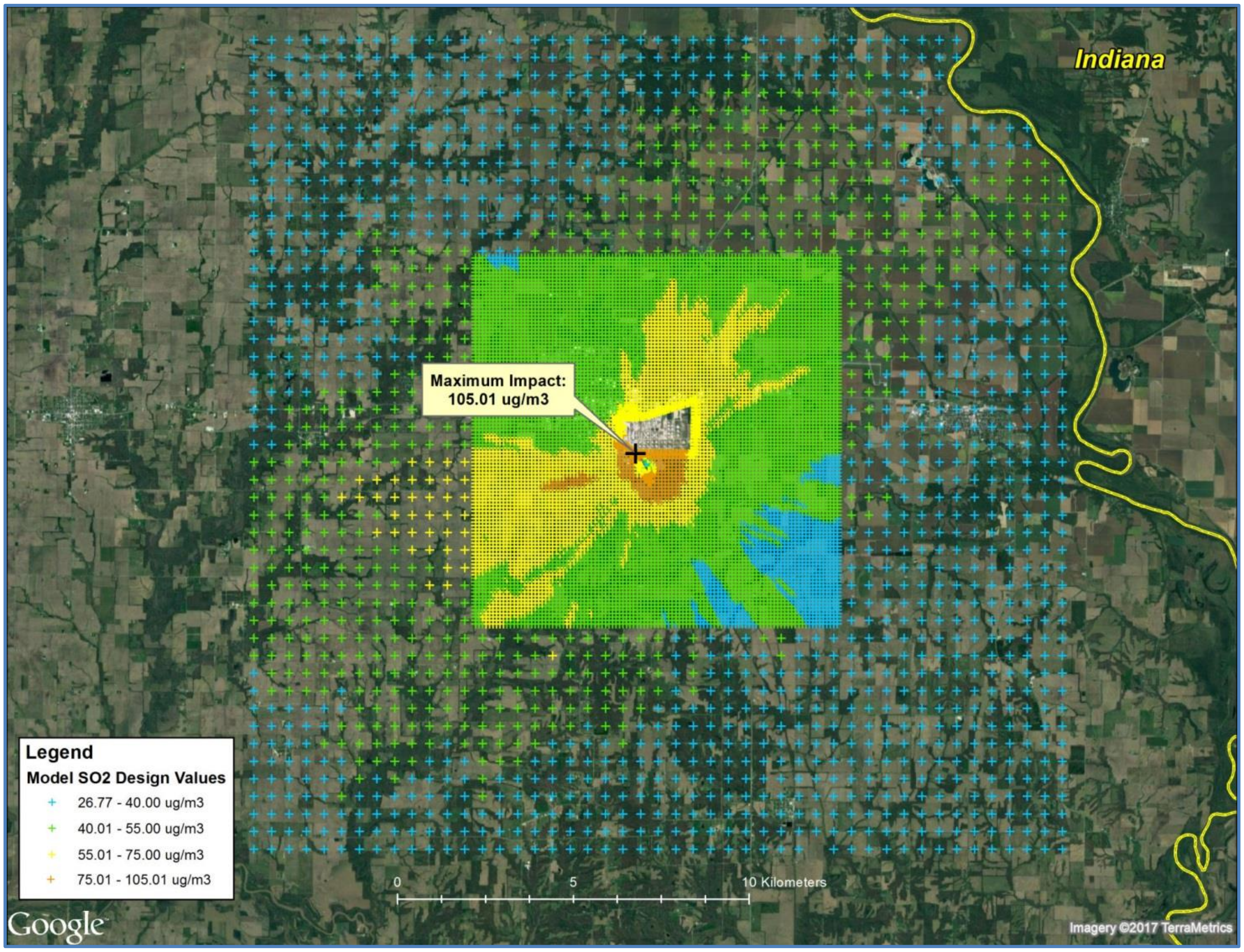
Table 8
Maximum Predicted 99^{th} Percentile 1-Hour SO_2 Design Value Concentration
Rain CII Study Area

Averaging Period	Data Period	Receptor Location (Meters)		SO_2 Concentration ($\mu g/m^3$)	
		East	North	Modeled	NAAQS
99^{th} Percentile 1-Hour Average	2013-2015	437364	4316246	105.01	**196.32***

* Equivalent to the 75 ppb standard

The maximum predicted 99^{th} percentile 1-hour average concentration within the modeling domain is **105.01** $\mu g/m^3$, or 40.1 ppb. The maximum occurred within the 100-meter grid 0.4 km northwest of Rain CII's northern pyro-scrubber stack. The color coded contour map in Figure 13 depicts maximum predicted concentrations for each receptor in the study area and indicates the location of the predicted maximum.

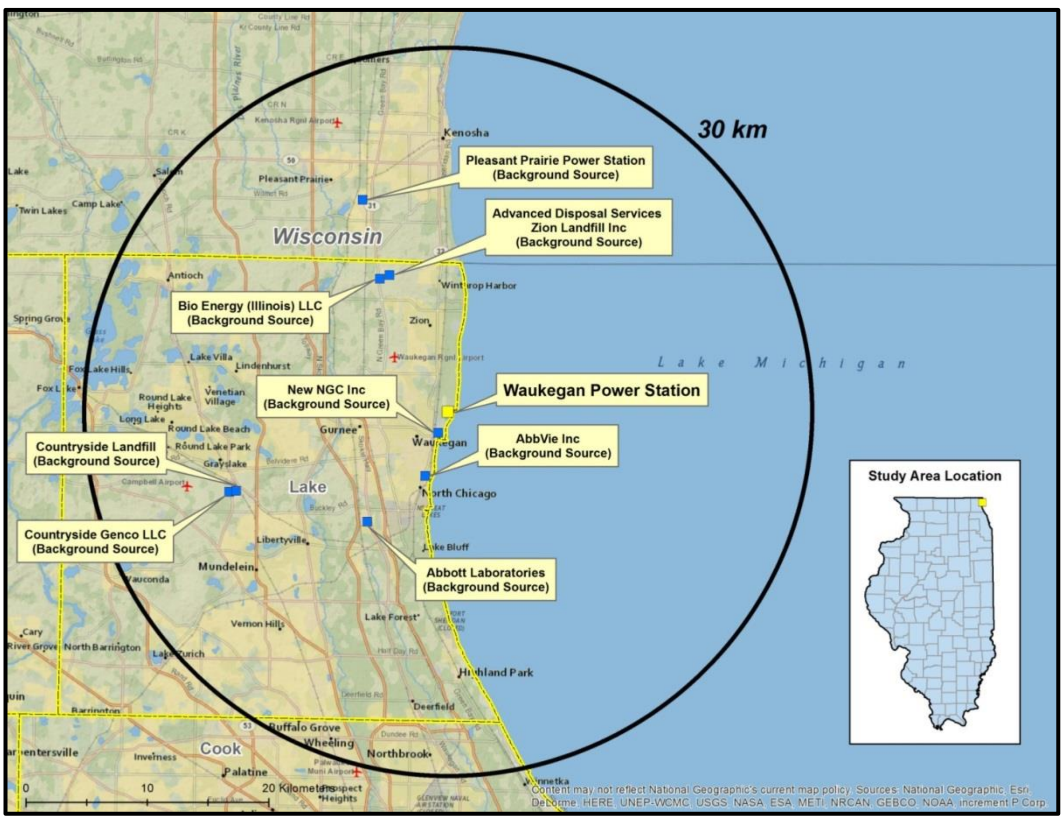
Figure 13
Maximum Predicted 99th Percentile 1-Hour SO_2 Concentrations – Rain CII Study Area



3.2.3 Midwest Generation LLC – Waukegan

NRG Energy Inc. ("NRG") owns the Midwest Generation LLC – Waukegan (Waukegan Station) electrical power generating station located in Lake County, along a section of western Lake Michigan coastal area in the City of Waukegan (see Figure 14). The company operates two coal-fired boilers (Unit #7 and Unit #8) with nominal capacities of 3,255 and 3,262 mmBtu/hour, and these boilers also have the capability of firing natural gas and/or fuel oil either with or without coal. SO_2 emissions are controlled through dry sorbent injection of trona and the associated use of electrostatic precipitators. The company operates four distillate oil-fired turbines, each with a nominal capacity of 552.6 mmBtu/hour, to meet peak power demands. A natural gas-fired auxiliary boiler, with a nominal capacity of 51.1 mmBtu/hour, is used to provide steam for building heat and other internal purposes, but not for electricity generation by the steam turbine generators.

Figure 14
Midwest Generation LLC - Waukegan Study Area



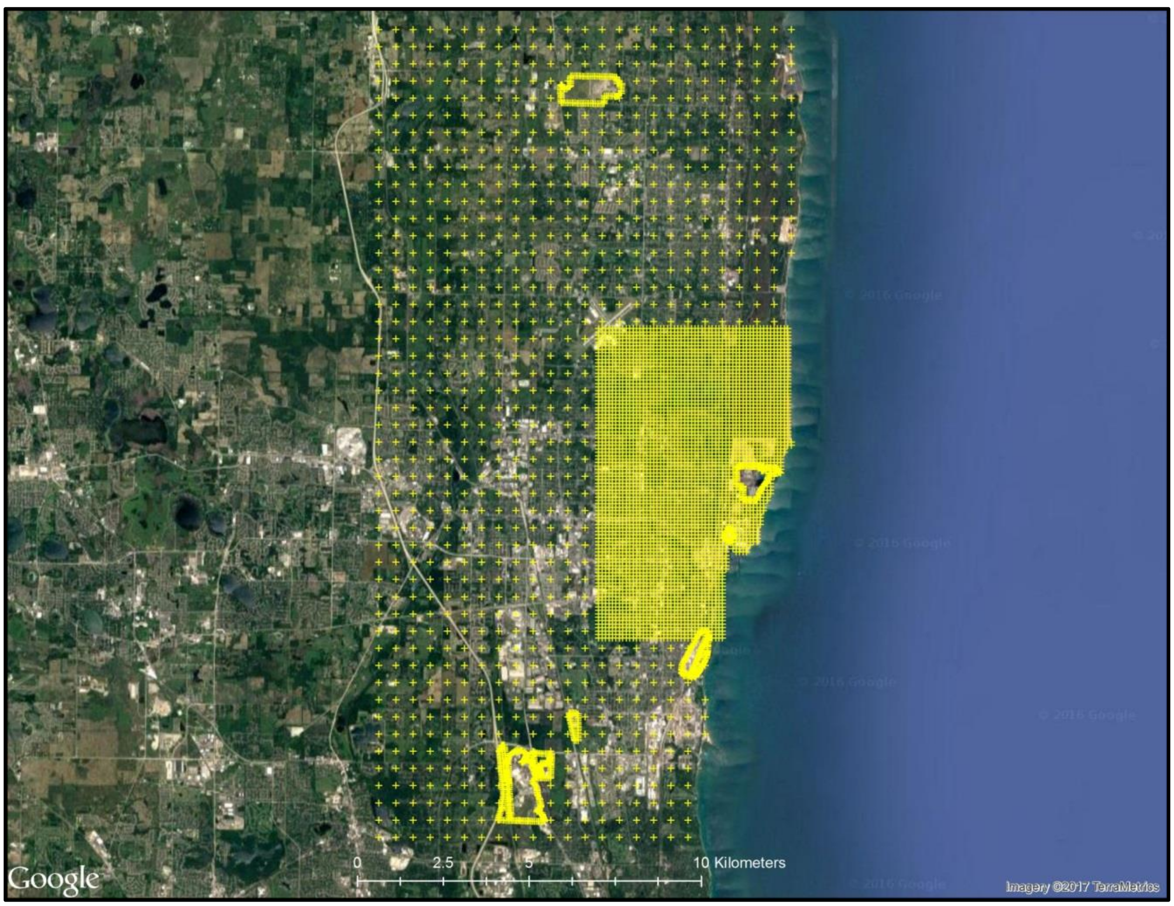
3.2.3.1 Modeling Domain and Receptor Network

The modeling domain for the Waukegan Station and all potentially significant regional emission sources is centered on the generating station's southernmost primary boiler stack and extends outward to encompass an area of 30-kilometer radius. In addition to the Waukegan Station, this domain includes eight background sources (Abbvie Inc.; New NGC Inc.; Advanced Disposal Services Zion Landfill Inc.; Bio Energy (Illinois) LLC; Abbott Laboratories; Countryside Genco, LLC; Countryside Landfill; and Wisconsin's Pleasant Prairie Generating Station). To ensure adequate capture of predicted maximums near the DRR facility, the receptor network includes fenceline receptors and a dense near-field receptor array. The receptor network for the study area includes the following:

- 50 meters along fencelines (Waukegan Station, New NGC, Abbvie, Abbott Laboratories, Advanced Disposal Services Zion Landfill, and Bio Energy (Illinois))
- 100 meters from the Waukegan Station out to a distance of approximately four kilometers
- 500 meters from four kilometers out to a distance of approximately 10 kilometers from the Waukegan Station.

The Waukegan Study Area receptor network (see Figure 15) consists of 6,098 receptors, and is contained entirely in Lake County. Per the recommendation of the TAD, receptors were not placed on large water bodies (Lake Michigan). The study area terrain is best characterized as flat to gently rolling.

