# AIR DISPERSION MODELING REPORT
# WILSON STATION
# $SO_2$ DESIGNATION ANALYSIS
# REVISION 1

**Prepared for:**
Mark Bertram
Manager, Environmental
Big Rivers Electric Corporation
201 Third Street
Henderson, KY 42420

**Prepared By:**
TRINITY CONSULTANTS
1717 Dixie Highway
Suite 900
Covington, Kentucky 41011

Project 151801.0045

August 25, 2015

Trinity Consultants

*Environmental solutions delivered uncommonly well*

# TABLE OF CONTENTS


**1. EXECUTIVE SUMMARY** 1-3

**2. INTRODUCTION** 2-0

- **2.1. Facility Information** ........ 2-0
- **2.2. Basis for Analysis** ........ 2-1
- **2.3. Regulatory Background** ........ 2-2
- **2.4. Emission Rates for Wilson Station** ........ 2-3

**3. 1-HOUR $SO_2$ DESIGNATION MODELING METHODOLOGY** 3-0

- **3.1. Model Selection** ........ 3-0
- **3.2. Rural Urban Option in AERMOD** ........ 3-1
- **3.3. Meteorological Data** ........ 3-3
  - *3.3.1. Surface Data* ........ 3-4
  - *3.3.2. Upper Air Data* ........ 3-5
  - *3.3.3. Land Use Analysis* ........ 3-5
- **3.4. Coordinate System** ........ 3-6
- **3.5. Receptor Locations** ........ 3-6
- **3.6. Terrain Elevations** ........ 3-9
- **3.7. Wilson Station Emission Sources** ........ 3-10
- **3.8. Other Source Inventory** ........ 3-11
- **3.9. Building Influences** ........ 3-13
- **3.10. Source Contributions** ........ 3-13
- **3.11. Background Concentrations** ........ 3-13
- **3.12. Modeling Files** ........ 3-15

**4. 1-HOUR $SO_2$ DESIGNATION MODELING RESULTS** 4-1

# LIST OF FIGURES


**Figure 2-1. Aerial Photograph of Wilson Station** 2-0

**Figure 2-2. Area Map of Wilson Station** 2-1

**Figure 2-3. Location of 1-hour $SO_2$ Modeling Sources in Relation to Wilson Station and Nearby Towns** 2-3

**Figure 3-1. Distribution of Land Use Within 3 km of Wilson Station** 3-2

**Figure 3-2. Meteorological Stations and $SO_2$ Monitors in the Area Near Wilson Station** 3-4

**Figure 3-3. Modeling TAD Receptor Grid Showing Example Excluded Locations Over Water** 3-7

**Figure 3-4. Innermost Portion of the Modeling Receptor Grid for Wilson** 3-8

**Figure 3-5. Overall Modeling Receptor Grid for Wilson** 3-9

**Figure 3-6. Map Showing Regional $SO_2$ Sources Near Wilson Station** 3-11

**Figure 3-7. $99^{th}$ Percentile $SO_2$ Averages by Hour of Day for Baskett Monitor (21-101-0014)** 3-15

**Figure 4-1. Spatial Display of 3-year Average $99^{th}$ Percentile Annual Distribution** 4-2

# LIST OF TABLES


**Table 3-1. Modeling TAD Urban / Rural Categories** 3-1

**Table 3-2. Wilson Station Urban/Rural Determination** 3-2

**Table 3-3. Proximity Analysis of Meteorological Stations to Wilson Station** 3-5

**Table 3-4. Moisture Calculation for Evansville Airport (inches of precipitation)** 3-7

**Table 3-5. Wilson Station Source Characterization** 3-10

**Table 3-6. Nearby Source Characterization** 3-12

**Table 4-1. Highest 4th High Modeled 1-hour SO2 Results for Comparison to the NAAQS** 4-1

# 1. EXECUTIVE SUMMARY

The Big Rivers Electric Corporation (BREC) in association with our air quality contractor, Trinity Consultants (Trinity), submits this dispersion modeling report for air quality modeling analysis that was performed with respect to BREC's D.B. Wilson Station (Wilson) and the surrounding area. This work was undertaken in support of the Kentucky Division for Air Quality (KDAQ or Division) response to the March 20, 2015 letter from the U.S. Environmental Protection Agency (U.S. EPA) to Commissioner Scott of the Kentucky Department for Environmental Protection (KDEP) regarding designations of areas currently unclassified with respect to the 2010 1-hour $SO_2$ National Ambient Air Quality Standard (NAAQS). In that letter, U.S. EPA identified the Wilson Station as one of the Kentucky sources meeting the criteria for evaluation of unclassified areas in the first round of designations through modeling as part of a required response by U.S. EPA to the recent Sierra Club vs. Regina McCarthy Consent Decree[1]. Wilson was also identified on the U.S. EPA website listing all areas where designations would be required under the consent decree by the July 2, 2016 date[2]. The criteria to determine if a source was subject to the Consent Decree are: 1) a nearby monitor showing a violation, and 2) that an area contain a 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 lbs $SO_2$/MMBtu in 2012. According to EPA's Air Markets Database, the Wilson Station emitted 7,387 tons $SO_2$ in 2012 and had an average $SO_2$ emission rate of 0.45 lbs $SO_2$/MMBtu in 2012. Wilson Station is located on State Highway 85 just east of Island, Kentucky in Ohio County.

Just after the Consent Decree was signed, U.S. EPA stated that it would base the designation of the Ohio County and surrounding area on the emission criteria alone (Criteria No. 2) as no $SO_2$ monitors are in the area. However, U.S. EPA invited state agencies to submit updated recommendations and supporting information that could be considered in the final designations. To that end, BREC commissioned this modeling analysis to aid KDEP/KDAQ in the designation determination for the Ohio County area. This modeling was designed to meet the requirements of U.S. EPA's modeling Technical Assistance Document for $SO_2$ NAAQS designation modeling guidance[3] (Modeling TAD).

To that end, dispersion modeling was conducted following the TAD guidance. As allowed by the guidance, an allowable emission rate was used for the Wilson Station as a surrogate for actual emissions. Commensurate with these allowable limits, a Good Engineering Practice (GEP) stack height was used (the use of the actual stack height is permissible under the TAD if actual emissions were used). Nearby sources were considered within the TAD-suggested 20 km range of Wilson but also out to 50 km to allow comprehensive consideration of large nearby sources. Of these the Green River Station, 10 km to the south of Wilson has announced shut down of their units by April 2016; the TVA Paradise Station about 22 km to the southeast of Wilson has announced shut down of Units 1 and 2 by April 2016 leaving Unit 3 to be included in the modeling; several facilities at about 40-50 km to the northwest of Wilson were distant enough to fall outside of the TAD general consideration guidance and were likely captured as part of the regional, rural background concentration. Given this strategy and characterization of sources affecting air quality in the Ohio County area, modeling performed demonstrated that ambient concentrations in the area would be below the 3-year average of the $99^{th}$ percentile of the annual distribution of daily maximum 1-hr concentrations which is the form of the 1-hour $SO_2$ NAAQS. Therefore, this modeling demonstrates that the area will be considered for designation as attainment.

---

[1] *Order Granting Joint Motion to Approve and Enter Consent Decree and Denying Other Motions as Moot*, Sierra Club et. al. v. Regina McCarthy, Administrator of the United States Environmental Protection Agency, United States District Court, Northern District of California, Docket Nos. 120, 149, March 2, 2015.
[2] http://www.epa.gov/airquality/sulfurdioxide/designations/pdfs/sourceareas.pdf
[3] *$SO_2$ NAAQS Designations Modeling Technical Assistance Document*, Draft, U.S. EPA, Office of Air Quality Planning and Standards, Air Quality Assessment Division, December 2013.

This section of the modeling report provides an overview of the Wilson Station along with background information for the basis for the $SO_2$ designation modeling.

## 2.1. FACILITY INFORMATION

Big Rivers Electric Corporation (BREC) owns and operates a 417MW coal fired power plant in Centertown, KY which consists of one generating unit (EU01). This power generating unit is a pulverized coal fired boiler with a maximum continuous rating of 4,585 MMBtu/hr. The unit is equipped with multiple control devices to reduce emissions of pollutants regulated under various Federal and Commonwealth programs. The controls include: an electrostatic precipitator, low $NO_X$ burners, hydrated lime injection, wet flue gas desulfurization (WFGD), and selective catalytic reduction (SCR). This unit and other emission units (emergency generators, etc., not considered under the Consent Decree) at Wilson Station are subject to permit under the now draft Title V operating permit V-12-012 currently pending approval by KDAQ. EU01 is the only significant source of $SO_2$ emissions at Wilson station and as such EU01 is the only source represented in the modeling analysis.

The D.B. Wilson Station is located in Ohio County, approximately 3.5 miles east of the city of Island, Kentucky. An aerial photograph and area map of the facility and surrounding area are provided in Figures 2-1 and 2-2, respectively. These maps show the facility relative to predominant geographical features such as roads, rivers, and town areas as well as significant features of the property including the controlled area lines and buildings. Figure 2-1 shows the controlled area at Wilson. These figures and the locations of all emission sources, structures, and receptors in the modeling analysis are represented in the Universal Transverse Mercator (UTM) coordinate system. The datum is based on North American Datum 1983 (NAD 83). UTM coordinates for this analysis are located in UTM Zone 16. The central location of Wilson Station is approximately 492,883 meters East and 4,144,768 meters North in Zone 16 of the UTM system.