Figure 15
Receptor Grid – Waukegan Study Area



3.2.3.2 Auer's Analysis (Urban/Rural Environment)

The 30-kilometer study area and three-kilometer near-field ring applied in the Auer's analysis for the Waukegan Study Area are both centered on the southernmost primary boiler stack at Waukegan Station. The results of the Auer's analysis for the Waukegan Study Area are presented in Figure 16, Figure 17, and Table 9.

Figure 16
Land Cover in the Waukegan Study Area
(Urban vs. Rural)

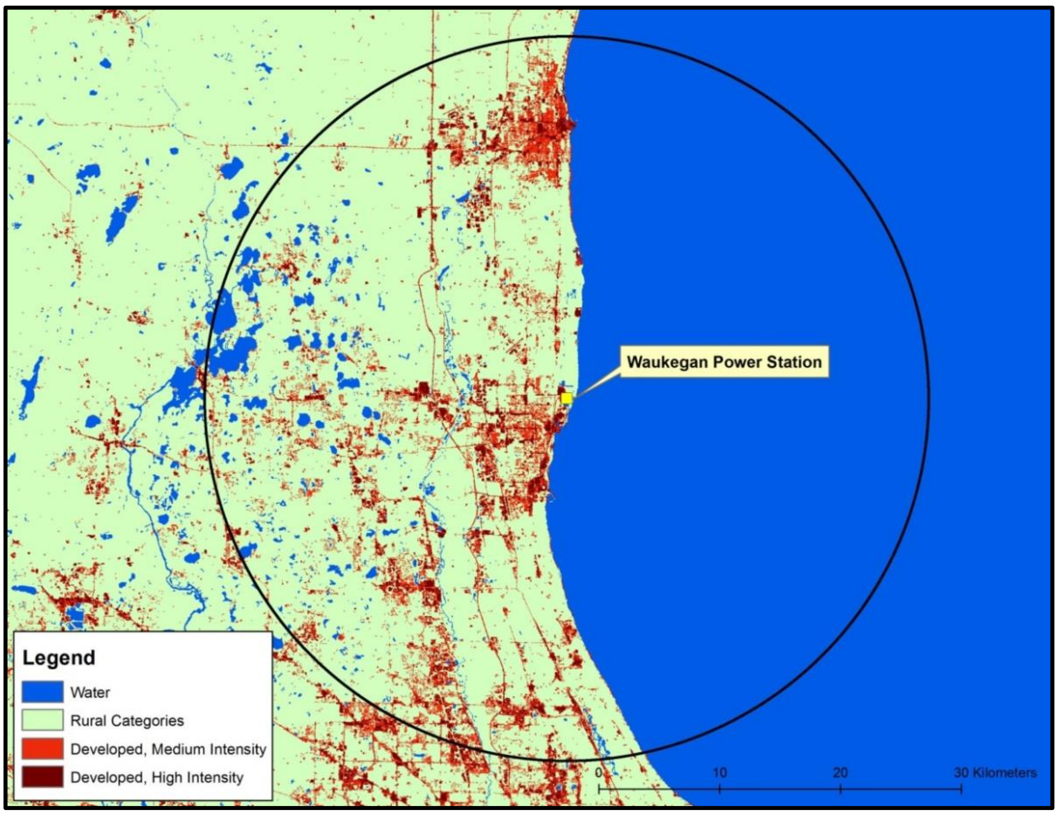


Figure 17
Land Cover within a Three-Kilometer Radius of Waukegan Station (Urban vs. Rural)

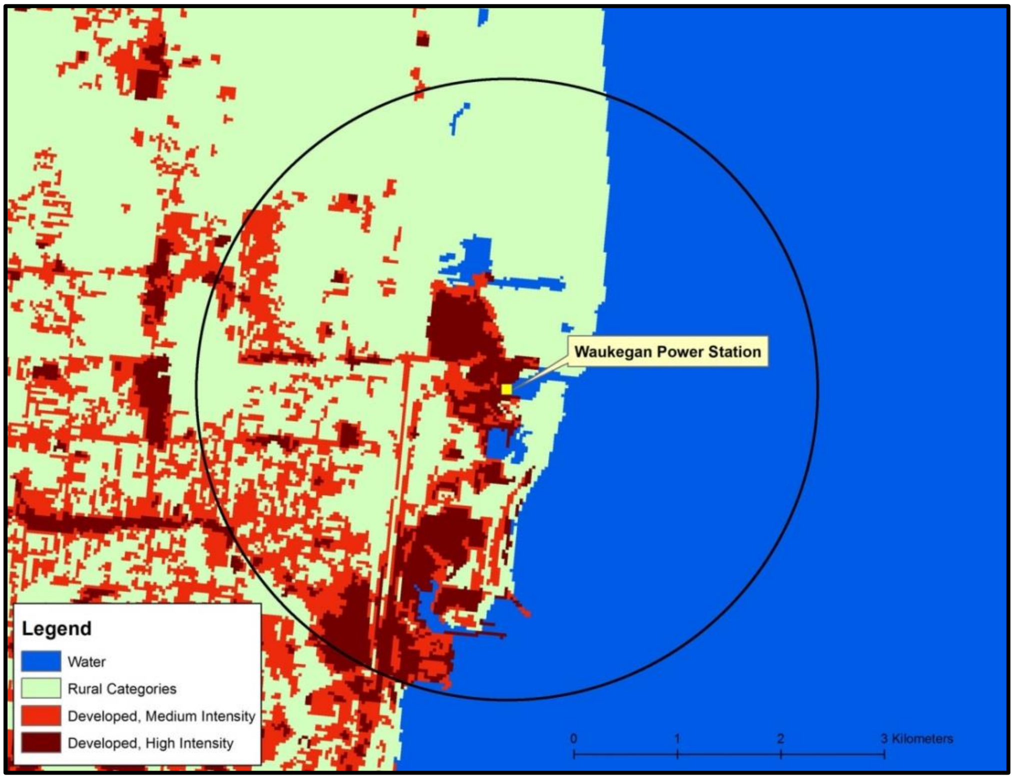


Table 9

Land Cover Percentages by Auer's Category for a Three-Kilometer Radius Area and for the Modeling Domain (30-Kilometer Radius) – Waukegan Study Area

Waukegan Study Area Auer's Analysis				Auer's 3 km Ring			Study Area 30 km Ring		
NLCD Value	NLCD 2011 Description	Auer's Code	Auer's Class	Cell Count	Percentage	Totals	Cell Count	Percentage	Totals
23	Developed, Medium Intensity	R2/R3	Urban	3,755	11.79%	19.39%	175,101	5.50%	7.61%
24	Developed, High Intensity	I1/I2/C1		2,421	7.60%		67,206	2.11%	
11	Open Water	A5	Rural	13,342	41.89%	80.61%	1,612,299	50.64%	92.39%
21	Developed, Open Space	A1/R4		2,246	7.05%		256,320	8.05%	
22	Developed, Low Intensity	R1		3,692	11.59%		391,686	12.30%	
31	Barren Land (Rock/Sand/Clay)	A3		893	2.80%		6,584	0.21%	
41	Deciduous Forest	A4		1,069	3.36%		161,115	5.06%	
42	Evergreen Forest	A4		44	0.14%		859	0.03%	
43	Mixed Forest	A4		91	0.29%		19,318	0.61%	
52	Shrub/Scrub	A4		7	0.02%		5,202	0.16%	
71	Grassland/Herbaceous	A3		202	0.63%		49,433	1.55%	
81	Pasture/Hay	A3		0	0.00%		62,997	1.98%	
82	Cultivated Crops	A2		0	0.00%		265,513	8.34%	
90	Wood Wetlands	A4		620	1.95%		72,447	2.28%	
95	Emergent Herbaceous Wetlands	A3		3,467	10.89%		37,720	1.18%	
Analysis based on 30 meter by 30 meter raster cells extracted for each area.			*Total*	*31,849*	*100.00%*	*100.00%*	*3,183,800*	*100.00%*	*100.00%*

The Auer's analysis indicates that the study area is at least 92% rural and the three-kilometer near-field is approximately 81% rural. Based upon these results, the dispersion regime will be treated as rural.

3.2.3.3 Emissions

Illinois EPA has acquired or developed high quality emissions data for the nine facilities in the Waukegan Study Area for the most recent years of operation. Agency staff produced refined hourly emission temporalizations for those sources in which hourly-specific data from continuous emission monitoring was not available. For the Waukegan Station, the parent company NRG provided hourly-specific SO_2 emission rates for Unit #7 and Unit #8 for calendar years 2012-2015. NRG also provided annual SO_2 emission totals and total hours of operation for each of the turbine peaker units during the years 2012-2015. This latter information was temporally adjusted by Illinois EPA staff to hourly rates consistent with procedures identified in the modeling guidance TAD. Hourly-specific SO_2 emission rates and estimated hourly stack gas exit temperatures and velocities were modeled for the WE Energies – Pleasant Prairie power plant (Pleasant Prairie, Wisconsin) based upon information provided by USEPA. Other modeling inputs for the Pleasant Prairie power plant were previously obtained from staff at the Wisconsin DNR. The development of emission rates for all other sources modeled in the Waukegan study area has adhered to the recommendations in the modeling TAD.

Reported actual annual SO_2 tonnages for 2013-2015 are presented in Table 10 for the DRR facility and the background source facilities that were modeled. The magnitude of the emissions of these background sources may individually be several orders (or more) less than those of the Waukegan Station. Despite this, the potential for cumulative impacts that may exceed the one-hour SO_2 NAAQS warranted their inclusion.

Table 10
Facility Actual Emissions – Waukegan Study Area

Company I.D.	Facility Name	SO_2 Emissions (tons per year)		
		2013	**2014**	**2015**
097190AAC	Midwest Generation LLC – Waukegan	7,749.9	5792.4	2,339.3
097190AAP	New NGC Inc.	8.7	8.7	8.7
097025AAR	Countryside Genco LLC	27.1	53.1	41.5
097806AAG	Countryside Landfill	23.9	6.3	14.5
097809AAD	Abbott Laboratories	74.0	22.8	0.2
097125AAA	AbbVie Inc.	59.5	16.2	6.6
097200AAV	ADS Zion Landfill Inc.	48.1	28.4	26.7
097200ABC	Bio Energy (Illinois) LLC	40.9	24.7	22.3
230006260	Pleasant Prairie Generating Station	1,173.8	1,310.1	1,335.5
Total Emissions	**All Facilities**	**9205.9**	**7262.7**	**3795.3**

The emissions reported in Table 10 in 2014 for Waukegan Station differ from the modeling protocol totals (5792.4 vs. 7683.4). The company provided revised data due to an inadvertent reporting of the hours of operation in the total tons column of the company-submitted AER for Boiler Unit 8. The corrected emissions tonnages for the plant are provided below and also reflected in the model.

Please refer to Appendix A for a complete listing of all emission sources modeled in the Waukegan study area, and the associated locational data, stack release parameter data, and emission rate profiles.

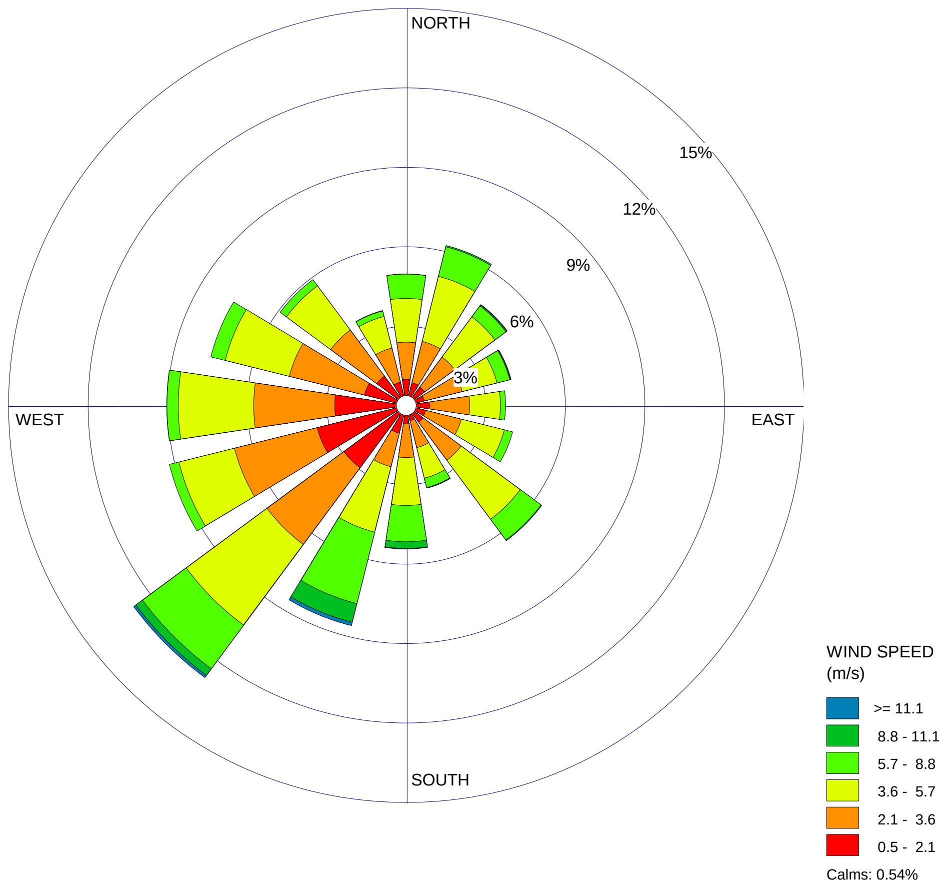
3.2.3.4 Meteorology

The same meteorological data site selection and processing procedure used in the previous study areas was applied to the Waukegan Study Area. As described in the protocol, Illinois proposed the use of surface NWS meteorology from Milwaukee Wisconsin (40 miles north of the Waukegan station), but promised investigation into the viability of utilizing the data from nearby Waukegan National Airport (3.5 miles northwest of Waukegan station). Milwaukee’s General Mitchell Airport is a first order NWS station, while Waukegan National Airport is a Second Order station. After analysis of the Waukegan data and comparison of completeness (i.e., calms, missing) relative to the Milwaukee site, Illinois EPA found a negligible difference (less than 0.07 percent) in the number of calms and missing hours between the two sites. In addition, the Waukegan site had greater data completeness for cloud cover and temperature data than the Milwaukee site. Consequently, Illinois EPA considered the Waukegan National Airport data more robust and more representative geographically and opted to perform the modeling for the study area using that meteorology.

NCDC NWS surface meteorology from Waukegan, Illinois (WBAN No. 14880, 3.5 miles to the northwest), and coincident upper air observations from Davenport, Iowa (WBAN No. 14923, 152 miles to the southwest), were considered reasonably representative of meteorological conditions within the study area.

The three-year surface wind rose for Waukegan National Airport is depicted in Figure 18. The frequency and magnitude of wind speed and direction are defined in terms of where the wind is blowing from, parsed out in sixteen 22.5-degree wind sectors. The predominant wind direction during the three-year time period proposed in the modeling is from the southwest, occurring approximately 12.7% of the time. The highest percentage wind speed range, occurring 33.0% of the time period, was in the 3.6 - 5.7 m/s range.

Figure 18
Waukegan National Airport, Waukegan, Illinois
Cumulative Annual Wind Rose
2013-2015



COMMENTS: Direction Wind is blowing from.	DATA PERIOD: **Start Date: 1/1/2013 - 00:00** **End Date: 12/31/2015 - 23:00**	COMPANY NAME:	
		MODELER:	
	CALM WINDS: **0.54%**	TOTAL COUNT: **26213 hrs.**	
	AVG. WIND SPEED: **3.73 m/s**	DATE: **12/8/2016**	PROJECT NO.:

3.2.3.5 Background SO_2

The Northbrook and Oglesby, Illinois, monitors were evaluated for use as background SO_2 monitors for the Waukegan Study Area. Although the Northbrook monitor is much closer to the study area, the data completeness percentage was too low to consider it a viable background site for the modeling. The Oglesby monitor is located approximately 98 miles southwest of the center of the study area in LaSalle County. This monitor, which is operated and maintained by Illinois EPA, has validated hourly SO_2 concentrations for the three years proposed to be utilized in this analysis (2013-2015).

Illinois EPA incorporated temporally-varying background one-hour concentrations developed from the Oglesby monitor. The values developed for input were based on the 99th percentile monitored concentrations and vary by hour and season in the same manner as discussed previously in Section 3.1.4.2. A table of the background SO_2 seasonally and hourly varying values is provided in Appendix B.

3.2.3.6 Modeling Results

The AERMOD simulation for the Waukegan Study Area comprised 34 stacks, 70 structures, seven fencelines, and 6,031 receptors. The model simulated year 2013-2015, taking into account maximum actual emissions expected from the source, in conjunction with meteorology, terrain, and background SO_2 levels to calculate a maximum 99th percentile 1-hour SO_2 concentration for each receptor in the grid. The results presented in Table 11 report the magnitude and geographic location of the highest predicted design value concentration.

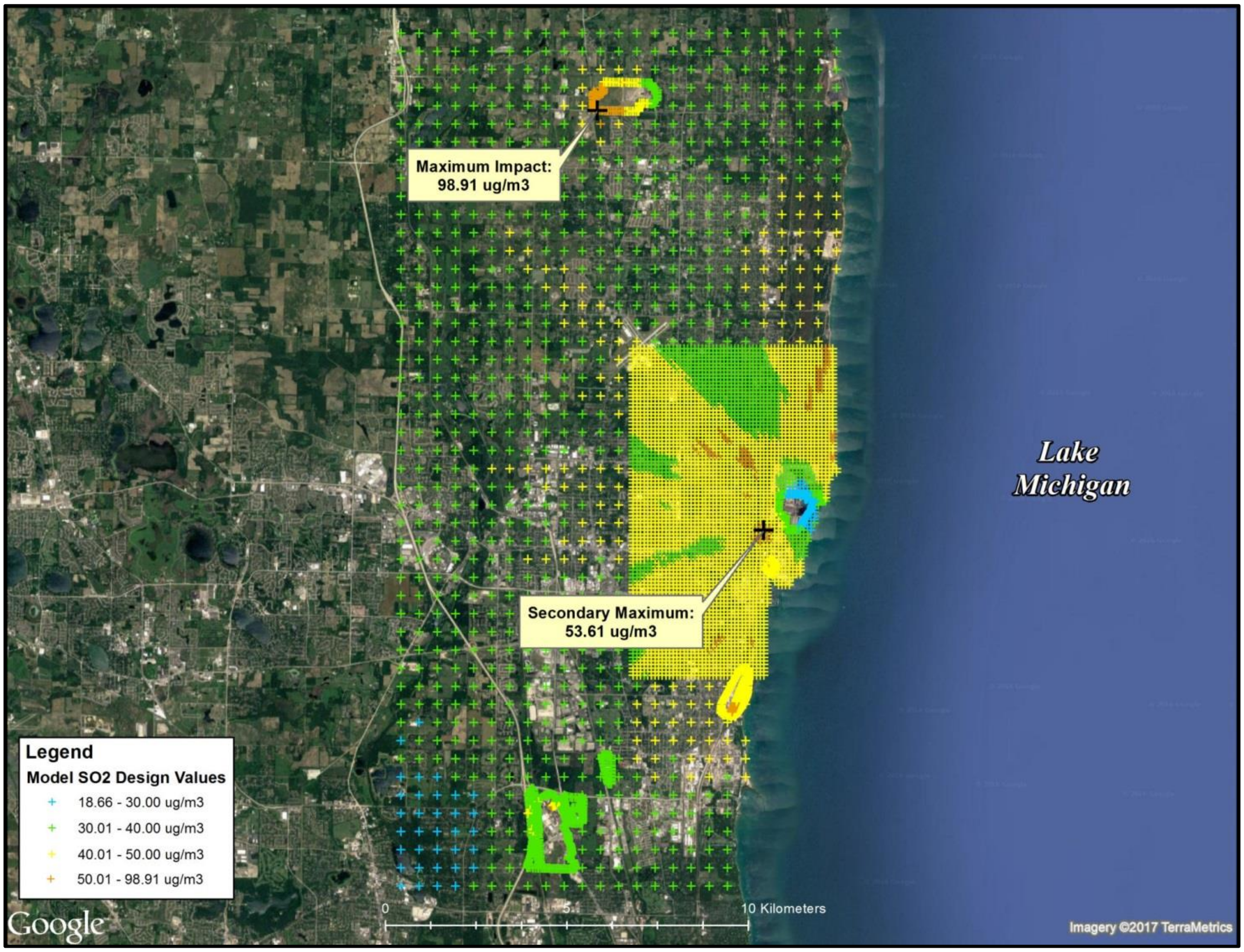
Table 11
Maximum Predicted 99th Percentile 1-Hour SO_2 Design Value Concentration
Waukegan Study Area

Averaging Period	Data Period	Receptor Location (Meters)		SO_2 Concentration ($\mu g/m^3$)	
		East	North	Modeled	NAAQS
99th Percentile 1-Hour Average	2013-2015	427419	4703366	**98.91**	**196.32***

* Equivalent to the 75 ppb standard

The maximum predicted 99th percentile 1-hour average concentration within the modeling domain is **98.91** $\mu g/m^3$, or 37.8 ppb. The maximum occurred along the Advanced Disposal Services fenceline (50 meter spacing), approximately 12.3 km northwest of the Waukegan Station in Zion, IL. The maximum concentration downwind of the Waukegan Station is **53.61** $\mu g/m^3$, or 20.5 ppb. The color coded contour map in Figure 19 depicts maximum predicted concentrations for each receptor in the study area and indicates the location of the predicted maximum.

Figure 19
Maximum Predicted 99th Percentile 1-Hour SO_2 Concentrations – Waukegan Study Area



3.2.4 Dynegy Midwest Generation – Baldwin/Prairie State Generating Station

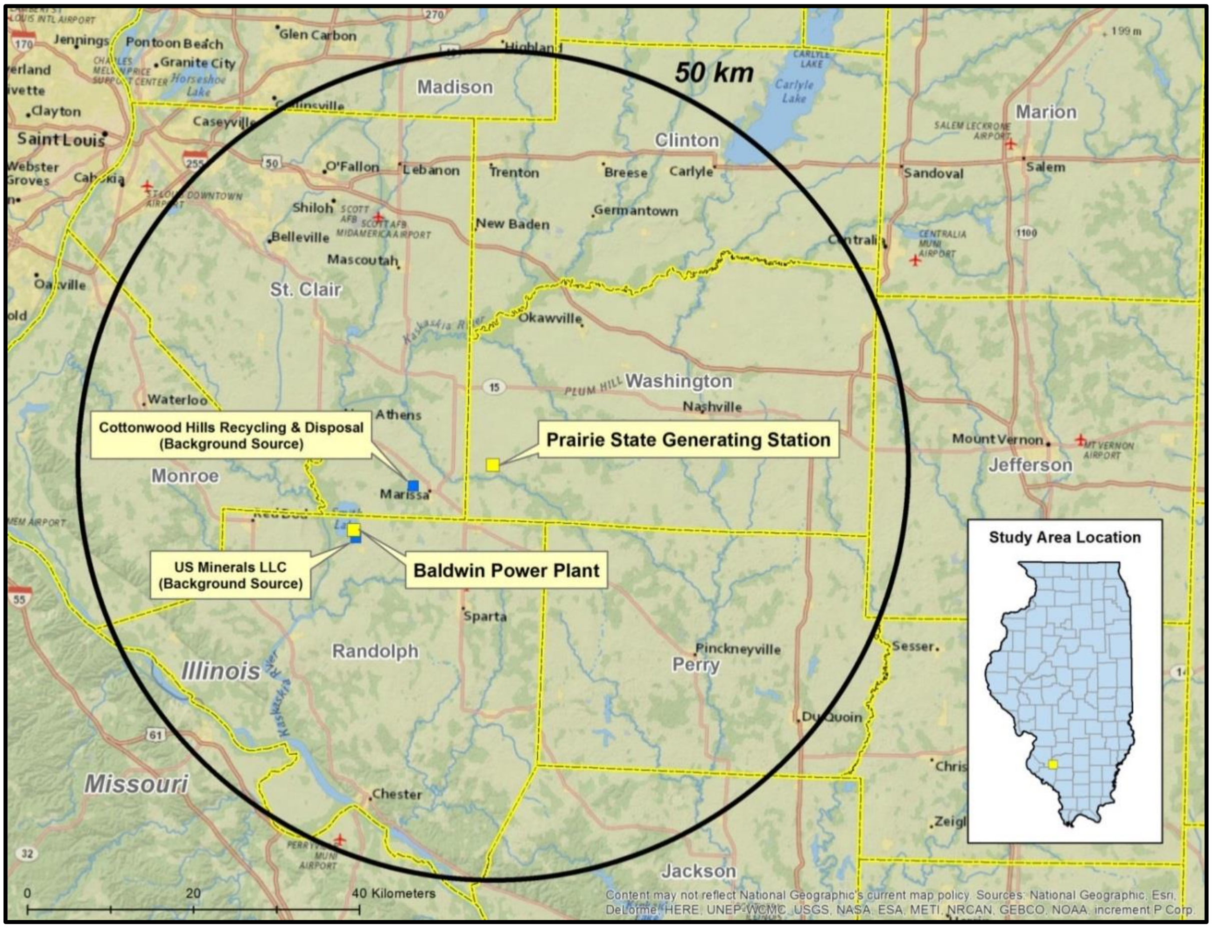
The Dynegy Midwest Generation Inc. – Baldwin Power Plant (“DMG – Baldwin”) is located just outside the community of Baldwin, in Randolph County. The Illinois EPA air emissions inventory system indicates that DMG – Baldwin has four SO_2-emitting sources: three steam electric coal-fired generating units that are nominally rated at 584 megawatts (Boiler #1), 586 megawatts (Boiler #2), and 627 megawatts (Boiler #3), and an oil-fired auxiliary heating boiler that is nominally rated at 130 mmBtu/hour. SO_2 emissions from the three steam electric coal-fired generating units are controlled by flue gas desulfurization systems (sorbent injection and scrubbers) and exhaust through separate unobstructed vertical stacks. The uncontrolled auxiliary heating boiler has horizontally-directed exhaust, and the exhaust exit velocity was adjusted (in accordance with federal modeling guidance) to minimize mechanically-induced plume rise.