**Figure 2-1. Aerial Photograph of Wilson Station**

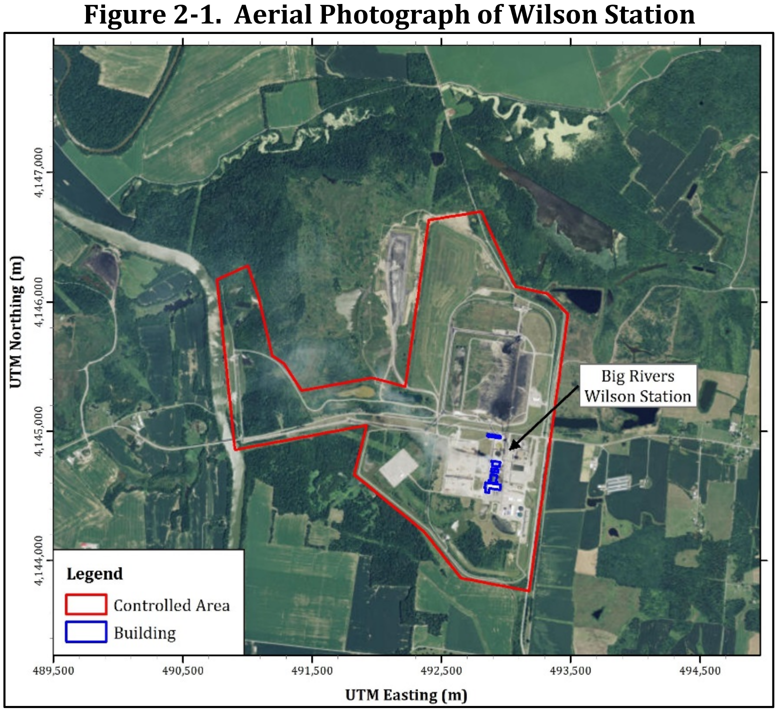
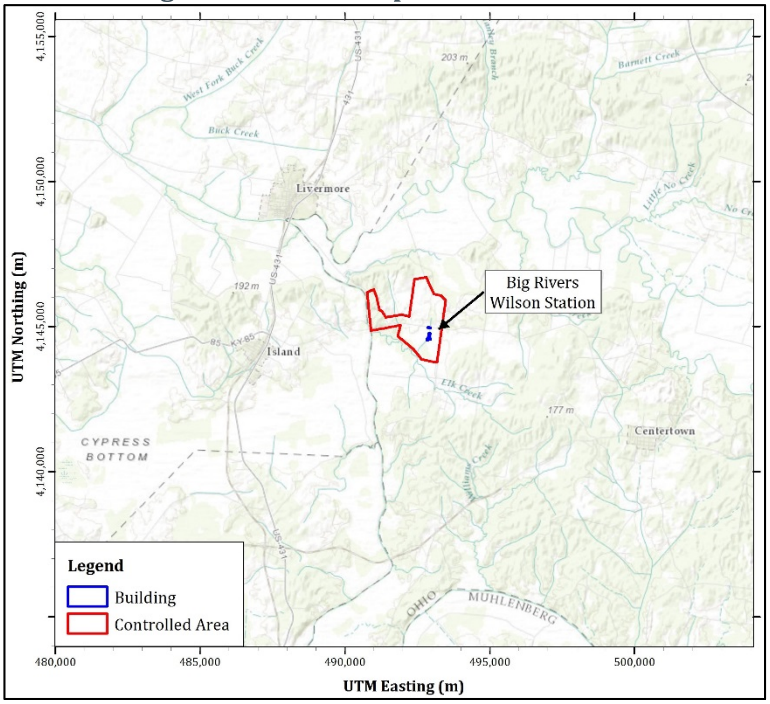


**Figure 2-2. Area Map of Wilson Station**




## 2.2. BASIS FOR ANALYSIS

Big Rivers Electric Corporation (BREC) in association with our air quality contractor, Trinity Consultants (Trinity) submits this dispersion modeling protocol for the air quality analysis that will be conducted as part of a required response to the recent enforceable Sierra Club vs. Regina McCarthy Consent Decree[4] for the first round of unclassified areas subject to the 2010 1-hour $SO_2$ National Ambient Air Quality Standard (NAAQS). The BREC facility that falls under this requirement is the D.B. Wilson Station on State Highway 85 located in Ohio County, Kentucky just east of Island, Kentucky. The area in the vicinity of Wilson Station possibly including some or all of Ohio County and because of its proximity may include portions of McLean and Muhlenberg Counties, is required to be designated as attainment or nonattainment according to an accelerated schedule as compared to the Data Requirements Rule (DRR) schedule (promulgated August 10, 2015)[5].

Under the $SO_2$ Data Requirements Rule (prior to the consent decree which is not dependent on the DRR as per the consent decree), KDAQ had the option of installing a new monitor in the area around Wilson Station or performing dispersion modeling. In either case, a schedule for completion of the designations was established as December 31, 2017 for modeling and December 31, 2020 for monitoring. Under the consent decree, however, the designation of the area around the Wilson Station must be completed no later than July 2, 2016, which does not allow sufficient time for collection of three (3) years of valid data, let alone undergoing the monitor siting process.

Thus, KDAQ is required to perform dispersion modeling of the Wilson Station to determine the attainment status of the area. BREC has performed this modeling analyses and is providing the results to KDAQ to assist in the

[4] *Order Granting Joint Motion to Approve and Enter Consent Decree and Denying Other Motions as Moot*, Sierra Club et. al. v. Regina McCarthy, Administrator of the United States Environmental Protection Agency, United States District Court, Northern District of California, Docket Nos. 120, 149, March 2, 2015.
[5] *Data Requirements Rule for the 1-Hour Sulfur Dioxide ($SO_2$) Primary National Ambient Air Quality Standards (NAAQS): Proposed Rule,* Federal Register Vol. 79 No. 92, pages 27445-27472, May 13, 2014.

designation process. This modeling follows the methodology and modeling guidance from the U.S. EPA in the form of the $SO_2$ NAAQS designation modeling guidance TAD[6] and assists in KDAQ's determination of the ambient levels of $SO_2$ at the 1-hour averaging period in the area around Wilson Station. This report only covers the dispersion modeling requirement and does not cover the other items required to be included in KDAQ's consideration of the five-factor analysis components for determining the boundary of the attainment area.

## 2.3. REGULATORY BACKGROUND

The U.S. Environmental Protection Agency (U.S. EPA) is currently going through a multi-phase designation process with variable timelines with respect to the 2010 1-hour $SO_2$ National Ambient Air Quality Standard (NAAQS). The process of designating areas has been slowed considerably compared to former criteria pollutant NAAQS whereby monitoring data was the primary tool for assessing attainment/nonattainment status of areas around the country. Inadequate monitoring at a sparse number of sites does not allow this primary tool to be used as in the past. Under the current regulatory guidance and proposed rules, EPA:

- On June 2, 2010 issued a new 1-hr $SO_2$ NAAQS,
- On September 21, 2011 sought public comment on draft guidance for implementing the new NAAQS,
- May and June 2012 held stakeholder meetings with industry, trade groups, and environmental groups to ascertain the interest and concern over using dispersion modeling versus monitoring data which had been the standard methodology prior to this NAAQS;
- February 2013 developed and released white papers on the strategy for states to characterize air quality near large sources,
- August 5, 2013 designated 29 areas in 16 states as nonattainment based on monitoring,
- 2014, released a draft and final draft set of two Technical Assistance Documents (TADs) offering guidance to states on a methodology to perform modeling (modeling TAD) or to conduct source-oriented monitoring (monitoring TAD) to support a designation approach[7,8],
- May 13, 2014 released the proposed Data Requirement Rule (DRR),
- And March 2, 2015 signed the Consent Decree with Sierra Club to require certain large sources across the U.S. to undergo early consideration for designation.
- August 10, 2015 released the final Data Requirement Rule (DRR).

Following the U.S EPA's May 2014 publication of the proposed Data Requirements Rule, the U.S. EPA was sued for "failing to undertake a certain nondiscretionary duty under the Clean Air Act ("CAA"), 42 U.S.C. §§ 7401-7671q, and that such alleged failure is actionable under section 304(a)(2) of the CAA, 42 U.S.C. § 7604(a)(2)". The lawsuit resulted in the Consent Decree that was entered on March 2, 2015 in the U.S. District Court for the Northern District of California (same as that mentioned above and referenced in Footnote 1). As a result of the Consent Decree, an additional designation phase was added to the two designation phases that were already included in the U.S. EPA's May 2014 proposed Data Requirements Rule. The additional phase affects areas with stationary sources that meet specific emission criteria laid out in the Consent Decree and described above. The U.S. EPA released a memorandum on March 20, 2015 (referred to herein as the 2015 $SO_2$ Area Designation Guidance) to the Regional Directors clarifying the path forward for states with sources affected by the decree[9]. BREC is very aware of these requirements and has had informal discussions with KDAQ to determine a path forward to meet the deadlines for modeling, strategic assessment, and eventual designation of the area around the Wilson Station.

---

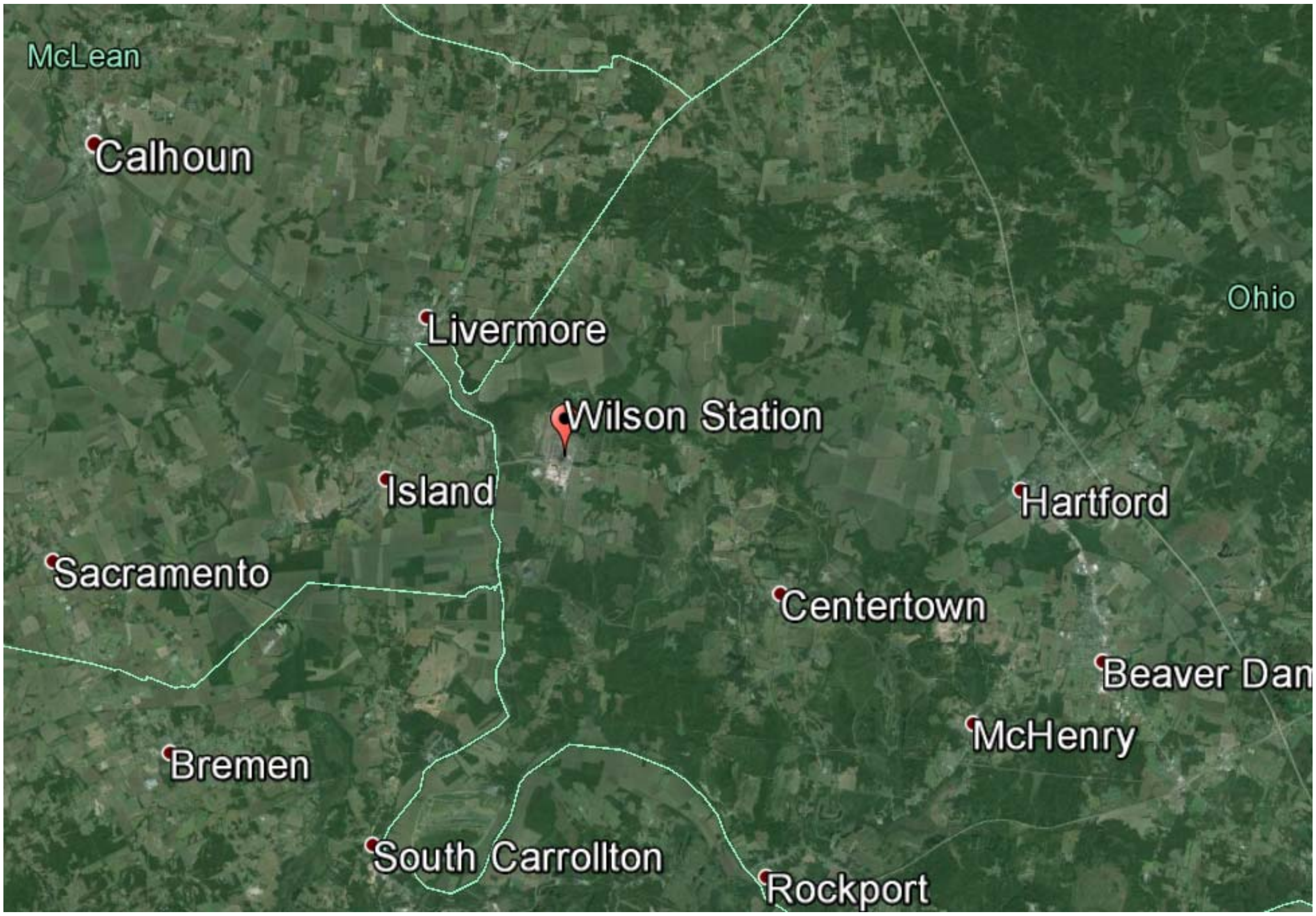
[6] Ibid.

[7] Ibid.