Approximately 25 kilometers to the east of DMG – Baldwin, near the town of Lively Grove in rural Washington County, is the Prairie State Generating Company (“PSGC”) power plant. The company operates two pulverized coal boilers – each with a maximum rated capacity of approximately 7,500 mmBtu/hour – an auxiliary natural gas-fired boiler, and two emergency engines burning ultra-low sulfur diesel fuel. SO_2 emissions from the power generation boilers are controlled through wet flue gas desulfurization (scrubbers) in separate air pollution control trains, and released to the atmosphere through separate flues in a common stack.

3.2.4.1 Modeling Domain and Receptor Network

The modeling domain for capturing regional emission sources is centered on the PSGC main stack and extends outward to encompass an area with 50-kilometer radius. As depicted in Figure 20, this domain includes the Baldwin and Prairie State plants and two background sources (U. S. Minerals Inc. and Cottonwood Hills Recycling & Disposal).

Figure 20
Baldwin and Prairie State Generating Station Study Area

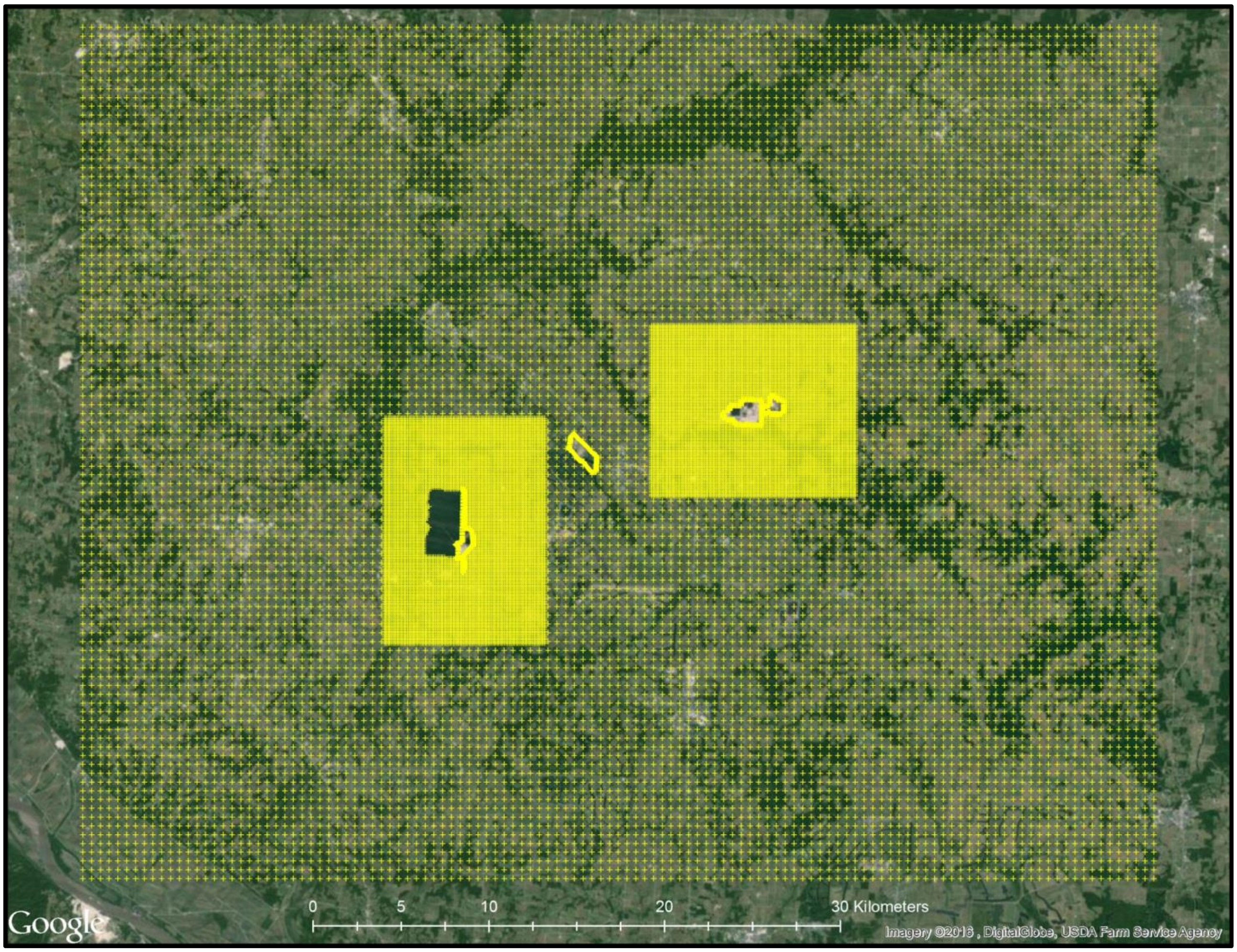


To ensure adequate capture of predicted maximums near the DMG – Baldwin and PSGC facilities, the receptor network includes fenceline receptors and a dense near-field receptor array. The receptor network for the study area is as follows:

- 50 meters along the fencelines (DMG – Baldwin, PSGC, U.S. Minerals, and Cottonwood Hills)
- 100 meters from the DMG – Baldwin and PSGC fencelines out to a distance of approximately four kilometers
- 500 meters from four kilometers out to a distance of approximately 20 kilometers from both main power plants.

The DMG – Baldwin and PSGC receptor network (see Figure 21) consists of 20,485 receptors, and is centered approximately at a midpoint between the two large power plants. The grid encompasses portions of Randolph, Washington, St. Clair, and Perry Counties in Illinois. Per the recommendation of the TAD, receptors were not placed on large water bodies (Mississippi River and Lake Baldwin). The study area terrain is best characterized as flat to gently rolling.

Figure 21
Receptor Grid
Baldwin and Prairie State Generating Station Study Area



3.2.4.2 Auer's Analysis (Urban/Rural Environment)

An Auer's analysis was applied to the Baldwin and Prairie State Generating Station Study Area. Figures 22 and 23 graphically depict the near-field areas (three-kilometer rings) applied in the Auer's analysis to the DMG – Baldwin and PSGC plants, respectively. Table 9 provides a statistical breakdown by land cover category for both three-kilometer rings. The same analysis encompassing the full study area is provided in Figure 24 and Tables 12 and 13.

Figure 22
Land Cover within a Three-Kilometer Radius of the Baldwin Plant
(Urban vs. Rural)

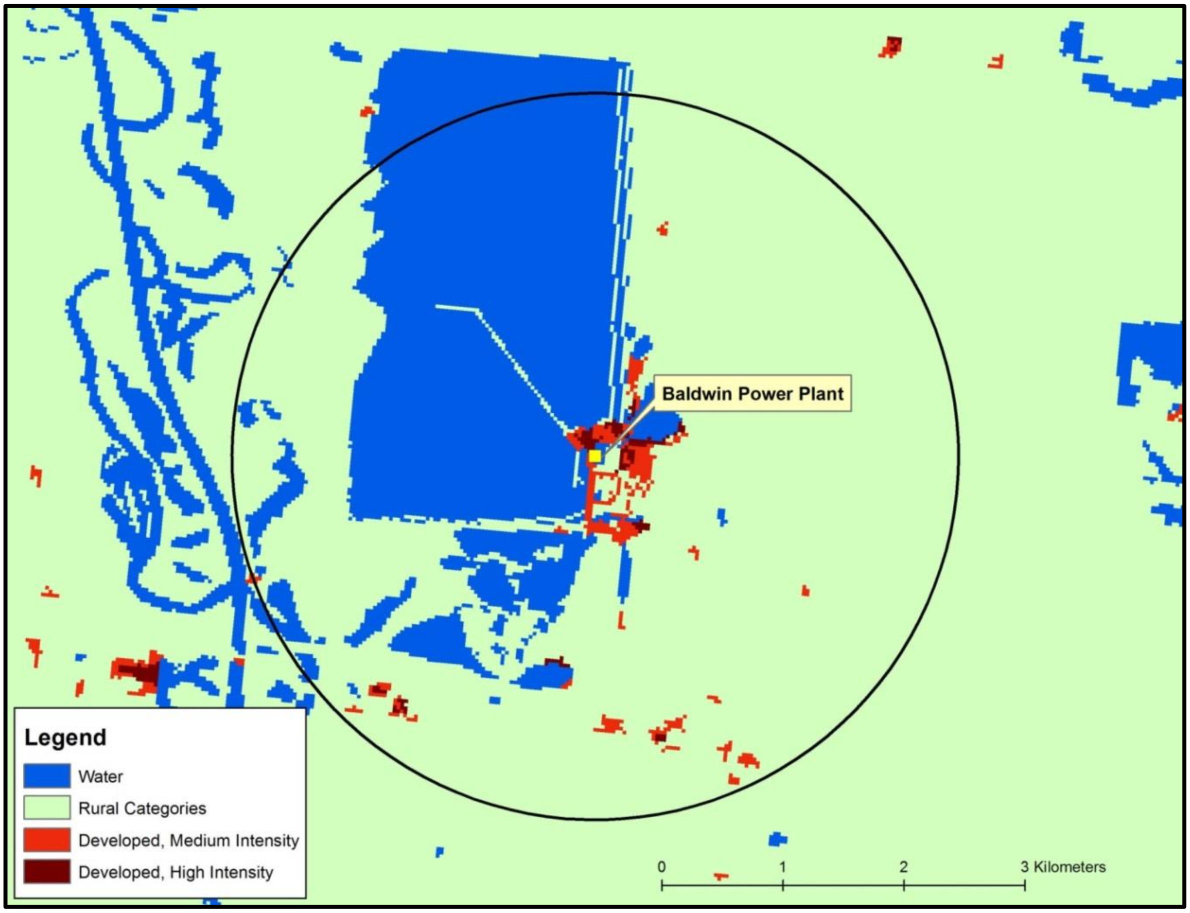


Figure 23
Land Cover within a Three-Kilometer Radius of Prairie State Generating Station (Urban vs. Rural)

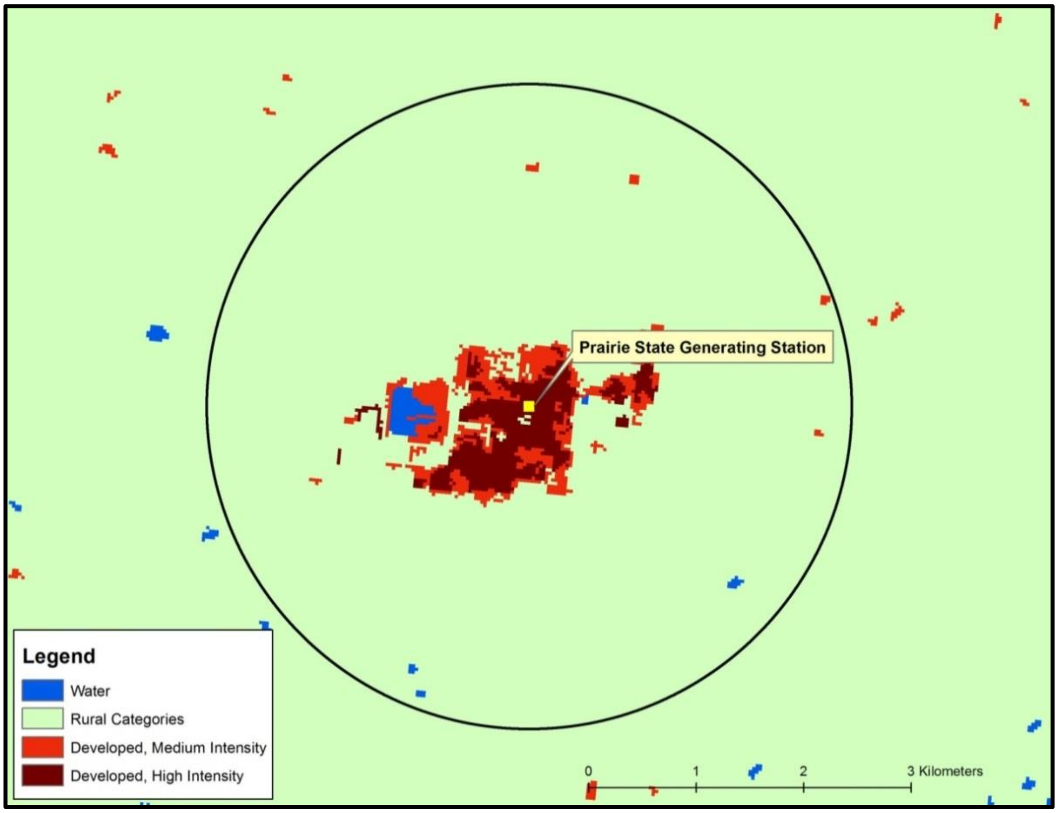


Table 12
Land Cover Percentages by Auer's Category for Three-Kilometer Radius Areas – Baldwin and Prairie State Generating Station

Baldwin-Prairie State Study Area Auer's Analysis				Baldwin Auer's 3 km Ring			PSGC Auer's 3 km Ring		
NLCD Value	NLCD 2011 Description	Auer's Code	Auer's Class	Cell Count	Percentage	Totals	Cell Count	Percentage	Totals
23	Developed, Medium Intensity	R2/R3	Urban	457	1.46%	1.89%	1,057	3.30%	6.75%
24	Developed, High Intensity	I1/I2/C1		136	0.43%		1,104	3.45%	
11	Open Water	A5	Rural	9,298	29.61%	98.11%	167	0.52%	93.25%
21	Developed, Open Space	A1/R4		2,013	6.41%		1,444	4.51%	
22	Developed, Low Intensity	R1		949	3.02%		982	3.07%	
31	Barren Land (Rock/Sand/Clay)	A3		307	0.98%		61	0.19%	
41	Deciduous Forest	A4		3,131	9.97%		3,228	10.08%	
42	Evergreen Forest	A4		0	0.00%		0	0.00%	
43	Mixed Forest	A4		0	0.00%		0	0.00%	
52	Shrub/Scrub	A4		0	0.00%		0	0.00%	
71	Grassland/Herbaceous	A3		1,164	3.71%		112	0.35%	
81	Pasture/Hay	A3		1,745	5.56%		3,635	11.35%	
82	Cultivated Crops	A2		11,861	37.77%		17,865	55.79%	
90	Wood Wetlands	A4		246	0.78%		2,364	7.38%	
95	Emergent Herbaceous Wetlands	A3		94	0.30%		0	0.00%	
Analysis based on 30 meter by 30 meter raster cells extracted for each area.			*Total*	*31,401*	*100.00%*	*100.00%*	*32,019*	*100.00%*	*100.00%*

Figure 24
Land Cover in the Baldwin and Prairie State Generating Station Study Area (Urban vs. Rural)

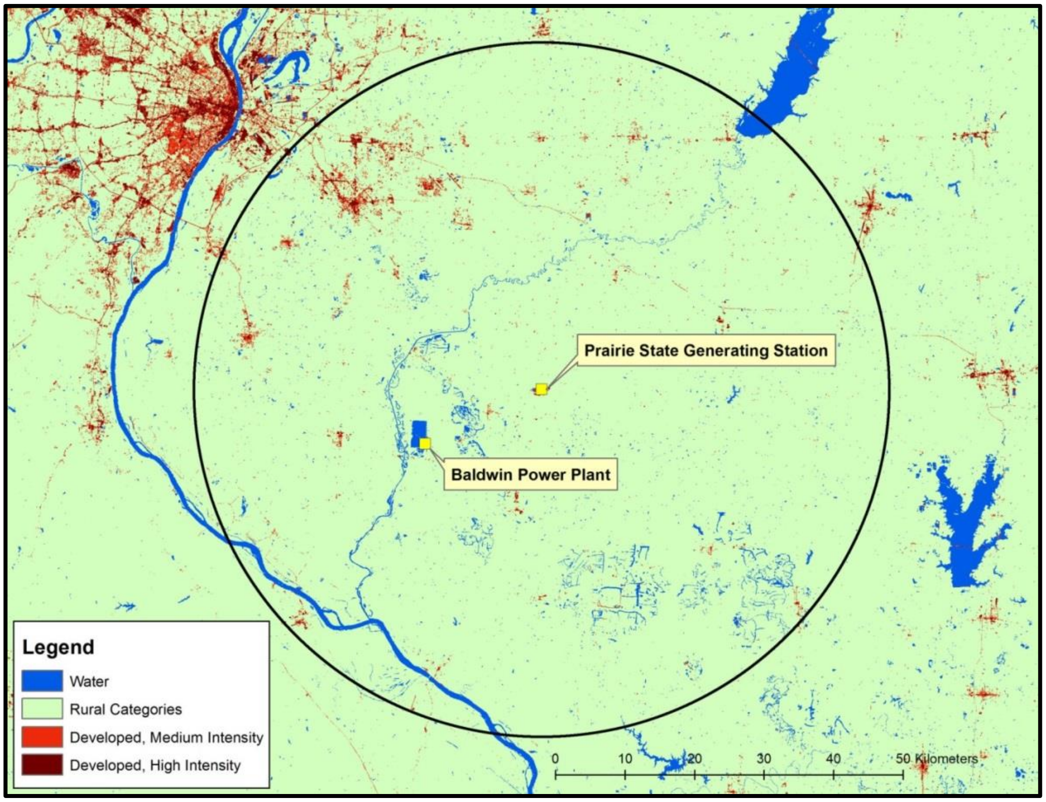


Table 13
Land Cover Percentages by Auer's Category for the Modeling Domain (50-Kilometer Radius) – Baldwin and Prairie State Generating Station Study Area

Baldwin-Prairie State Study Area Auer's Analysis				Study Area 50 km Ring		
NLCD Value	**NLCD 2011 Description**	**Auer's Code**	**Auer's Class**	**Cell Count**	**Percentage**	**Totals**
23	Developed, Medium Intensity	R2/R3	**Urban**	92,258	1.04%	**1.26%**
24	Developed, High Intensity	I1/I2/C1		19,620	0.22%	
11	Open Water	A5	**Rural**	202,691	2.28%	**98.74%**
21	Developed, Open Space	A1/R4		431,525	4.85%	
22	Developed, Low Intensity	R1		365,733	4.11%	
31	Barren Land (Rock/Sand/Clay)	A3		14,458	0.16%	
41	Deciduous Forest	A4		1,695,685	19.07%	
42	Evergreen Forest	A4		1,446	0.02%	
43	Mixed Forest	A4		1,886	0.02%	
52	Shrub/Scrub	A4		341	0.00%	
71	Grassland/Herbaceous	A3		151,951	1.71%	
81	Pasture/Hay	A3		1,819,610	20.46%	
82	Cultivated Crops	A2		3,830,733	43.08%	
90	Wood Wetlands	A4		248,303	2.79%	
95	Emergent Herbaceous Wetlands	A3		15,959	0.18%	
Analysis based on 30 meter by 30 meter raster cells extracted for each area.			***Total***	***8,892,199***	***100.00%***	***100.00%***

The Auer's analysis indicates the study area is at least 98% rural and the three-kilometer near-field areas for both power stations are over 93% rural. Based upon these results, the dispersion regime was treated as rural.

3.2.4.3 Emissions

Illinois EPA received or developed emissions inputs for the four facilities in the Baldwin and Prairie State Generating Station Study Area for the most recent years of operation. Hourly SO_2 emission rates based upon continuous emission monitoring were available for the large electrical power generation boilers. For other sources, such as backup generators and fire pumps, Illinois EPA examined fuel usage data and other available information to determine hourly emissions.

Hourly-specific SO_2 emission rates for the DMG – Baldwin coal-fired generating units (Boiler #1, Boiler #2, and Boiler #3) were provided by Dynegy Inc. for calendar years 2012-2015. For the auxiliary heating boiler, monthly fuel usage (gallons of #2 fuel oil) and operating time (hours per calendar month) were provided for the same period. Based on the calculated SO_2 emissions from the auxiliary boiler (0.004 tons in highest year) and operating hours of less than 50 hours in any year, the Illinois EPA deemed emissions too low and intermittent to be applicable to the form of the 1-hour SO_2 standard for this analysis. Consequently, it was not included in the model. This determination also applies for the diesel engines and fire pumps at the facility.

Prairie State Generating Company provided hourly-specific temperature, flow rate, and emissions data for both of the pulverized coal-fired boilers (Unit #1 and Unit #2), and hourly emissions data computed from gas consumption records and AP-42 emission factors for the auxiliary boiler. The data for all boilers were for the period 2012-2015. Hourly data for Unit #1 contains an outage due to a boiler tube leak during the very latter part of December 2015. The company also provided annual hours of operation for both the emergency diesel fire pump and the emergency diesel generator during this four-year period. Emission estimates for these two sources were calculated based upon emission factors from the company's AER, and the emissions and operating time were determined to be too low and, consequently, were not included in the modeling.

Total actual emissions reported for both the DMG – Baldwin facility and the PSGC facility for years 2013-2015 are provided in Table 14, together with the annual emission totals for the two background sources (U.S. Minerals Inc. and Cottonwood Hills Recycling & Disposal). The quantity of emissions for these background sources are orders of magnitude less than those of the power plants, but given their proximity to the power plants, they were included in the modeling simulations to assure adequate consideration and assessment of areas of potential high local impact.

Table 14
Facility Actual Emissions – Baldwin and Prairie State Generating Station Study Area

Company I.D.	Facility Name	SO_2 Emissions (tons per year)		
		2013	2014	2015
157851AAA	DMG Baldwin	4,803.4	4,409.5	4,160.0
189808AAB	Prairie State Generating Station	4,719.5	5,696.0	7,847.6
157851AAC	U. S. Minerals Inc.	3.1	3.5	1.0
163075AAL	Cottonwood Hills Recycling & Disposal	17.0	21.8	24.3
Total Emissions	**All Facilities**	**9,543.0**	**10,130.8**	**12,032.9**

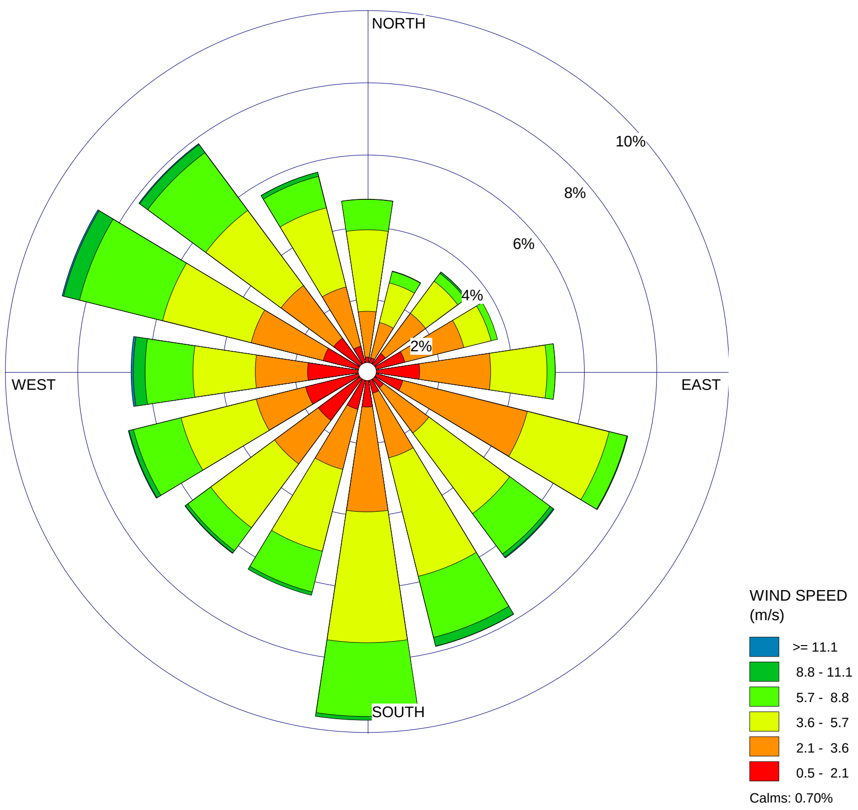
Please refer to Appendix A for a complete listing of all emission sources modeled in the Baldwin and Prairie State Generating Station study area, and the associated locational data, stack release parameters, and emission rate profiles.

3.2.4.4 Meteorology

The same meteorological data site selection and processing procedure used for the previous study area was applied to the Baldwin and Prairie State Generating Station Study Area. NCDC NWS surface meteorology from St. Louis, Missouri (WBAN No. 13994, 50 miles to the northwest), and coincident upper air observations from Lincoln, Illinois (WBAN No. 04833, 130 miles to the north-northeast), were considered reasonably representative of meteorological conditions within this study area.

The three-year surface wind rose for Lambert – St. Louis International Airport (St. Louis, MO) is depicted in Figure 25. The frequency and magnitude of wind speed and direction are defined in terms of where the wind is blowing from, parsed out in sixteen 22.5-degree wind sectors. The predominant wind direction during the three-year time period evaluated in the modeling is from the south, occurring approximately 9.6% of the time. The highest percentage wind speed range, occurring 34.6% of the time period, was in the 3.6 - 5.7 m/s range.

Figure 25
Lambert – St. Louis International Airport, Missouri
Cumulative Annual Wind Rose
2013-2015



COMMENTS: Direction Wind is blowing from.	DATA PERIOD: **Start Date: 1/1/2013 - 00:00** **End Date: 12/31/2015 - 23:00**	COMPANY NAME:	
		MODELER:	
	CALM WINDS: **0.70%**	TOTAL COUNT: **26270 hrs.**	
	AVG. WIND SPEED: **4.04 m/s**	DATE: **6/10/2016**	PROJECT NO.:

3.2.4.5 Background SO_2

Illinois EPA incorporated temporally-varying background one-hour concentrations developed from the East St. Louis monitor, which is located approximately 35 miles northwest of the center of the study area in northwestern St. Clair County. The monitor, which is operated and maintained by Illinois EPA, has validated hourly SO_2 concentrations for the three years utilized in this analysis

(2013-2015). The values developed for input were based on the 99th percentile monitored concentrations and vary by hour and season. A table of the proposed background SO_2 seasonally and hourly varying values used in the Baldwin and Prairie State Generating Station Study Area modeling is provided in Appendix B.