[8] *$SO_2$ NAAQS Designations Source-Oriented Monitoring Technical Assistance Document*, draft, U.S. Environmental Protection Agency, Research Triangle Park, NC, December 2013.

[9] *Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standard*, memorandum from Stephen Page to Regional Air division Directors, Regions 1-10, March 20, 2015.

**Figure 2-3. Location of 1-hour $SO_2$ Modeling Sources in Relation to Wilson Station and Nearby Towns**




## 2.4. EMISSION RATES FOR WILSON STATION

As discussed under Section 5.3 Allowable Emissions of the guidance provided in the modeling TAD, the dispersion modeling can be conducted either at allowable emission rate or at actual emissions preferably on an hour by hour basis. The modeling TAD states that the approach of using allowable emissions is a simpler way to perform the modeling and provide air quality impacts for the designation process. The TAD goes on to say that an air agency may choose to follow this type of approach if the conservative analysis of this type still indicates attainment for the area of interest, in this case the Ohio County area and surrounding portions of other counties. For this modeling analysis, an allowable emission rate less than the current rate was used, namely 0.85 lb $SO_2$/MMBtu rather than the current 1.2 lb $SO_2$/MMBtu. As per Section V.B.1.(b) of the proposed Data Requirements Rule, as long as this limit is agreed to and permitted by the designations process decision date of January 15, 2016 (when KDAQ has to select either a modeling or monitoring path), its consideration in the modeling is acceptable.

This modeling of the Wilson Station will allow proactive participation with KDAQ in terms of what actions can be taken and the designation of nonattainment area boundaries as described in the March 20, 2015 guidance memorandum. This dispersion modeling, thus, is the appropriate tool for designating attainment status of the area.

# 3. 1-HOUR $SO_2$ DESIGNATION MODELING METHODOLOGY

As prescribed by the EPA in the Data Requirements Rule and modeling TAD, dispersion modeling was used to evaluate the attainment status of the area in the vicinity of the BREC Wilson Station. EPA's rationale for allowing the use of dispersion modeling rather than requiring new $SO_2$ monitors to be established are that $SO_2$ sources are limited in distance to where ambient concentration impacts occur and thus, modeling is applicable and representative. In preparation for providing modeling guidance for designation analysis, EPA reviewed $SO_2$ ambient monitoring and modeling of concentrations around and near $SO_2$ sources and found that most of the highest impacts fall within a few 10's of kilometers for large sources and a few kilometers for smaller sources. Also of note was that the gradient of these concentrations falls off significantly after the maximum is reached. Thus, this modeling focused on the use of appropriate computational methods such that EPA's primary preferred industrial source model, the AERMOD Model, is the primary model recommended for use. In addition to AERMOD and to allow the best representation of simulated ambient air concentrations, the modeling TAD recommends:

- Using actual emissions as an input for assessing violations to provide results that reflect current actual air quality (i.e., modeling that simulates a monitor) or use allowable emissions which will result in a more conservative estimate of actual ambient air impacts of the source;
- Using three years of modeling results to calculate a simulated design value consistent with the 3-year monitoring period required to develop a design value for comparison to the NAAQS;
- Placing receptors for the modeling only in locations where a monitor could be placed; and
- Using actual stack heights rather than following the Good Engineering Practice (GEP) stack height policy when using actual emissions and the GEP stack height when using allowable emissions.

Following these modeling guidelines for DRR modeling, dispersion modeling was performed for the Wilson Station and the area around it. The remainder of this section provides an overview of the modeling that was followed for the Wilson Station which was approved by KDAQ[10] in the modeling protocol[11] submitted for Wilson Station modeling.

## 3.1. MODEL SELECTION

Modeling was performed for 1-hour $SO_2$ analysis using the AERMOD Model in its most current version at the time of the modeling. The current applicable version is Version 15181 which released by U.S. EPA on July 24, 2015. U.S. EPA also released an updated proposed version of its modeling guidance in the form of the *Guideline on Air Quality Models*[12] about that same time. This proposed guidance and enhanced AERMOD model has new beta options that are expected to affect the outcome of designation modeling with respect to some of the low wind options (LOWWIND) in the model. As of the release of the proposed Guideline, the options remained beta and were subject to scrutiny at the U.S. EPA Regional and Clearinghouse level prior to use. These options were not used in this modeling for the Wilson Station.

Of the options in the AERMOD Model, the following were selected. The pollutant identification was set to "$SO_2$" in AERMOD, which allowed additional internal model options to be available thus enabling the output options to

[10] Letter from Ben Cordes, Supervisor, Air Dispersion Modeling Section to Mark Bertram, Big River Electric Corporation, July 15, 2015.
[11] *Air Dispersion Modeling Protocol Wilson Station So2 Designation Analysis*, prepared for Big Rivers Electric Corporation, prepared by Trinity Consultants, Covington, Kentucky, June 12, 2015.
[12] *Guideline on Air Quality Models*. Appendix W to 40 CFR Parts 51 and 52. Federal Register, November 9, 2005. pp. 68217-68261.

be configured properly for $SO_2$. Because of the probabilistic form of the 1-hour NAAQS, selecting these correct input options allowed AERMOD to properly calculate an $SO_2$ design value based on the 3-year average of the 99$^{th}$ percentile of the annual distribution of the daily maximum 1-hour concentrations for comparison with the 1-hour $SO_2$ NAAQS of 75 ppb (196 μg/m$^3$).

## 3.2. RURAL URBAN OPTION IN AERMOD

As stated by Section 6.3, Urban/Rural Determination of the modeling TAD, for any dispersion modeling exercise for $SO_2$, the "urban" or "rural" determination of the location surrounding the subject source is important in determining the applicable boundary layer characteristics that affect a model's calculation of ambient concentrations as well as the possible invocation of AERMOD's 4-hour half-life. Thus, a determination was made of whether the area around the Wilson Station was urban or rural.

The first method discussed in the modeling TAD (also referred therein to Section 7.2.3c of the Guideline on Air Quality Models, Appendix W) was used to determine the urban or rural status of the area around Wilson. This is the so-called "land use" technique because it examines the various land use within 3 km of Wilson and quantifies the percentage of area in various land use categories. Following this guidance, 2011 land use data (most recent available) were obtained from the U.S. Geological Survey[13] through ArcGIS and a 3 km radius circle inscribed electronically around the Wilson stack coordinates. All data were georeferenced and tabulated using the categories shown in Table 3.1 for urban and rural designation.

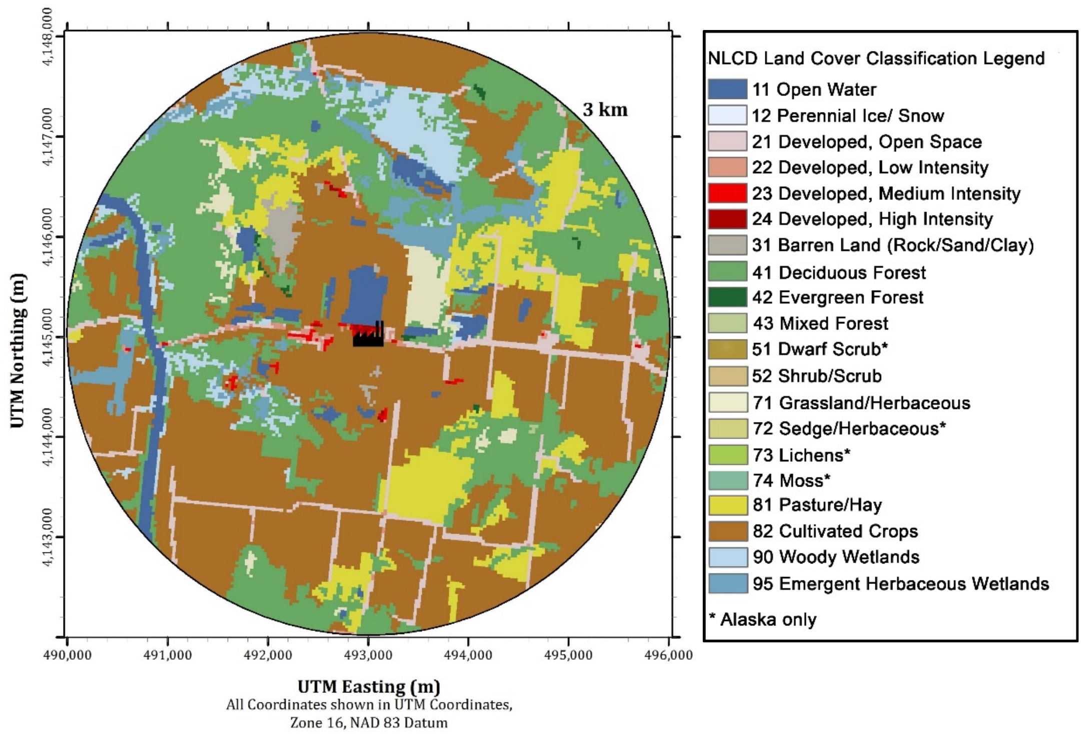
**Table 3-1. Modeling TAD Urban / Rural Categories**

| 2011 NLCD Land Cover Classification | | Auer Land-Use Classification | | Modeling TAD Rural or Urban |
|---|---|---|---|---|
| 11 | Open Water | A5 | Water Surfaces | rural |
| 12 | Perennial Ice/Snow | A5 | Water Surfaces | rural |
| 21 | Developed, Open Space | A1 | Metropolitan Natural | rural |
| 22 | Developed, Low Intensity | R1 | Common Residential | rural |
| 23 | Developed, Medium Intensity | I1, I2, C1, R2, R3 | Industrial/Commercial/Compact Residential | urban |
| 24 | Developed, High Intensity | I1, I2, C1, R2, R3 | Industrial/Commercial/Compact Residential | urban |
| 31 | Barren Land | A3 | Undeveloped (Grasses/Shrub) | rural |
| 41 | Deciduous Forest | A4 | Undeveloped (Wooded) | rural |
| 42 | Evergreen Forest | A4 | Undeveloped (Wooded) | rural |
| 43 | Mixed Forest | A4 | Undeveloped (Wooded) | rural |
| 52 | Shrub/Scrub | A3 | Undeveloped (Grasses/Shrub) | rural |
| 71 | Grassland/Herbaceous | A3 | Undeveloped (Grasses/Shrub) | rural |
| 81 | Pasture/Hay | A2 | Agricultural | rural |
| 82 | Cultivated Crops | A2 | Agricultural | rural |
| 90 | Woody Wetlands | A4 | Undeveloped (Wooded) | rural |
| 95 | Emergent Herbaceous Wetlands | A3 | Undeveloped (Grasses/Shrub) | rural |

Figure 3-1 shows the layout of the land use where greens, yellows and browns are farmland, forests, and grasses and red and pinks are urban areas. Table 3-2 shows the results of this land categorization process. As can be seen the area is predominantly rural by an overwhelming margin at 99.2 percent and therefore was treated as rural in the AERMOD Model.

[13] http://www.mrlc.gov/viewerjs/

## Figure 3-1. Distribution of Land Use Within 3 km of Wilson Station




## Table 3-2. Wilson Station Urban/Rural Determination

| *Percent Land Categorization ArcGIS Analysis Results for Wilson Station* | | |
|---|---|---|
| **Category ID** | **Category Description** | **Percent** |
| 11 | Open Water | 3.8% |
| 21 | Developed, Open Space | 4.3% |
| 22 | Developed, Low Intensity | 0.4% |
| 23 | Developed, Medium Intensity | 0.3% |
| 24 | Developed, High Intensity | 0.1% |
| 31 | Barren Land | 0.7% |
| 41 | Deciduous Forest | 27.3% |
| 42 | Evergreen Forest | 0.1% |
| 43 | Mixed Forest | 0.0% |
| 52 | Shrub/Scrub | 0.0% |
| 71 | Grassland/Herbaceous | 1.9% |
| 81 | Pasture/Hay | 8.9% |
| 82 | Cultivated Crops | 44.1% |
| 90 | Woody Wetlands | 4.3% |
| 95 | Emergent Herbaceous Wetlands | 3.8% |
| | Total | 100% |
| | Urban | 0.8% |
| | Rural | 99.2% |

## 3.3. METEOROLOGICAL DATA

Meteorological data was required as input to the AERMOD model to allow the characterization of the transport and dispersion of the Wilson Station $SO_2$ emissions in the atmosphere. As per the modeling TAD, three years of recent data were obtained. Onsite meteorological data was collected by BREC. A preliminary evaluation of the onsite meteorological data indicated that the 2014 data was available and thus, was evaluated for inclusion in the study. The wind instruments are located on the northwest portion of the BREC property on a cell and microwave transmission tower. The placement and disposition of the instruments were evaluated to determine if they were located such that the tower was not influencing the reading of wind speed and direction and causing any potential bias in the data prior to use. Although onsite data are generally preferred for modeling, in this case the proximity of the instrument sensors to the cell tower on which they were placed did not meet the siting criteria for such instruments which caused significant bias in the measurements. Therefore, this data was not considered further for the analysis.

Data, therefore, were obtained from the National Weather Service (NWS). The data collected was reported in three formats including surface data in both the hourly averaged format as well as the minute data and upper air (radiosonde) meteorological data. The most recent three full year data set (2012, 2013, and 2014) was obtained and processed from archived data from the most representative NWS meteorological station in the vicinity of the Wilson Station. This representativeness was determined on the basis of proximity, similarity in terms of land use (and its effect on surface roughness, albedo, and Bowen ratio), and meteorological judgement as to applicability to the Wilson Station area. Details on the data selection are provided in the following subsections.

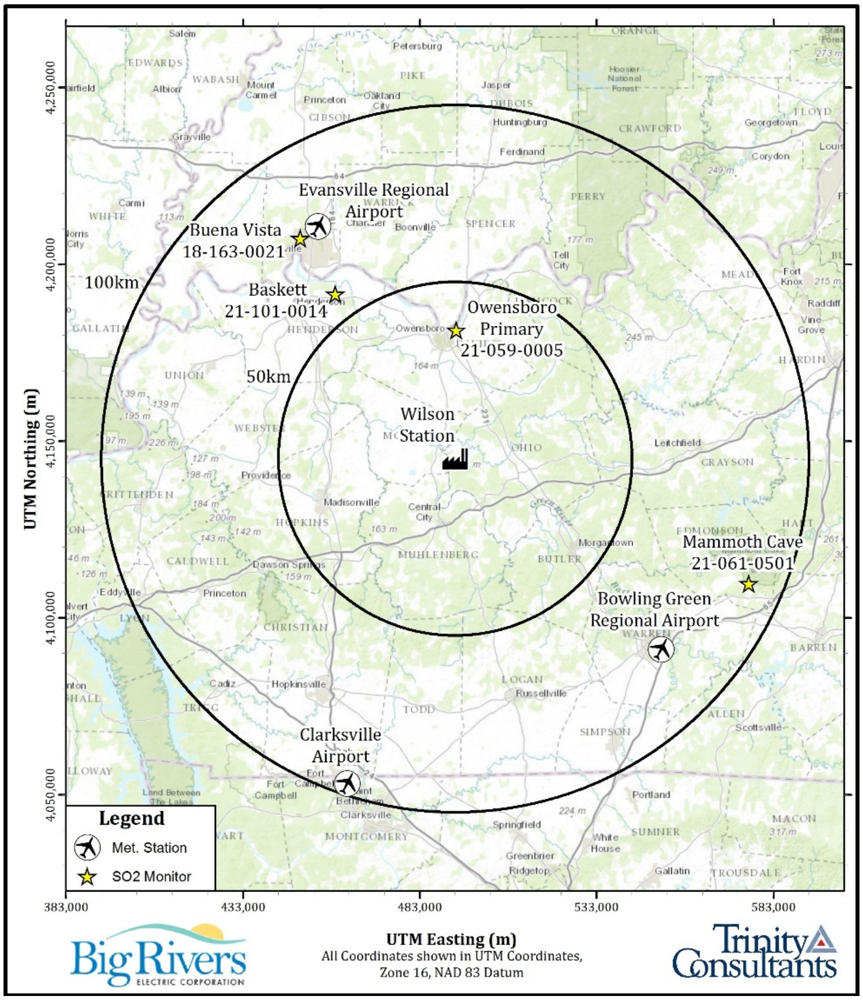
AERMOD-ready meteorological data were prepared using the latest version of the AERMET meteorological processing utility (Version 15181). Standard U.S. EPA meteorological data processing guidance was used as outlined in a recent U.S. EPA memorandum[14] as well as other AERMET and associated processor documentation.

NWS sites were located nearby and were of similar geographical setting to the Wilson Station. A preliminary evaluation of the NWS meteorological data sites within approximately 150 km indicated that several airports were located in the region. Several of these were smaller airports in the region including Madisonville Municipal Airport (MADI, 30 km to Wilson Station), Owensboro-Davies County Airport (KOWB, 34 km to Wilson Station), and Henderson City-County Airport (66 km to Wilson Station) and are in close proximity to the Wilson Station. However, each of these smaller airports lack sufficient hour-by-hour full year meteorological data sets that can be used in the dispersion modeling. Thus, other airports were evaluated in the region.

Figure 3-2 shows the locations of the airports having meteorological data sets that were considered for this modeling. Of these candidate sites, the most representative site, the Evansville Regional Airport, was one of only three sites having the sufficient hour-by-hour and one-minute meteorological data sets that can be used in the dispersion modeling. Table 3-3 presents the results of a NWS identification exercise based on proximity to Wilson Station and availability of data with all candidate sites. As can be seen the three smaller airports are closer than Evansville but fail to have adequate data. As can be seen, other candidate sites are located farther away and in a different geographical setting than the Wilson Station.

[14] Fox, Tyler, U.S. Environmental Protection Agency. 2013. "Use of ASOS Meteorological Data in AERMOD Dispersion Modeling." Available Online:
http://www.epa.gov/ttn/scram/guidance/clarification/20130308_Met_Data_Clarification.pdf

**Figure 3-2. Meteorological Stations and $SO_2$ Monitors in the Area Near Wilson Station**




The most representative 2012-2014 surface meteorology data was determined to be from the Evansville Regional Airport (KEVV, WBAN No. 93817) with upper air data from the Nashville International Airport (KBNA, WBAN No. 13897). The Evansville Regional Airport lies about 76.5 km to the northwest of the Wilson Station.

### 3.3.1. Surface Data

Unprocessed hourly surface meteorological field data was obtained from the U.S. National Climatic Data Center (NCDC) for the Evansville Regional Airport (KEVV) for 2012-2014 in the standard ISHD (integrated surface hourly data) format[15]. This data was supplemented, as recommended by the U.S. EPA with TD-6405 format (so-

[15] ftp://ftp.ncdc.noaa.gov/pub/data/noaa/

**Table 3-3. Proximity Analysis of Meteorological Stations to Wilson Station**

| Station Name | WBAN Station ID | Station Call Sign | Lat. | Long. | UTM East (m) | UTM North (m) | ASOS One Minute Data Available | Distance to Wilson (km) |
|---|---|---|---|---|---|---|---|---|
| Madisonville Municipal Airpor | 00421 | MADI | 37.350 | -87.400 | 464,573 | 4,133,775 | No | 30.4 |
| Owensboro-Daviess County Airp | 53803 | KOWB | 37.750 | -87.167 | 485,288 | 4,178,091 | No | 34.2 |
| Henderson City-County Arpt | 53886 | KEHR | 37.800 | -87.683 | 439,872 | 4,183,845 | No | 65.9 |
| Evansville Regional Airport | 93817 | KEVV | 38.044 | -87.521 | 454,285 | 4,210,825 | Yes | 76.5 |
| Bowling Green 21 Nne | 63849 | NBWG | 37.250 | -86.233 | 568,021 | 4,122,882 | No | 78.3 |
| Bow Grn-Warren Co. Rgnl Ap | 93808 | KBWG | 36.965 | -86.424 | 551,274 | 4,091,145 | Yes | 79.3 |
| Huntingburg Airport | 53896 | KHNB | 38.249 | -86.954 | 504,025 | 4,233,444 | No | 89.4 |
| Campbell Aaf Airport | 13806 | KHOP | 36.667 | -87.483 | 456,838 | 4,058,041 | No | 93.9 |
| Clarksville | 03894 | KCKV | 36.624 | -87.419 | 462,536 | 4,053,245 | Yes | 96.4 |
| Godman Aaf Airport | 13807 | KFTK | 37.900 | -85.967 | 590,819 | 4,195,223 | No | 110.2 |
| Glasgow Municipal Airport | 00361 | KGLW | 37.033 | -85.950 | 593,386 | 4,099,049 | No | 110.4 |
| Carmi Minicipal Airport | 63840 | KCUL | 38.089 | -88.123 | 401,521 | 4,216,285 | No | 116.0 |
| Harrisburg-Raleigh Airport | 53897 | KHSB | 37.811 | -88.549 | 363,649 | 4,185,976 | No | 135.6 |
| Mount Carmel Municipal Airpor | 63853 | KAJG | 38.607 | -87.727 | 436,701 | 4,273,417 | No | 140.4 |
| Louisville Intl-Standiford F | 93821 | KSDF | 38.181 | -85.739 | 610,442 | 4,226,649 | Yes | 143.3 |
| Kyle Oakley Field Airport | 00437 | KCEY | 36.665 | -88.373 | 377,299 | 4,058,589 | No | 144.2 |
| Bowman Field Airport | 13810 | KLOU | 38.228 | -85.664 | 616,936 | 4,231,956 | Yes | 151.6 |
| Nashville International Airpo | 13897 | KBNA | 36.119 | -86.689 | 527,988 | 3,997,192 | Yes | 151.7 |
| Lrncvll-Vincnes Intl Arpt | 13809 | KLWV | 38.764 | -87.606 | 447,351 | 4,290,762 | Yes | 152.9 |
| Fairfield Municipal Arpt | 53891 | KFWC | 38.379 | -88.413 | 376,581 | 4,248,812 | No | 156.0 |
| Olney-Noble Airport | 53822 | KOLY | 38.722 | -88.176 | 397,769 | 4,286,584 | No | 170.8 |
| Flora Municipal Airport | 53889 | KFOA | 38.665 | -88.453 | 373,588 | 4,280,604 | No | 180.8 |
| **Central Coordinates of Wilson:** | **492,883** | **4,144,768** | | | | | | |

called "1-minute") wind data also from the KEVV archives[16] and processed using the latest version of the AERMINUTE pre-processing tool (version 14337). The "Ice-Free Winds Group" AERMINUTE option was selected for processing due to the fact that a sonic anemometer has been installed at KEVV in 2006.