3.2.4.6 Modeling Results

The AERMOD simulation for the Baldwin and Prairie State Generating Station Study Area comprised nine stacks, 143 structures, four fencelines, and 20,485 receptors. The model simulated years 2013-2015, taking into account maximum actual emissions expected from the source, in conjunction with meteorology, terrain, and background SO_2 levels to calculate a maximum 99^{th} percentile 1-hour SO_2 concentration for each receptor in the grid. The results presented in Table 15 report the magnitude and geographic location of the highest predicted design value concentration.

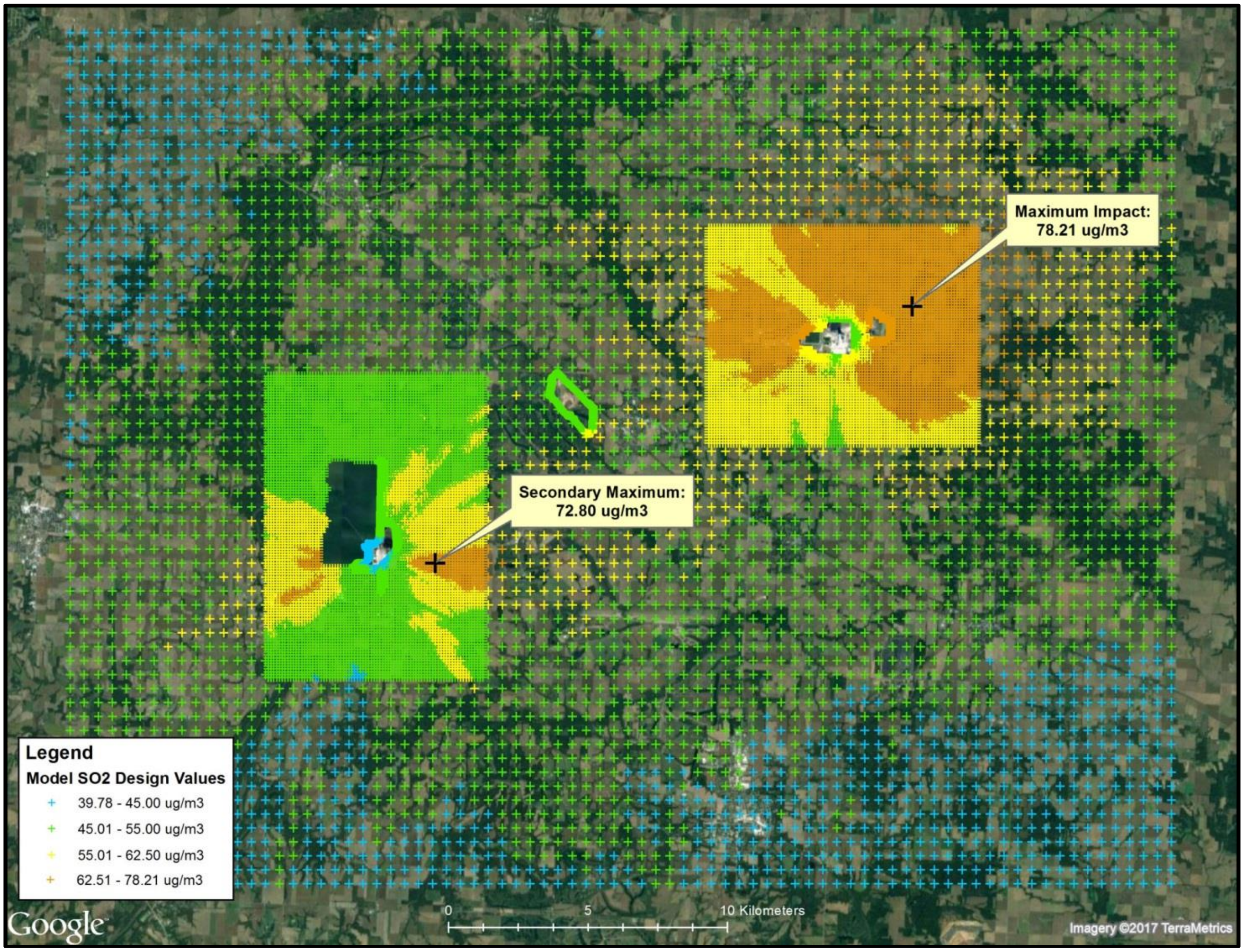
Table 15
Maximum Predicted 99^{th} Percentile 1-Hour SO_2 Design Value Concentration
Baldwin and Prairie State Generating Study Area

Averaging Period	Data Period	Receptor Location (Meters)		SO_2 Concentration ($\mu g/m^3$)	
		East	North	Modeled	NAAQS
99^{th} Percentile 1-Hour Average	2013-2015	269200	4241200	**78.21**	**196.32***

* Equivalent to the 75 ppb standard

The maximum predicted 99^{th} percentile 1-hour average concentration within the modeling domain is **78.21** $\mu g/m^3$, or 29.9 ppb, and occurred approximately 2.8 km northeast of the Prairie State Generating Station. The maximum concentration predicted downwind of the Baldwin Plant is **72.80** $\mu g/m^3$, or 27.8 ppb. The color coded contour map in Figure 26 depicts maximum predicted concentrations for each receptor in the study area and indicates the location of the predicted maximum.

Figure 26
Maximum Predicted 99th Percentile 1-Hour SO_2 Concentrations – Baldwin and Prairie State Generating Study Area



4.0 Air Quality Characterization: Ambient Monitoring

Archer Daniels Midland Company (Decatur, IL) and Tate & Lyle Ingredients Americas (Decatur, IL) had SO_2 emissions of 9,961 and 4,379 tons, respectively, in calendar year 2014. These companies have jointly requested that the air quality characterization for their facilities and surrounding area be accomplished through ambient air monitoring. The monitoring commenced by January 1, 2017, and will continue beyond January 1, 2020. This collaborative arrangement has included the development and design of a monitoring plan,[25,26,27,28] which has been approved by the Illinois EPA and USEPA Region 5. Preceding this approval, Illinois EPA responded to comments received from USEPA on the revised monitoring plan (dated July 22, 2016) in a conference call on September 13, 2016, and forwarded supplementary information requested by USEPA during the call. The monitoring network will consist of instrumentation at three locations – one site just north of the ADM - Decatur East complex (Figure 27), and the remaining two sites in proximity (a northwesterly site and a southeasterly site) to Tate & Lyle (Figures 28 and 29). The expansion of the Illinois SO_2 monitoring network to include these additional monitors was identified in the 2017 Monitoring Plan. The companies assume responsibility for the acquisition, deployment, and operation of the monitors, as well as responsibility for quality assurance/quality control, data processing, and data transmittal functions. The Illinois EPA will provide Primary Quality Assurance Organization oversight responsibilities.

[25] Preliminary Monitoring Plan – Sulfur Dioxide Monitoring to Determine 1-Hr. NAAQS Attainment Status in the Vicinity of the ADM/T&L Decatur, Illinois Facilities, Environmental Resources Management, Inc., November 6, 2015.

[26] Modeling Report - SO_2 Dispersion Modeling Analyses to Support an Ambient Air Quality Monitoring Program – Tate & Lyle (Decatur, Illinois Corn Wet Milling Plant), Archer Daniels Midland (Decatur, Illinois Decatur Complex), Environmental Resources Management, Inc., June 20, 2016.

[27] Modeling Report - SO_2 Dispersion Modeling Analyses to Support an Ambient Air Quality Monitoring Program – Tate & Lyle (Decatur, Illinois Corn Wet Milling Plant), Archer Daniels Midland (Decatur, Illinois Decatur Complex), Environmental Resources Management, Inc., Revised July 22, 2016.

[28] Decatur SO2 DRR Ambient Air Quality Monitoring Network Design, Environmental Resources Management, Inc., July, 2016.

Figure 27
ADM SO_2 and Meteorological Monitoring Location

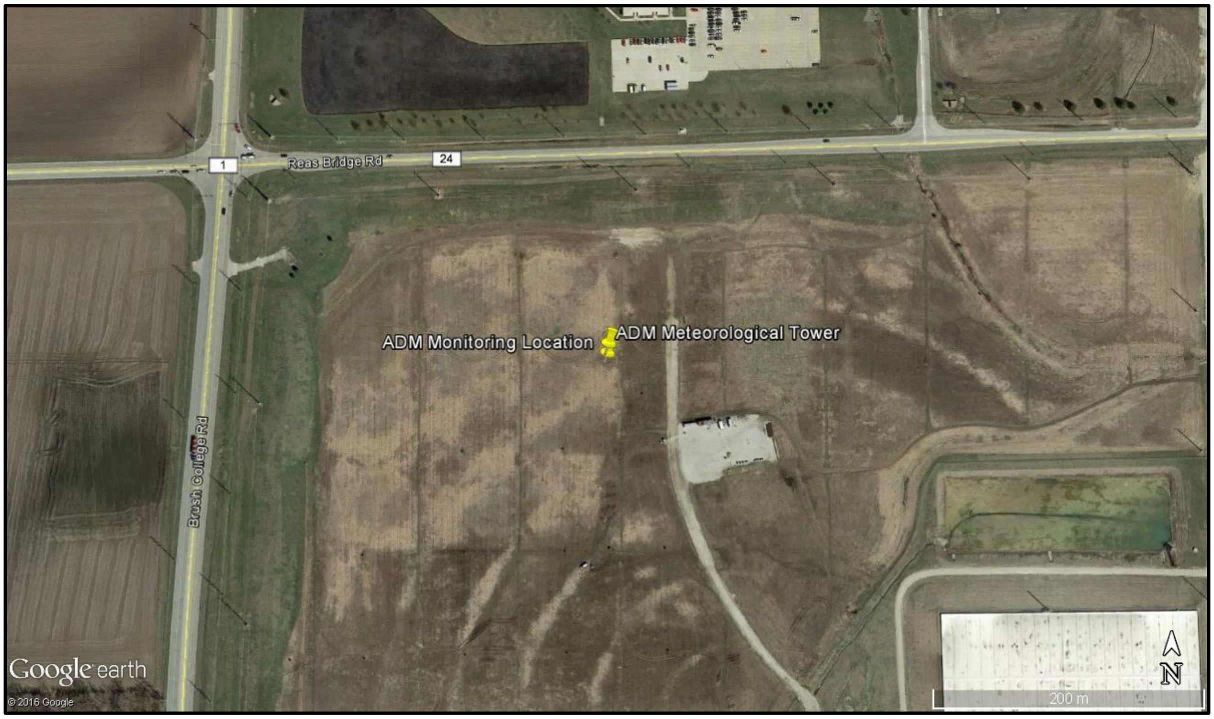
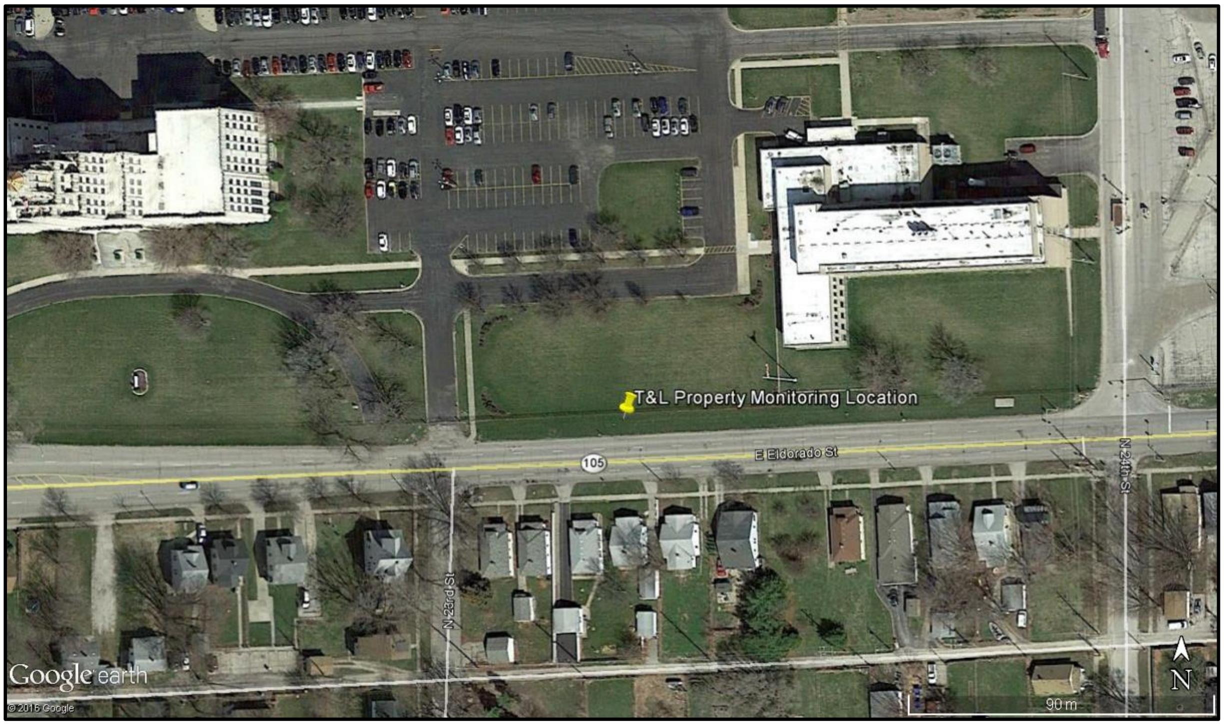


Figure 28
Tate & Lyle Off-Property Northwest SO_2 Monitoring Location

Figure 29
Tate & Lyle Southeast Fenceline SO_2 Monitoring Location



5.0 Area Designation Recommendations

Though the State of Illinois is not required by Clean Air Act section 107(d) to submit updated area designation recommendations, the DRR air quality characterization requirements provide an opportunity to supplement recommendations made previously in implementation of the 1-hour SO_2 NAAQS. In keeping with the federal guidance memorandum[29] that identifies specific considerations by which "updated recommendations and supporting information for area designations" under Round 3 are to be provided to USEPA, this document and the accompanying letter provide the necessary background and detail regarding Illinois' updated recommendations.

Similar to the "Round 2" area designation recommendations, the "Round 3" recommendations are based primarily on modeling analyses. Table 16 provides a summary of the maximum predicted 1-hour SO_2 design value concentrations for the four study areas.

[29] Memorandum from Stephen D. Page to Regional Air Division Directors, Regions 1 – 10, "Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standard – Round 3," July 22, 2016.

Table 16
Summary of the Four Study Areas
Maximum Predicted 99th Percentile 1-Hour SO_2 Design Value Concentration

Study Area	Data Period	SO_2 Concentration ($\mu g/m^3$)	
		Modeled	NAAQS
Kincaid	2013 - 2015	**64.28**	**196.32**
Rain CII		**105.01**	
Waukegan		**98.91**	
Baldwin/Prairie State		**78.21**	

The air quality characterization of the Kincaid Generation LLC electrical power generating station, and vicinity, was a multi-county modeling analysis spanning large portions of Christian and Sangamon counties and much lesser portions of Montgomery, Macoupin, and Macon counties. Within the 45-kilometer radius study domain, only three SO_2-emitting sources were considered to have the potential for causing elevated impacts, either individually or through plume interaction. The highest modeled 1-hour SO_2 design value for these three sources, in combination with an ambient background value, was less than one-third of the NAAQS. Given the widespread extent of low modeled design values, the Illinois EPA is recommending **attainment** for the multi-county area of Christian, Macoupin, Montgomery, and Sangamon counties.

The air quality characterization of the Rain CII Carbon facility and adjoining area in Crawford County, Illinois, was undertaken using a 25-kilometer radius modeling domain that also encompassed portions of neighboring Lawrence, Richland, Jasper, and Clark counties in Illinois and portions of Sullivan and Knox counties in Indiana. Modeled impacts were determined only within Crawford County and only from SO_2-emitting processes at Rain CII Carbon, Marathon Petroleum Company, and the Hoosier Energy – Merom Generating Station. The highest modeled 1-hour SO_2 design value for these three sources, in combination with an ambient background value, was slightly more than one-half of the NAAQS. The Illinois EPA is recommending a designation of **attainment** of the 1-hour SO_2 standard for Crawford County.

The air quality characterization of the NRG Energy Inc. – Waukegan Station electrical power generating plant and surrounding area involved modeling many more background sources than for other study areas. The inclusion of these sources reflects the known local interest in air quality in Lake County and the potential for combined elevated impacts from these sources. The land-based portion of the 30-kilometer radius study domain consists mostly of eastern Lake County, a small portion of Cook County, and a large portion of neighboring Kenosha County in Wisconsin. Modeled impacts were generated for a large area of eastern Lake County, with the highest modeled 1-hour SO_2 design value less than one-half of the NAAQS. The Illinois EPA recommends that all of Lake County be designated as **attainment** for the 1-hour SO_2 standard.

The air quality characterization of the area surrounding the Dynegy Midwest Generation – Baldwin and Prairie State Generating Station power plants was a multi-county evaluation spanning large portions of Randolph, Washington, and St. Clair counties, and much smaller portions of Perry, Jackson, Clinton, Madison, and Monroe counties in Illinois, and Ste. Genevieve and Perry counties in Missouri. Within the 50-kilometer radius study domain, two background sources in proximity to the power plants were modeled. The inclusion of these sources provided reasonable assurance of capture of potential maximum near-field impacts. The highest modeled 1-hour SO_2 design value for all four sources, in combination with an ambient background value, was less than one-half of the NAAQS. Given the widespread extent of low modeled design values, the Illinois EPA recommends that Monroe, Randolph, St. Clair, Perry, and Washington counties be designated as **attainment** for the 1-hour SO_2 standard.

Appendices

Appendix A
Emission Inventories for the Study Areas

<u>**Kincaid Study Area Emission Inventory**</u>

AERMOD	Source Description	Receptor Location (Meters)		Stack Height	Temperature and Exit Velocity	Stack Diameter	Emissions Profile
Source ID		**East**	**North**	**(m)**	**(K and m/s)**	**(m)**	
0001KC	Stack 0001 - Auxiliary Boiler Stack (Gas Fired Kincaid)	285670.58	4385485.58	41.15	**See Hourly File**	1.22	A
0007KC	Stack 0007 - Unit 1/Unit 2 Main Stack (Boiler Unit 1-Kincaid)	285609.63	4385297.00	186.84	**See Hourly File**	9.02	A
0001CPP	Boiler #4 Stack (Rain Cap) (CPP) - Gas Fired	272584.10	4409442.21	22.86	**See Hourly File**	1.22	B
0002CPP	Boilers #1 #2 and #3 Stack (CPP) - Coal Fired	272538.09	4409435.07	50.29	**See Hourly File**	1.92	B
0006CPP	Boiler #5 Stack (Rain Cap) (CPP) - Gas Fired	272583.75	4409433.06	22.86	**See Hourly File**	1.22	B
0005CWLP	Units 31/32 Stack (CWLP)	277154.75	4403721.32	137.16	**See Hourly File**	3.96	A
0009CWLP	Dallman 3 Unit 33 Stack (CWLP)	277047.97	4403790.25	152.40	**See Hourly File**	5.03	A
0017CWLP	Dallman 4 Stack (CWLP)	276830.83	4403754.28	137.16	**See Hourly File**	4.57	A

A: CEMS data, hourly varying emissions, temperature, exit velocity.

B: Hourly Profile of emissions based on three years of daily emissions, a constant used for temperature and exit velocity

Rain CII Carbon Study Area Emission Inventory

AERMOD	Source Description	Receptor Location (Meters)		Stack Height	Temperature and Exit Velocity	Stack Diameter	Emissions Profile
Source ID		East	North	(m)	(K and m/s)	(m)	
0001RCII	Pyroscrubber #1 Stack	437642.68	4315969.54	45.72	**See Hourly File**	3.05	A
0003RCII	Pyroscrubber #2 Stack	437639.42	4315893.11	45.72	**See Hourly File**	3.05	A
MEROM_1	Unit 1 & 2 Stack (Merom)	455758.5	4324641.70	214.58	**See Hourly File**	5.79	B
MEROM_2	Unit 1 & 2 Stack (Merom)	455765.5	4324641.40	214.58	**See Hourly File**	5.79	B
HTR_1F1	Atmospheric Heater 1F1 (Marathon)	437504.23	4316843.68	55.78	**See Hourly File**	3.66	B
HTR_1F2	Vacuum Distillation Heater 1F2	437464.99	4316834.33	57.91	**See Hourly File**	2.24	C
HTR_2F1	Reactor Heater 2F1	437420.03	4316847.93	38.10	**See Hourly File**	1.04	C
HTR_2F2	Stripper Reboiler 2F2	437400.68	4316849.62	39.62	**See Hourly File**	1.47	C
HTR_3F1	Reactor Preheaters 3F1	437422.97	4316691.16	63.09	**See Hourly File**	3.86	C
HTR_3F2	Reactor Preheaters 3F2	437422.97	4316691.16	63.09	**See Hourly File**	3.86	C
HTR_3F3	Reactor Preheaters 3F3	437422.00	4316680.87	46.63	**See Hourly File**	2.79	C
HTR_3F4	Reactor Preheaters 3F4	437422.00	4316680.87	46.63	**See Hourly File**	2.79	C
HTR_3F7	Ultraformer Regen. Heater 3F7	437392.76	4316700.60	30.48	**See Hourly File**	0.91	C
HTR_4F1	Hydrotreater Reactor Heater 4F1	437350.90	4316850.43	38.10	**See Hourly File**	1.42	C
HTR_4F2	Hydrocracker Reactor Heater 4F2	437350.60	4316843.46	38.100	**See Hourly File**	1.42	C
HTR_4F3	Splitter Reboiler 4F3	437350.90	4316836.48	37.790	**See Hourly File**	1.60	C
HTR_4F4	Debutanizer Reboiler 4F4	437351.21	4316828.59	38.100	**See Hourly File**	1.60	C
HTR_7F1	HF Alkyl. Isostripper Reb. 7F1	437153.20	4316860.94	42.977	**See Hourly File**	2.74	C
HTR_8F1	Debutanizer Reboiler 8F1	437128.74	4316648.29	38.100	**See Hourly File**	1.52	C

HTR16F1	Naphtha 16F1 Reboiler 16F2 Plat 16F4	437113.40	4316976.46	67.056	**See Hourly File**	1.93	C
HTR16F2	Naphtha 16F1 Reboiler 16F2 Plat 16F4	437113.40	4316976.46	67.056	**See Hourly File**	1.93	C
HT16F3A	Platformer Interheaters 16F3	437125.44	4316895.69	78.03	**See Hourly File**	3.07	C
HT16F3B	Platformer Interheaters 16F3	437125.44	4316895.69	78.03	**See Hourly File**	3.07	C
HT16F3C	Platformer Interheaters 16F3	437125.44	4316895.69	78.03	**See Hourly File**	3.07	C
HT16F3D	Platformer Interheaters 16F3	437125.44	4316895.69	78.03	**See Hourly File**	3.07	C
HTR16F4	Naphtha 16F1 Reboiler 16F2 Plat 16F4	437113.40	4316976.46	67.06	**See Hourly File**	1.93	C
HTR23F1	Debutanizer Reboiler 23F1	437255.52	4316649.80	35.97	**See Hourly File**	1.60	C
HTR42F1	Benzene Removal Unit Heater 42F1	437329.58	4316647.91	50.29	**See Hourly File**	2.08	C
HT69F1A	DHT Charge Heater 69F1A	437197.81	4317060.77	76.20	**See Hourly File**	1.37	C
HT69F1B	HT Charge Heater 69F1B	437198.62	4317049.24	76.20	**See Hourly File**	1.37	C
HTR69F2	DHT Fractionator Reboiler 69F2	437198.75	4317036.21	76.20	**See Hourly File**	1.88	C
HTR74F1	Gasoline Desulfurizer Feed Heater 74F1	437303.28	4317177.94	45.42	**See Hourly File**	1.47	C
HTR74F2	Gasoline Desulfurizer Reboiler 74F2	437303.46	4317167.91	45.42	**See Hourly File**	2.29	C
HTR77F1	Penex Isom Heater 77F1	437249.36	4317100.14	28.04	**See Hourly File**	1.22	C
HTR77F2	Penex Isom Reboiler 77F2	437248.94	4317154.46	14.63	**See Hourly File**	0.91	C
HTR82F2	FCCU Feed Preheater 82F2	437248.81	4316901.24	45.72	**See Hourly File**	2.06	C
H87F103	Special Coker Heater 87F103	437451.39	4317026.97	45.72	**See Hourly File**	1.75	C
HTR90F1	Regular Coker Heater 90F1	437438.02	4317118.67	38.10	**See Hourly File**	2.90	C

HTR90F2	Regular Coker Preheater 90F2	437433.39	4317098.87	40.23	**See Hourly File**	1.22	C
HT90F41	90F41	437438.02	4317118.67	44.20	**See Hourly File**	2.21	C
BOILER_3	Boiler 3 59F3	437126.91	4317134.56	34.14	**See Hourly File**	1.83	C
BOILER_4	Boiler 4 59F4	437137.09	4317134.34	34.14	**See Hourly File**	1.83	C
BOILER_6	Boiler 6 59F6	437159.02	4317128.36	32.31	**See Hourly File**	1.52	C
FCCU	FCCU CO Boiler/FGSS 60F1	437280.13	4316886.45	60.96	**See Hourly File**	2.74	C
SRU_66F3	SRU Thermal Oxidizer 66F3	437273.00	4316993.00	45.72	**See Hourly File**	1.63	B
SRU_66F5	SRU Thermal Oxidizer 66F5	437251.23	4316983.61	45.72	**See Hourly File**	1.68	B
FLARE_1	Flare #1	438084.35	4316922.30	139.90	**See Hourly File**	18.01	D
FLARE_2	Flare #2	437375.72	4317068.40	139.90	**See Hourly File**	18.01	D
FLARE_3	Flare #3	437225.45	4316460.75	139.90	**See Hourly File**	18.01	D
FLARE_4	New Flare #4	437243.46	4316421.95	152.10	**See Hourly File**	18.01	D
FLARE_5	Flare #5	438160.28	4316921.26	139.90	**See Hourly File**	18.01	D
FLARE_6	Flare #6	438153.00	4317044.00	155.14	**See Hourly File**	18.01	D
YORKFP_N	York Pond Fire Pump (North)	438891.84	4317656.51	4.57	**See Hourly File**	0.15	E
YORKFP_S	York Pond Fire Pump (South)	438887.24	4317646.34	5.18	**See Hourly File**	0.15	E
DIESFP_S	Diesel Fire Pump (South)	438002.55	4316902.03	3.66	**See Hourly File**	0.15	E
DIESELFP	Diesel Fire Pump	437531.76	4316267.64	2.59	**See Hourly File**	0.22	E
STORM_PE	Stormwater Pump Engine	438051.89	4316995.22	3.66	**See Hourly File**	0.15	E
YP24GE18	York Pond Pump	438866.95	4317593.36	5.00	**See Hourly File**	0.15	E

A: Company provided hourly varying emissions and temperature, and invariant exit velocity (from stack tests).