### 3.3.2. Upper Air Data

In addition to surface meteorological data, AERMET requires the use of data from an upper air sounding to estimate mixing heights and other boundary layer turbulence parameters. Upper air data from the nearest U.S. NWS radiosonde equipped station was utilized in the modeling analysis. In this case, upper air data from the Nashville International Airport (KBNA, WBAN No. 13897) was obtained from the National Oceanic and Atmospheric Administration (NOAA) in FSL (Forecast Systems Laboratory) format[17].

### 3.3.3. Land Use Analysis

Parameters derived from analysis of land use data (surface roughness, Bowen ratio, and albedo) are also required by AERMET. In accordance with U.S. EPA guidance, these values will be determined using the latest version of the AERSURFACE tool (version 13016).[18] AERSURFACE reads gridded land use, land cover data as provided by the USGS[19] and associates such data with representative values of the three parameters listed above. Specific AERSURFACE settings will be used that represent the location of the Evansville meteorological station. These include settings like location coordinates, monthly versus seasonal differentiation, aridity, and surface moisture determination. The surface moisture will be determined based on whether precipitation at the Evansville Airport is classified as wet, dry, or average in comparison to a recent 30-year climatological record at the site. This determination is used in AERSURFACE to adjust the Bowen ratio estimated by AERSURFACE which

[16] ftp://ftp.ncdc.noaa.gov/pub/data/asos-onemin
[17] http://www.esrl.noaa.gov/raobs/
[18] U.S. Environmental Protection Agency. 2013. "AERSURFACE User's Guide." EPA-454/B-08-001, Revised 01/16/2013. Available Online: http://www.epa.gov/scram001/7thconf/aermod/aersurface_userguide.pdf
[19] http://www.mrlc.gov/viewerjs/

in turn affects the calculation of the daytime mixing heights used in AERMOD. To make the moisture conditions determination, climatological records of the annual precipitation in each modeled year (2012-2014) will be compared to the 1985-2014 climatological record for each site[20].

Table 3-4 shows the 30 year precipitation by month for Evansville along with the seasonal totals, averages, and 30th percentile high and low values. These were compared to the actual rainfall in each season for each year of January 1, 2012 through December 31, 2014 which determined the average, wet, or dry option in AERSURFACE for each year and each season.

## 3.4. COORDINATE SYSTEM

In all modeling input and output files, the locations of emission sources, structures, and receptors will be represented in the appropriate Zone of the Universal Transverse Mercator (UTM) coordinate system using the North American Datum 1983 (NAD83). The Wilson Station and the surrounding area lies within Zone 16.

## 3.5. RECEPTOR LOCATIONS

The dispersion modeling followed the guidance of the modeling TAD in terms of only putting receptors in areas where it is feasible to place an actual monitor. As shown in the example Figure 3-3 from the modeling TAD, no receptors were placed in lakes, rivers or similar areas. As the modeling TAD states:

> *receptor placement should be of sufficient density to provide resolution needed to detect significant gradients in the concentrations, with receptors placed closer together near the source to detect local gradients and placed farther apart away from the source. In addition, the user should place receptors at key locations such as around facility fence lines (which define the ambient air boundary for a particular source) or monitor locations (for comparison to monitored concentrations for model evaluation purposes).*

The receptor grid for the modeling of the Wilson Station combined a multi-nested Cartesian grid at various spacing centered on the main Wilson Station stack along with receptor points along the facility's controlled area. For the air dispersion modeling analyses, ground-level concentrations were calculated from the controlled area out to 50 km. The receptors are characterized by the following grids:

- **Fence Line Grid:** "Fence line" grid consisting of evenly-spaced receptors 50 meters apart placed along the controlled area of the Wilson Station including the main generation area, coal piles and conveying areas and the ash landfills,

- **Fine Cartesian Grid:** A "fine" grid containing 100-meter spaced receptors extending to 3 km from the center of the property and beyond the fence line, including receptors along State Route 85,

- **Medium-Fine Cartesian Grid:** A "medium-fine" grid containing 250-meter spaced receptors extending from 3 km to 5 km from the center of the facility, exclusive of receptors on the fine grid,

[20] National Climactic Data Center. 2014 Local Climatological Data (LCD).

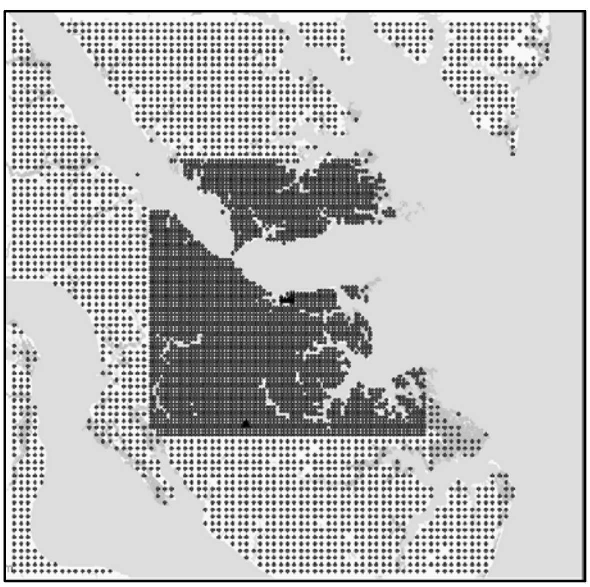
## Table 3-4. Moisture Calculation for Evansville Airport (inches of precipitation)

| YEAR | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANNUAL | | Winter | Spring | Summer | Fall |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1985 | 1.76 | 4.24 | 6.10 | 3.80 | 2.97 | 4.68 | 1.18 | 3.76 | 3.59 | 4.46 | 7.61 | 1.74 | 45.89 | | 7.74 | 12.87 | 9.62 | 15.66 |
| 1986 | 1.15 | 5.77 | 2.64 | 2.29 | 2.93 | 3.77 | 5.39 | 2.07 | 3.84 | 3.30 | 2.35 | 2.18 | 37.68 | | 9.10 | 7.86 | 11.23 | 9.49 |
| 1987 | 0.77 | 3.51 | 2.11 | 2.31 | 3.90 | 5.97 | 3.19 | 0.47 | 1.98 | 1.23 | 3.36 | 5.71 | 34.51 | | 9.99 | 8.32 | 9.63 | 6.57 |
| 1988 | 3.28 | 3.94 | 2.89 | 1.77 | 1.33 | 1.11 | 6.63 | 2.72 | 1.19 | 2.86 | 7.96 | 2.75 | 38.43 | | 9.97 | 5.99 | 10.46 | 12.01 |
| 1989 | 3.35 | 7.00 | 6.40 | 4.19 | 3.72 | 4.00 | 7.83 | 3.46 | 2.21 | 2.16 | 1.64 | 1.38 | 47.34 | | 11.73 | 14.31 | 15.29 | 6.01 |
| 1990 | 4.26 | 5.60 | 2.15 | 3.75 | 11.34 | 3.22 | 1.01 | 3.47 | 2.54 | 4.81 | 2.92 | 7.45 | 52.52 | | 17.31 | 17.24 | 7.70 | 10.27 |
| 1991 | 3.02 | 2.99 | 4.27 | 2.56 | 3.11 | 0.65 | 2.58 | 0.46 | 2.60 | 3.05 | 3.67 | 3.72 | 32.68 | | 9.73 | 9.94 | 3.69 | 9.32 |
| 1992 | 0.85 | 1.51 | 4.50 | 1.19 | 3.44 | 1.44 | 8.40 | 4.39 | 2.89 | 1.17 | 4.34 | 1.69 | 35.81 | | 4.05 | 9.13 | 14.23 | 8.40 |
| 1993 | 3.57 | 2.61 | 3.23 | 4.38 | 4.20 | 4.65 | 2.37 | 2.17 | 5.59 | 3.76 | 6.62 | 2.68 | 45.83 | | 8.86 | 11.81 | 9.19 | 15.97 |
| 1994 | 3.18 | 2.32 | 1.88 | 5.77 | 0.94 | 3.45 | 2.30 | 2.52 | 2.61 | 2.67 | 6.52 | 2.59 | 36.75 | | 8.09 | 8.59 | 8.27 | 11.80 |
| 1995 | 2.82 | 2.98 | 2.53 | 5.59 | 13.51 | 4.56 | 2.88 | 3.60 | 0.47 | 2.01 | 2.32 | 3.19 | 46.46 | | 8.99 | 21.63 | 11.04 | 4.80 |
| 1996 | 3.51 | 1.50 | 5.19 | 11.83 | 7.32 | 7.78 | 4.56 | 1.20 | 8.45 | 2.53 | 6.66 | 3.50 | 64.03 | | 8.51 | 24.34 | 13.54 | 17.64 |
| 1997 | 4.20 | 3.35 | 6.90 | 4.16 | 7.57 | 6.12 | 1.71 | 4.02 | 1.31 | 1.73 | 4.17 | 2.34 | 47.58 | | 9.89 | 18.63 | 11.85 | 7.21 |
| 1998 | 2.24 | 2.71 | 3.07 | 8.50 | 5.91 | 5.31 | 3.89 | 3.91 | 0.49 | 3.38 | 2.78 | 3.48 | 45.67 | | 8.43 | 17.48 | 13.11 | 6.65 |
| 1999 | 6.00 | 1.94 | 4.30 | 6.15 | 3.21 | 6.27 | 2.00 | 0.64 | 0.39 | 2.80 | 0.51 | 5.13 | 39.34 | | 13.07 | 13.66 | 8.91 | 3.70 |
| 2000 | 4.36 | 7.26 | 3.21 | 2.35 | 2.60 | 5.86 | 4.14 | 5.60 | 5.03 | 0.59 | 3.43 | 4.12 | 48.55 | | 15.74 | 8.16 | 15.60 | 9.05 |
| 2001 | 1.29 | 3.26 | 2.23 | 1.60 | 3.82 | 3.82 | 5.54 | 6.09 | 2.40 | 7.27 | 5.40 | 7.16 | 49.88 | | 11.71 | 7.65 | 15.45 | 15.07 |
| 2002 | 3.72 | 0.74 | 6.20 | 8.58 | 5.70 | 2.86 | 4.32 | 0.63 | 5.22 | 3.75 | 2.97 | 5.65 | 50.34 | | 10.11 | 20.48 | 7.81 | 11.94 |
| 2003 | 0.90 | 4.92 | 2.60 | 3.91 | 6.48 | 4.50 | 4.38 | 1.88 | 3.17 | 1.61 | 4.36 | 1.20 | 39.91 | | 7.02 | 12.99 | 10.76 | 9.14 |
| 2004 | 2.95 | 0.59 | 2.17 | 1.91 | 9.31 | 1.66 | 7.56 | 3.08 | 0.09 | 5.62 | 6.23 | 2.31 | 43.48 | | 5.85 | 13.39 | 12.30 | 11.94 |
| 2005 | 4.59 | 2.77 | 2.85 | 2.13 | 2.33 | 4.88 | 2.69 | 8.51 | 2.00 | 0.73 | 5.93 | 1.76 | 41.17 | | 9.12 | 7.31 | 16.08 | 8.66 |
| 2006 | 4.09 | 2.17 | 9.36 | 3.44 | 5.77 | 3.73 | 6.46 | 7.41 | 8.75 | 5.46 | 4.95 | 4.59 | 66.18 | | 10.85 | 18.57 | 17.60 | 19.16 |
| 2007 | 5.47 | 3.41 | 2.66 | 2.88 | 2.73 | 2.71 | 1.97 | 0.99 | 2.22 | 4.64 | 1.77 | 6.34 | 37.79 | | 15.22 | 8.27 | 5.67 | 8.63 |
| 2008 | 3.97 | 5.97 | 12.34 | 5.07 | 8.07 | 3.09 | 3.90 | 0.52 | 1.16 | 1.61 | 3.42 | 4.76 | 53.88 | | 14.70 | 25.48 | 7.51 | 6.19 |
| 2009 | 2.85 | 2.76 | 3.32 | 6.01 | 6.47 | 2.20 | 6.46 | 1.91 | 5.17 | 8.21 | 1.22 | 3.62 | 50.20 | | 9.23 | 15.80 | 10.57 | 14.60 |
| 2010 | 2.41 | 1.58 | 3.97 | 3.27 | 3.03 | 2.49 | 3.51 | 0.84 | 0.36 | 1.06 | 8.46 | 1.80 | 32.78 | | 5.79 | 10.27 | 6.84 | 9.88 |
| 2011 | 1.65 | 4.52 | 5.34 | 11.77 | 7.90 | 6.52 | 6.66 | 0.62 | 8.20 | 2.49 | 8.32 | 6.04 | 70.03 | | 12.21 | 25.01 | 13.80 | 19.01 |
| 2012 | 3.39 | 1.75 | 2.51 | 1.44 | 2.29 | 0.15 | 2.34 | 4.10 | 7.60 | 2.90 | 1.19 | 3.47 | 33.13 | | 8.61 | 6.24 | 6.59 | 11.69 |
| 2013 | 6.76 | 2.77 | 4.08 | 3.86 | 5.08 | 7.55 | 3.59 | 1.64 | 2.81 | 6.07 | 2.04 | 7.33 | 53.58 | | 16.86 | 13.02 | 12.78 | 10.92 |
| 2014 | 1.69 | 2.26 | 2.85 | 10.97 | 3.72 | 3.87 | 4.02 | 4.80 | 2.55 | 4.20 | 2.85 | 3.43 | 47.21 | | 7.38 | 17.54 | 12.69 | 9.60 |
| | | | | | | | | | | | | | | Upper 30th | 11.11 | 17.31 | 12.88 | 11.94 |
| | | | | | | | | | | | | | | Lower 30th | 8.58 | 8.97 | 9.11 | 8.65 |
| | | | | | | | | | | | | | | 2012 | A | D | D | A |
| | | | | | | | | | | | | | | 2013 | W | A | A | A |
| | | | | | | | | | | | | | | 2014 | D | W | A | A |

Precipitation location from http://www.ncdc.noaa.gov/cdo-web/datatools/findstation
KEVV precipitation data - obtained 2014 cumulative report from http:/wwwi.ncdc.noaa.gov/pub/orders

A = Average Precipitation
W = Wet Precipitation
D = Dry Precipitation

## Figure 3-3. Modeling TAD Receptor Grid Showing Example Excluded Locations Over Water



- **Medium-Coarse Cartesian Grid:** A "medium-coarse" grid containing 500-meter spaced receptors extending from 5 km to 10 km from the center of the facility, exclusive of receptors on the fine and medium-fine grids,

- **Coarse Cartesian Grid:** A "coarse grid" containing 1,000-meter spaced receptors extending from 10 km to 20 km from the center of the facility, exclusive of receptors on the fine, medium-fine, and medium-coarse grids.

- **Very Coarse Cartesian Grid:** A "very coarse grid" containing 2,000-meter spaced receptors extending from 20 km to 50 km from the center of the facility, exclusive of receptors on the fine, medium-fine, medium-coarse, and coarse grids.

The latter grid extended out to 50 km and was deemed adequate to capture the maximum impacts of Wilson Station and combined impacts due to other nearby sources and background concentrations. This domain distance was deemed sufficient to capture the distances to maximum concentrations as well as the significant gradients of concentrations.

Figures 3-4 and 3-5 show the innermost grids of the receptors as well as the overall receptor grid across the modeling domain, respectively. As can be seen, receptors in various nearby creeks and lakes have been eliminated from the analysis. Also shown is the current controlled area of the facility (innermost line of yellow receptors).

**Figure 3-4. Innermost Portion of the Modeling Receptor Grid for Wilson**

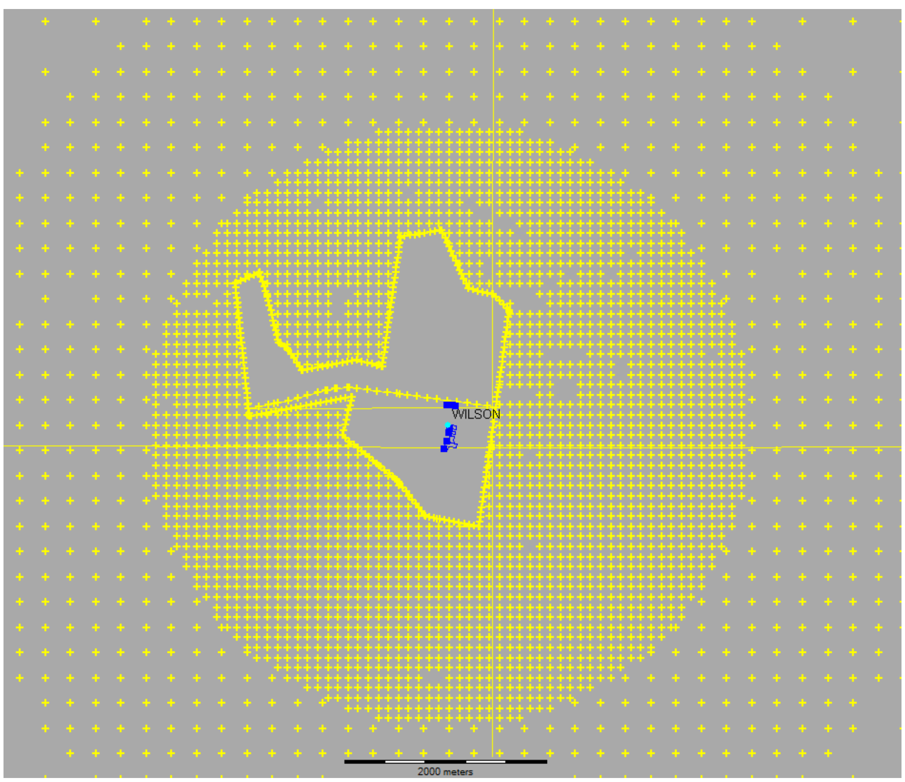
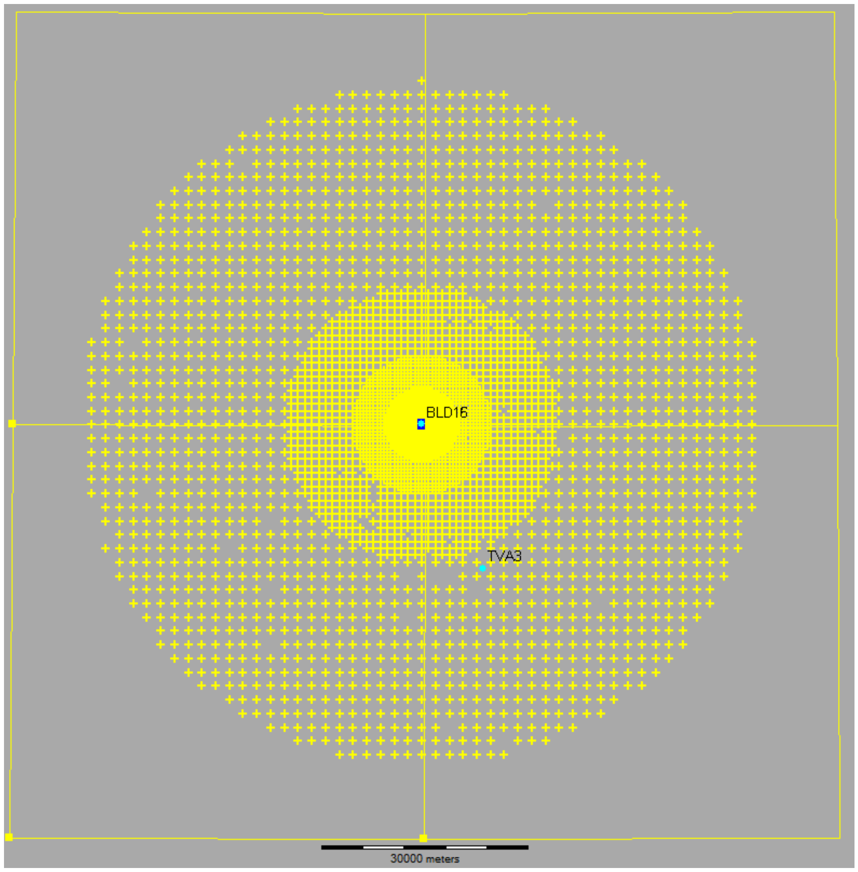


**Figure 3-5. Overall Modeling Receptor Grid for Wilson**




## 3.6. TERRAIN ELEVATIONS

The terrain elevation for each receptor, building, and emission source were determined using USGS 1 arc-second National Elevation Data (NED). The NED, obtained from the USGS[21], has terrain elevations at 30-meter intervals. Using the AERMOD terrain processor, AERMAP (version 11103), the terrain height for each receptor, building, and emission source included in the model were determined by assigning the interpolated height from the digital terrain elevations surrounding each point of interest. These were used directly in the AERMOD model.

In addition, AERMAP was used to compute the hill height scales associated with each elevated receptor located at a different elevation than the base of the Wilson stack. This computation enabled the AERMOD Model to determine the effect that terrain has on plumes from the Wilson stack as well as other sources considered. AERMAP searches all nearby elevation points for the terrain height and location that has the greatest influence on each receptor to determine the hill height scale for that receptor. AERMOD then uses the hill height scale in order to select the point where a plume may divide between going around a terrain feature and lofting over the feature. Initial review of the area does not indicate that any significant terrain features exist near the Wilson Station, but the terrain will be incorporated as required.