B: CEMS data, hourly varying emissions, temperature, exit velocity.

C: Derived from hourly heat input rates in combination with fuel gas emission factors (determined from continuous emission monitoring of H_2S in refinery fuel gas) provided the basis of the hourly emissions.

D: SO_2 emission estimates for flaring reflect the H_2S content of the gases flared and the quantity of gas being flared.

E: Day-specific operational data were provided for the stationary engines (fire pumps) at Marathon, and together with SO_2 emission rates developed from stack testing data and horsepower ratings, a particular engine's emissions were allocated uniformly across all hours of each specific day of operation.

Waukegan Study Area Emission Inventory

AERMOD	Source Description	Receptor Location (Meters)		Stack Height	Temperature and Exit Velocity	Stack Diameter	Emissions Profile
Source ID		East	North	(m)	(K and m/s)	(m)	(g/s)
0018WAU	Waukegan Power Unit #8	430011.73	4692529.25	137.16	**See Hourly File**	4.1	A
0021WAU	Waukegan Power Unit #7	433012.39	4692584.59	137.16	**See Hourly File**	4.3	A
0020WAU	Peaker Stack 1 of 4	432761.42	4692481.37	13.11	672.0/21.64	3.3	B
0069WAU	Peaker Stack 2 of 4	432762.09	4692508.58	13.11	672.0/21.64	3.3	B
0070WAU	Peaker Stack 3 of 4	432788.52	4692508.27	13.11	672.0/21.64	3.2	B
0071WAU	Peaker Stack 4 of 4	432787.89	4692481.06	13.11	672.0/21.64	3.3	B
PP_01	Pleasant Prairie Unit 1/2 Stack	425857.0	4709911.0	137.200	**See Hourly File**	3.50	A
PP_02	Pleasant Prairie Unit 1/2 Stack	425857.0	4709910.0	137.200	**See Hourly File**	3.50	A
0123ABBV	Biogas flare (Abbvie, Inc.)	431272.7	4687130.2	13.4627	1273.0/20.0	0.68	B
0086ABL	Boiler #4AP (Abbott Labs)	425854.3	4683793.7	32.949	428.7/8.07	1.83	B
0087ABL	Boiler #5AP (Abbott Labs)	425849.5	4683800.9	32.949	424.8/8.19	1.83	B
0006ABL	Boiler #6AP (Abbott Labs)	425858.05	4683791.54	21.708	505.4/7.92	1.22	C
0063ABL	Boiler #7AP 9abbott Labs)	425831.27	4683824.28	210.976	422.0/7.81	1.22	C
0001AD	Landfill Gas Flare Enclosed Stack - (Adv Disposal Services Zion)	427387.1	4703452.0	18.290	1273.0/20/0	3.96	B
0003CG	Turbine #1 Stack (Countryside Genco)	414962.4	4685957.6	14.940	699.8/17.0	1.00	B
0004CG	Turbine #2 Stack (Countryside Genco)	414962.5	4685963.0	14.940	699.8/17.0	1.00	B
0005CG	Turbine #3 Stack (Countryside Genco)	414962.5	4685968.6	14.940	699.8/17.0	1.00	B
0006CG	Turbine #4 Stack (Countryside Genco)	414962.5	4685974.3	14.940	699.8/17.0	1.00	B
0001CL	Callidus Enclosed Flare (Countryside Landfill)	415403.8	4685577.3	13.720	1273.0/20/0	3.81	B
0007CL	Parnel Enclosed Flare (Countryside Landfill)	415432.5	4685586.4	15.240	1273.0/20.0	3.81	B
0001BE	Engine #1 Stack (Bio Energy Illinois LLC)	427390.6	4703495.5	9.997	738.15/26.5	0.36	B

0002BE	Engine #2 Stack (Bio Energy Illinois LLC)	427390.6	4703490.6	9.997	738.15/26.5	0.36	B
0003BE	Engine #3 Stack (Bio Energy Illinois LLC)	427390.4	4703485.7	9.997	738.15/26.5	0.36	B
0004BE	Engine #4 Stack (Bio Energy Illinois LLC)	427390.4	4703480.3	9.997	738.15/26.5	0.36	B
0005BE	Engine #5 Stack (Bio Energy Illinois LLC)	427390.3	4703475.4	9.997	738.15/26,5	0.36	B
0001NGC	Rock dryer stack (New NGC)	432147.1	4690868.0	9.449	355.4/20.2	0.76	D
0008NGC	Board kiln stack #1 of 3 (New NGC)	432222.5	4690757.8	13.411	422.0/10.8	0.91	D
0027NGC	Board kiln stack #2 of 3 (New NGC)	432227.1	4690704.0	13.411	422.0/10.8	0.91	D
0028NGC	Board kiln stack #3 of 3 (New NGC)	432230.0	4690654.1	13.411	422.0/10.8	0.91	D
0022NGC	Calcidyne Units stack #1 (New NGC)	432241.8	4690944.4	24.689	449.8/22.6	0.33	D
0029NGC	Calcidyne Units stack #2 (New NGC)	432241.8	4690941.0	24.689	449.8/22.6	0.33	D
0030NGC	Calcidyne Units stack #3 (New NGC)	432242.3	4690937.6	24.689	449.8/22.6	0.33	D
0031NGC	Calcidyne Units stack #4 (New NGC)	432242.4	4690934.2	24.689	449.8/22.6	0.33	D
0025NGC	#5 Calcidyne unit stack (New NGC)	432244.3	4690929.2	27.127	449.8/14.9	0.41	D

A: CEMS data, hourly varying emissions, temperature, exit velocity.

B: Hourly Profile of Emissions based on seasonal operation/throughput from AERs, invariant temperature/exit velocity.

C: Used EMISFACT function in model, emissions vary by season, applied worst-case emissions year to all years.

D: Hourly Profile based on worst-case emissions year and seasonal throughput, conservatively applied to each year.

Baldwin/Prairie State Generating Study Area Emission Inventory

AERMOD	Source Description	Receptor Location (Meters)		Stack Height	Temperature and Exit Velocity	Stack Diameter	Emissions Profile
Source ID		East	North	(m)	(K and m/s)	(m)	(g/s)
0001BD	Boiler #1 (Baldwin)	249934.19	4232425.13	184.40	**See Hourly File**	5.94	A
0002BD	Boiler #2 (Baldwin)	249931.24	4232363.94	184.40	**See Hourly File**	5.94	A
0013BD	Boiler #3 (Baldwin)	249928.04	4232301.51	184.40	**See Hourly File**	5.94	A
0005BD	Heating Boiler (Baldwin)	250017.08	423244.00	84.12	**See Hourly File**	1.07	B
0004PS	EP10A Boiler #1 (Prairie St.)	266714.30	4240167.70	213.36	**See Hourly File**	8.53	A
0006PS	EP10A Boiler # 2 (Prairie St.)	266725.10	4240167.30	213.36	**See Hourly File**	8.53	A
0006USM	ROTARY DRYER #4 FUEL OIL COMBUSTION (US Minerals)	250168.25	4231328.50	7.62	**See Hourly File**	2.19	C
0002CH	Flare (Cottonwood)	256967.25	4238205.70	17.75	**See Hourly File**	2.43	C
0005PS	Auxiliary Boiler (Prairie St.)	266583.30	4239848.58	30.48	425.00/20.00	1.52	D
0004CH	Crusher (Cottonwood)	256530.90	4238479.80	6.10	493.71/19.22	0.46	D

A: CEMS data, hourly varying emissions, temperature, exit velocity.
B: Hourly emissions profile based on data provided by company from monthly fuel usage and monthly operating hours.
C: Hourly Profile of emissions based on seasonal operation/throughput from AERs.
D: Hourly Profile based on worst-case emissions year and seasonal throughput, conservatively applied to each year.

Appendix B
Background SO_2 Data for Modeling

Nilwood*, Illinois Monitor
Seasonally and Hourly Varying Background SO_2**
Kincaid & Rain CII Carbon Study Areas

Hour of Day	SO_2 Concentration ($\mu g/m^3$)			
	Winter	Spring	Summer	Fall
1	7.68	5.58	5.41	5.41
2	7.50	4.80	5.93	5.50
3	7.68	4.54	4.19	6.37
4	6.89	5.58	6.11	5.32
5	7.68	4.54	5.24	6.28
6	7.59	5.76	6.46	6.37
7	7.59	5.32	6.89	6.28
8	7.50	8.38	8.90	6.81
9	9.07	10.91	9.16	9.77
10	14.75	10.73	9.42	9.16
11	15.44	13.70	10.82	12.65
12	15.09	12.56	9.42	12.56
13	14.13	11.60	7.68	11.78
14	13.52	10.30	8.46	9.51
15	13.52	9.51	8.55	8.46
16	12.04	9.07	6.19	8.64
17	11.43	7.33	5.85	7.77
18	10.12	6.72	5.24	6.72
19	8.20	6.54	4.97	6.72
20	9.51	4.80	4.97	6.37
21	9.60	5.32	4.89	6.46
22	7.85	5.06	4.10	7.15
23	7.50	4.36	4.10	6.54
24	7.68	4.36	4.80	5.93

* Monitor Latitude/Longitude Coordinates: (+39.396075 –89.80974)
** Seasons defined as: Winter (Dec, Jan, Feb), Spring (Mar, Apr, May), Summer (Jun, Jul, Aug), Fall (Sep, Oct, Nov)

Oglesby*, Illinois Monitor

Seasonally and Hourly Varying Background SO_2**

<u>Waukegan Study Area</u>

Hour of Day	SO_2 Concentration (μg/m^3)			
	Winter	Spring	Summer	Fall
1	5.76	6.63	4.62	5.85
2	6.46	8.03	5.06	5.24
3	5.24	8.20	3.32	4.45
4	5.76	6.72	2.44	4.80
5	6.72	5.76	1.92	7.15
6	6.98	7.15	2.27	7.85
7	6.46	6.28	4.10	6.11
8	7.85	8.46	8.03	5.50
9	9.69	10.91	10.47	6.19
10	12.22	11.52	10.56	9.77
11	12.74	11.95	10.21	11.78
12	14.13	12.91	6.72	10.30
13	15.09	9.95	7.68	8.20
14	15.01	9.95	7.50	8.38
15	12.22	8.03	6.46	7.50
16	11.26	7.24	5.85	6.98
17	10.64	8.46	6.37	7.33
18	9.95	7.42	6.37	7.24
19	9.25	9.77	7.59	4.71
20	8.29	7.85	4.62	7.33
21	8.81	9.16	4.28	7.68
22	7.15	10.38	4.97	6.89
23	6.72	8.20	4.97	4.97
24	6.54	6.72	3.93	5.50

* Monitor Latitude/Longitude Coordinates: (+41.29301 -89.04942)

** Seasons defined as: Winter (Dec, Jan, Feb), Spring (Mar, Apr, May), Summer (Jun, Jul, Aug), Fall (Sep, Oct, Nov)

East St. Louis*, Illinois Monitor
Seasonally and Hourly Varying Background SO_2**
Baldwin/Prairie State Generating Station

Hour of Day	SO_2 Concentration ($\mu g/m^3$)			
	Winter	Spring	Summer	Fall
1	21.73	14.57	7.50	10.56
2	17.28	11.87	18.32	11.08
3	9.60	13.26	17.63	14.40
4	11.26	17.36	12.91	12.13
5	12.13	22.34	13.79	11.43
6	10.38	13.44	10.30	9.25
7	9.60	17.71	11.69	11.43
8	12.83	15.53	19.98	21.81
9	14.48	16.93	31.85	22.95
10	19.98	23.12	27.05	34.29
11	28.53	27.75	24.78	25.83
12	23.03	19.54	19.54	19.89
13	31.32	16.40	18.67	16.23
14	24.26	15.97	17.10	19.98
15	19.02	16.75	15.01	15.71
16	18.15	13.79	17.71	14.22
17	17.89	17.63	12.91	13.79
18	18.06	14.40	13.52	14.57
19	15.71	14.57	10.64	12.48
20	10.38	12.22	9.51	9.16
21	10.56	10.47	14.57	7.07
22	14.83	9.51	9.34	9.86
23	17.54	9.95	8.29	7.24
24	28.10	13.87	8.81	7.94

* Monitor Latitude/Longitude Coordinates: (+38.61203 -90.16048)
** Seasons defined as: Winter (Dec, Jan, Feb), Spring (Mar, Apr, May), Summer (Jun, Jul, Aug), Fall (Sep, Oct, Nov)