[21] http://www.mrlc.gov/viewerjs/

## 3.7. WILSON STATION EMISSION SOURCES

The Wilson Station has only one source of $SO_2$ emissions, which is the flue in the main stack associated with coal-fired Unit 1. Table 3-5 below summarizes the stack parameters that were used in this initial modeling of the Wilson Station main stack. Modeling was performed at an emission rate of 0.853 lb $SO_2$/MMBtu and 4,585 MMBtu/hr capacity which is a limit that BREC is willing to take for the Wilson Station. This use of a new allowable emission rate limit is commensurate with the proposed Data Requirements Rule guidance for emissions to be considered for modeling in Section V.B.1.b (Emissions – Accounting for Recent Emission Reductions in Modeling Analyses[22]). As stated in Section V.B.1.b:

> *…the air agency may wish to consult with the source and conduct additional (modeling) analysis with the source to identify a control measure or an emission limit that would ensure attainment with the 1-hour SO2 standard for the area around the source.*

Thus, BREC has elected to perform this modeling to assist KDAQ in demonstrating that the area around the Wilson Station is in attainment via the modeling route. This emission limit would be enforceable by January 2017 and thus, qualifies for this modeling demonstration. As per the modeling TAD and guidance on area designations, if this analysis results in concentrations less than the NAAQS, then the area can be designated attainment. In the spirit of the modeling TAD and related DRR guidance, the modeling was performed to simulate what a monitor may have measured if one had been available. To this end, the modeling herein demonstrates what the ambient air quality would be if a monitor were measuring the air quality in the area after the new limit is set.

**Table 3-5. Wilson Station Source Characterization**

| Stack Identification | X Coordinate (m)[a] | Y Coordinate (m)[a] | Stack Height (ft) | Stack Diameter (ft) | Exit Velocity (ft/s) | Flow Rate (acfm) | Exit Temperature (°F) | Emission Rate (lb/hr) |
|---|---|---|---|---|---|---|---|---|
| Unit 1[b] | 492,876.8 | 4,144,766 | 600 | 22 | 67.4 | 1,536,428 | 130 | 3,911 |

[a] UTM Zone 16, NAD 83.

[b] At a permitted rate of 0.853 lb $SO_2$/MMBtu and 4,585 MMBtu/hr capacity.

Most other sources at the Wilson Station are related to coal and ash handling, conveying, and transport and do not relate to $SO_2$ emissions. However two other sources of $SO_2$ emissions at the Wilson Station facility include a 380 hp Fire Pump engine (EU06) which runs on diesel fuel and an 1,130 hp emergency generator which runs on diesel fuel. According to the pending Title V permit for the Wilson Station, each unit is limited to 50 hours of non-emergency operation. Maintenance checks and readiness testing of these units is limited to 100 hours per year. According to the modeling TAD, Section 5.4 Intermittent Emissions, only sources that are continuous or frequent enough to contribute significantly to the annual distribution of maximum daily 1-hour concentrations should be considered. As per the TAD-referenced U.S. EPA clarification memorandum[23], for the reasons stated therein, i.e., these sources do not operate continuous or often enough to contribute to the annual distribution of daily maximum 1-hour $SO_2$ concentrations, these two sources were excluded from the dispersion modeling of the Wilson Station. No other sources of $SO_2$ emissions exist at the Wilson Station.

[22] FR Volume 79 No. 92, *Data Requirements Rule for the 1-Hour Sulfur Dioxide ($SO_2$) Primary National Ambient Air Quality Standard (NAAQS); Proposed Rule,* May 13, 2014, pp 27464-27465.

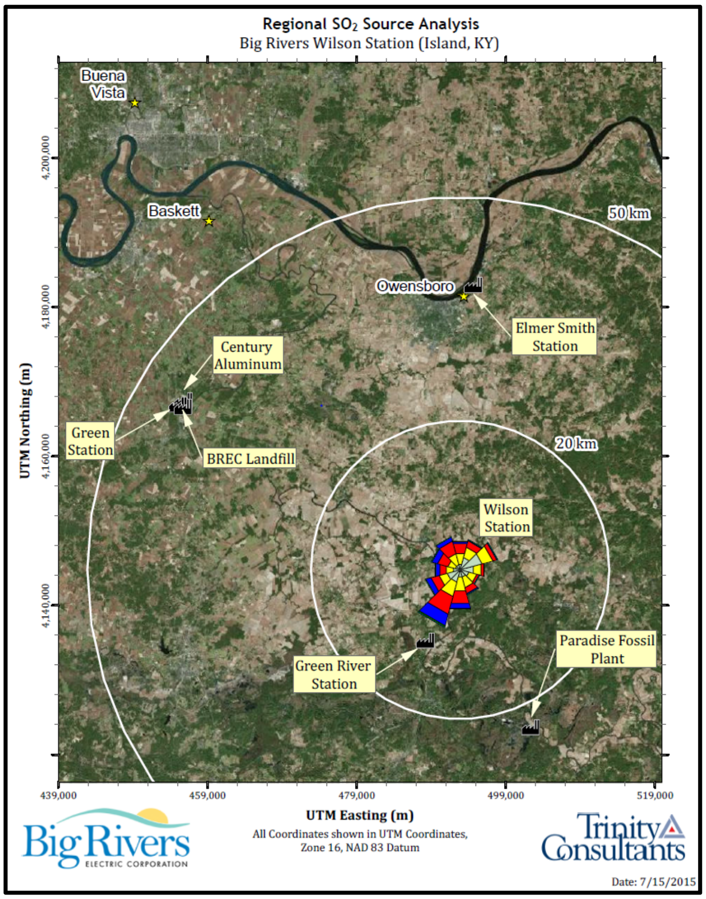
[23] *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO2 National Ambient Air Quality Standard,* from Tyler Fox, Leader to Regional Air Division Directors, U.S. Environmental Protection Agency. March 11, 2011.

# 3.8. OTHER SOURCE INVENTORY

Other sources of $SO_2$ emissions in the area surrounding the Wilson Station were included as required for the modeling of the Wilson Station to fully characterize the air quality in the area. Sources within about 20 km of Wilson were included (or large sources just beyond the 20 km range) in the modeling and were obtained from available inventories from KDAQ. Other large sources in the 20 km to 50 km range from Wilson were reviewed to determine if they should be included in the modeling and were reviewed on the basis of KDAQ data archives as well as from a perspective of possible future shut downs (thereby not requiring consideration).

Data sets were reduced by eliminating very small sources (less than 100 tons per year). Figure 3-5 shows major sources of $SO_2$ emissions within the 50 km range of Wilson.

**Figure 3-6. Map Showing Regional $SO_2$ Sources Near Wilson Station**




A summary of the consideration of each source in the area is as follows:

- Wilson Station, Unit 1 – modeled at 0.853 lb $SO_2$/MMBtu.

- TVA – Paradise Station – Units 1 and 2 will shut down by April 2016[24]; Unit 3 modeled using hourly 2013-2014 CEMs data from the U.S. EPA Air Markets Program Data for emissions only[25]; temperature and gas exit velocity were not available and were, therefore set equal to that in the KDAQ archive data.

- Green River Station – all units will shut down by April 2016[26].

- Century Aluminum located over 40 km to the northwest of Wilson Station was distant enough that its impacts would be significantly reduced in terms of its impacts overlapping with those of Wilson Station; $SO_2$ impacts were treated as regional in nature and assumed to be captured by the ambient monitor at the Henderson County monitor located at the Baskett Fire House (AQS-ID 21-101-0014) which is downwind a large portion of the time when winds are from the southwest through southeast as shown by the monitor location and wind rose for 2012-2014 in Figure 3-6.

- The Reid/Henderson Station II Generating Station and BREC Landfill are located over 40 km to the northwest of Wilson Station, which is distant enough that their impacts would be significantly reduced in terms of its impacts overlapping with those of Wilson Station; $SO_2$ impacts were treated as regional in nature and assumed to be captured by the ambient monitor at the Henderson County monitor located at the Baskett Fire House (AQS-ID 21-101-0014) which is downwind a large portion of the time when winds are from the southwest through southeast as shown by the monitor location and wind rose for 2012-2014 in Figure 3-6.

- Green Station located over 40 km to the northwest of Wilson Station was distant enough that its impacts would be significantly reduced in terms of its impacts overlapping with those of Wilson Station; $SO_2$ impacts were treated as regional in nature and assumed to be captured by the ambient monitor at the Henderson County monitor located at the Baskett Fire House (AQS-ID 21-101-0014) which is downwind a large portion of the time when winds are from the southwest through southeast as shown by the monitor location and wind rose for 2012-2014 in Figure 3-6.

- The Elmer Smith Station is located about 35 km to the north of Wilson Station and is distant enough and in a location that is not likely to overlap with the maximum concentrations due to Wilson nor is Wilson likely to contribute significantly to concentrations in the vicinity of Elmer Smith Station.

Thus, only TVA Paradise Unit 3 was included as a direct source in the modeling analysis. Table 2-2 provides the pertinent sources parameters and emissions for this unit.

**Table 3-6. Nearby Source Characterization**

| Stack Identification | X Coordinate (m)[a] | Y Coordinate (m)[a] | Stack Height (ft) | Stack Diameter (ft) | Exit Velocity (ft/s) | Flow Rate (acfm) | Exit Temperature (˚F) | Emission Rate (lb/hr)[b] |
|---|---|---|---|---|---|---|---|---|
| TVA3- EU03 | 502,305.5 | 4,123,697.4 | 600 | 37 | 50.44 | 3,254,000 | 130 | CEMS |

[a] UTM Zone 16, NAD 83.

[b] Based on CEMS emission data from 2012-2014 from Air Markets Program Data

[24] U.S. Energy Information Administration reporting, http://www.eia.gov/todayinenergy/detail.cfm?id=15491
[25] Air Markets Program Data, http://ampd.epa.gov/ampd/
[26] Coal Age, http://www.coalage.com/news/latest/4152-green-river-coal-plant-will-remain-in-operation-until-april-2016.html#.VckdfflVhBc

## 3.9. BUILDING INFLUENCES

The U.S. EPA's Building Profile Input Program (BPIP) with Plume Rise Model Enhancements (PRIME) (version 04274), will be used to account for building downwash influences on the Unit 1 main stack. The purpose of a building downwash analysis is to determine if the plume discharged from a stack will be influenced by the turbulent wake of any onsite buildings or other structures, resulting in downwash of the plume. The downwash of the plume can result in elevated ground-level concentrations in the near wake of a building and is required for consideration in the modeling. For "other" sources that are modeled in the area, downwash will not be considered.

## 3.10. SOURCE CONTRIBUTIONS

A number of output options are available in AERMOD to tabulate and display the concentration estimates made. The outputs that were of best use were MAXDCONT and the summary of maximum 4$^{th}$-highest maximum daily 1-hour concentrations averaged over the three period. Beyond just the maximum values, the use of MAXDCONT allows the model to generate output that provides the maximum 4$^{th}$-highest maximum daily 1-hour concentrations averaged over the three period for every receptor (or for those above a user established threshold value) and indicates both the cumulative concentrations as well as individual contributions from each user-specified group or individual source. The output from this computation is in the format and over the time period that is commensurate with the form of the NAAQS. Section 4 of this report will utilize these output options.

## 3.11. BACKGROUND CONCENTRATIONS

As described in Section 8 of the modeling TAD, the inclusion of background ambient monitored concentrations as part of the modeled concentrations is important in determining and deciphering the cumulative ambient air impacts. The TAD discusses a first tier approach based on the overall highest hourly monitored $SO_2$ concentration and goes on to note that this is a very conservative method to establish the background concentration. A second, less conservative method, is recommended whereby the monitored design values for the latest three year period is used. For a relatively isolated source, like Wilson, the modeling TAD proposes using a regional monitoring site that is located away from the Wilson area but is impacted by similar natural and distant anthropogenic sources. This regional source should be representative of all sources impacting an area and should not double-count source impacts in the modeling and monitoring. The other alternative for determining the appropriate background concentrations is the use of the 3-year averages of the 99$^{th}$ percentiles by season and hour of day or the 3-year averages by hour of day (across all seasons).

As with many locations in Kentucky, a nearby monitor does not exist and a regional site was determined to be the best choice for characterizing background concentrations. In the previously presented Figure 3-2, four $SO_2$ monitors were determined to be within 100 km of the Wilson Station, namely:

1. 18-163-0021, Evansville-Buena Vista, 75 km northwest of Wilson
2. 21-101-0014, Baskett Fire House, 55 km northwest of Wilson
3. 21-059-0005, Owensboro Primary, 35 km north of Wilson
4. 21-061-0501, Mammoth Cave National Park, 95 km east southeast of Wilson

Consideration of each monitor as an appropriate background monitor will consider a) the distance from Wilson Station to the monitor, 2) the land use in the surrounding area as compared between Wilson Station and the monitor, 3) the likelihood of influencing nearby local population-related sources (vehicles, residential heating, etc.), 4) ability of the monitor to capture the impacts of sources distant from the Wilson Station that may not explicitly be modeled because of the distance between them and Wilson Station and the apparent lack of overlapping significant concentration gradients, and 5) comparison of persistent wind directions with likely downwind impact areas for regional source influences on the candidate monitors.

The Mammoth Cave NP monitor (21-061-0501) site had the lowest $SO_2$ concentrations due to its location and monitoring objective, i.e., "General/Background". This monitor was the one located farthest from Wilson Station at about 95 km to the east southeast. Due to its background status, this monitor was thought to not be representative of the small towns and rural community that influence the air quality around Wilson Station. Also this monitor, given the wind patterns in the area (as shown by the Evansville Airport wind rose in Figure 3-6) will not reflect any contributions from sources located north and northwest of Wilson Station. Therefore, this site was not chosen to represent the background concentrations for the Wilson Station modeling analysis.

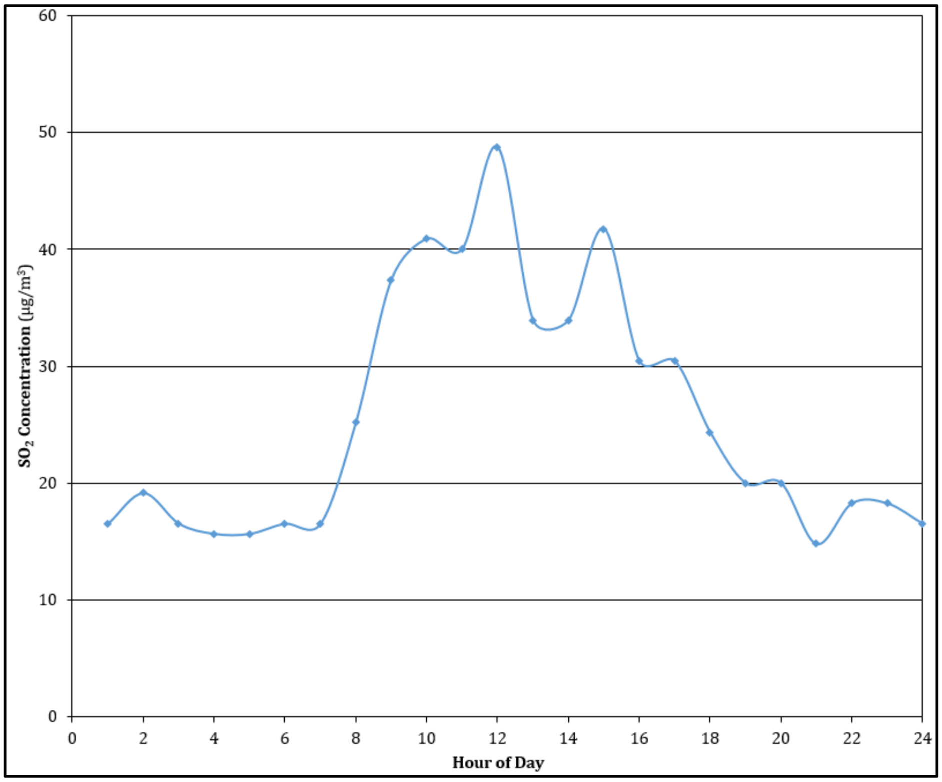
The Evansville-Buena Vista monitor (Site No. 18-163-0021) site is located as a "Neighborhood" site just to the north of downtown Evansville. This monitor is approximately 75 km to the northwest of the Wilson Station. The surrounding land use and location being in such an urban situation as well as its distance from the Wilson Station do not make it a suitable monitor for background concentrations for the DRR analysis. Therefore, this site was not chosen to represent the background concentrations for the Wilson Station modeling analysis.

The Owensboro Primary monitor (Site No. 21-059-0005) site is located as a "Neighborhood" site just northeast of the city of Owensboro. Of the candidate monitors this one is the closest to the Wilson Station at about 35 km to the north. The surrounding land use and location are residential and just outside and downwind of the urban core of Owensboro in a less densely populated area but likely influenced by the more dense urban population-related sources. The monitor is located only 2 km from the Owensboro Municipal Elmer Smith Station located up river. The potential influence of this station when winds are from the northeast wind fetch and by the City of Owensboro for all south through west wind fetches likely overwhelm any general regional $SO_2$ impacts and make this an unlikely candidate for using as the background for the Wilson Station modeling analysis. Therefore, this site was not chosen to represent the background concentrations for the Wilson Station modeling analysis.

The Baskett Fire House monitor (Site No. 21-101-0014) site is located as a general "Population Exposure" site about 8-9 km southeast of Evansville, Indiana. This candidate monitor is located about 55 km to the northwest of the Wilson Station. The surrounding land use and location are very light density residential surrounded by rural agricultural and woodland areas similar to Wilson Station. All sources noted to the northwest of Wilson Station at the 40-50 km range including Century Aluminum, BREC Landfill, and Green Station are located with respect to the monitor and with respect to the prevailing winds (see Figure 3-6) that their regional impacts are likely captured by the Baskett monitor. Also due to its proximity to the Baskett monitor and given the downwind direction for certain meteorological events, the Elmer Smith Station was assumed to also affect the Baskett monitor at a regional scale. On these bases, therefore, this site was chosen to represent the background concentrations for the Wilson Station modeling analysis.

Of the methods described above for the determination of the background concentrations, the method chosen was the use of the 3-year averages of the $99^{th}$ percentiles by hour of day (across all seasons). This selection was based on the review of the $99^{th}$ percentile hourly values across 2012-2014 which shows a diurnal variation of lowest $SO_2$ concentrations at night and highest in the day. Figure 3-7 shows the daily distribution of hourly $99^{th}$ percentile concentrations across all three years of data.

**Figure 3-7. 99th Percentile $SO_2$ Averages by Hour of Day for Baskett Monitor (21-101-0014)**




## 3.12. MODELING FILES

All modeling files will be provided to KDAQ in electronic format on a compact disk. Model and processor input, output, and data files will be provided. Spreadsheets tabulating source, emission, and other input data sets will also be provided. Appendix A provides a listing of the sources included for KDAQ consideration.

# 4. 1-HOUR $SO_2$ DESIGNATION MODELING RESULTS

Dispersion modeling of the Wilson Station was conducted using the AERMOD Model (Version 15181). Included in this modeling was the Wilson Station at 0.85 lb $SO_2$/MMBtu, TVA Unit 3 using the Air Markets CEMS $SO_2$ data, and background concentrations (with the assumption that it was characteristic of the regional impacts from more distant large $SO_2$ sources as well as general rural and natural background sources. Table 4-1 presents the overall results of the modeling for all sources and a contribution distribution for each source(s) and background to the 3-year average of the 99$^{th}$ percentile of the annual distribution of daily maximum 1-hr concentrations, which is the form of the 1-hour $SO_2$ NAAQS. As can be seen from Table 4-1, the concentrations are all less than the NAAQS and thus, the area can be said to be achieving the standards and be designated as attainment. To further show this, Table 4-1 not only gives the overall maximum concentration but also presents the highest ranked 10 highest 4$^{th}$ high concentrations, all at different receptors which further demonstrates compliance across a broader area than at the maximum receptor.

Figure 4-1 shows the distribution of 1-hour $SO_2$ concentrations across the near modeling domain as a further graphical presentation of the air concentrations estimates and their distribution.

**Table 4-1. Highest 4th High Modeled 1-hour SO2 Results for Comparison to the NAAQS**

| All Sources[1] (µg/m$^3$) | All Source Percent of 1-hour $SO_2$ NAAQS[2] (µg/m$^3$) | Wilson Station Contribution (µg/m$^3$) | TVA Unit 3 Contribution (µg/m$^3$) | Background Contribution[1] (µg/m$^3$) | UTM Easting (m) | UTM Northing (m) | Elevation (m) |
|---|---|---|---|---|---|---|---|
| 186.5 | 95.2% | 146.4 | 0.1 | 40.0 | 490,583 | 4,144,568 | 115.8 |
| 186.2 | 95.0% | 144.0 | 0.1 | 42.1 | 489,983 | 4,144,468 | 116.8 |
| 185.9 | 94.8% | 153.7 | 0.3 | 31.9 | 490,483 | 4,144,568 | 116.0 |
| 185.8 | 94.8% | 155.1 | 0.3 | 30.5 | 490,483 | 4,144,468 | 115.9 |
| 185.4 | 94.6% | 146.5 | 0.3 | 38.6 | 490,783 | 4,144,368 | 116.4 |
| 184.9 | 94.3% | 144.8 | 0.1 | 40.0 | 490,083 | 4,144,468 | 118.4 |
| 184.8 | 94.3% | 146.9 | 0.4 | 37.4 | 491,083 | 4,144,468 | 116.6 |
| 184.4 | 94.1% | 146.5 | 0.4 | 37.4 | 491,183 | 4,144,468 | 117.4 |
| 184.3 | 94.1% | 146.8 | 0.1 | 37.4 | 489,133 | 4,144,518 | 125.6 |
| 184.3 | 94.0% | 146.5 | 0.4 | 37.4 | 490,683 | 4,144,368 | 117.0 |

[1] Modeled concentrations include an hourly background concentration determined by taking the 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hr concentrations at the Baskett Fire Department $SO_2$ Monitor northwest of Wilson Station.

[2] Based on the Primary National Ambient Air Quality Standard (NAAQS) for $SO_2$ for the averaging period of 1-hr, 75 ppb (196 µg/m$^3$).

**Figure 4-1. Spatial Display of 3-year Average 99th Percentile Annual Distribution of Daily Maximum 1-hr $SO_2$ Concentrations**