

Appendix J

Supplemental Modeling Demonstration, William H. Zimmer Facility

Introduction

This document supports the redesignation request for the Campbell-Clermont partial nonattainment area in the State of Ohio and the Commonwealth of Kentucky. This nonattainment area encompasses emissions from the Walter C. Beckjord facility. There are no other significant sources of SO₂ emissions within the nonattainment area that warrant inclusion in the modeling analysis. As can be seen from the inventory included in the redesignation request, the SO₂ emissions from the point sources comprise 99.95% of the 2014 SO₂ emissions in the entire nonattainment area. Notably, violations at this monitor were determined to be caused by emissions from the Walter C. Beckjord facility located along the Ohio River in Ohio east of the monitor. On September 1, 2014¹, the Walter C. Beckjord facility ceased operations. Ohio EPA was notified of the permanent shutdown on October 14, 2014. (Appendix B and I of the redesignation request) There are no other significant point sources of SO₂ emissions located in the nonattainment area. Within the portion of Campbell County, KY that is a part of this area there are 11 sources which combined emit less than one ton per year (tpy) of SO₂. (Appendix C of the redesignation request) There are no other point sources of SO₂ emissions in the portion of Clermont County, OH that is a part of this area.

Located south (and slightly east) of the monitor, but outside of the nonattainment area, is the William H. Zimmer facility (see Figure 1). It was determined during the nonattainment designation process that emissions from the William H. Zimmer facility likely do not impact the violating monitor at question, and therefore, the nonattainment area was not expanded to encompass this facility. To support the previous conclusion, Ohio EPA performed an extensive meteorology, emissions and back-trajectory analysis and has included this analysis as Appendix D of the redesignation request. This analysis concludes that it was in fact the Walter C. Beckjord facility that caused the violations and not the William H. Zimmer facility.

¹ The letter contained in Appendix B identifies the permanent shutdown of all units occurred on October 1, 2014. However, a review of CAMD emissions showed that all the units ceased operation by September 1, 2014.

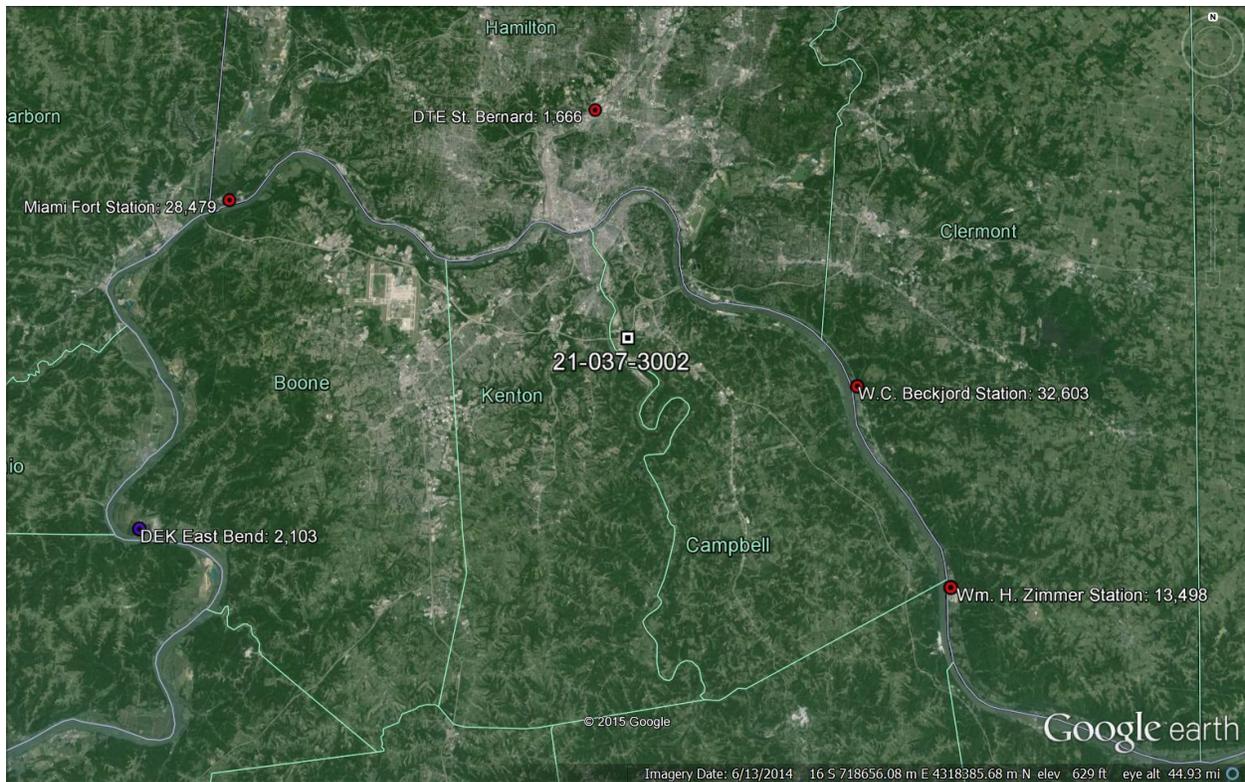


Figure 1: Location of monitor 21-037-3002 the William H. Zimmer Station.

In support of this conclusion, Ohio EPA conducted a supplemental modeling analysis to determine the location of maximum impact from emissions originating from the William H. Zimmer facility as well as a conservative extrapolation of monitored values to the point of maximum impact. The supplemental modeling was performed due to the proximity of the William H. Zimmer facility to the nonattainment area and the level of emissions from this source. Ohio EPA determined that the significant distance (30 to 35 km), prevailing winds, and emission reductions from sources located to the west of the nonattainment area did not warrant the inclusion of these sources in a supplemental modeling analysis. This is consistent with U.S. EPA's *Ohio Area Designations For the 2010 SO₂ Primary National Ambient Air Quality Standard* technical support document. The analysis presented in this document further demonstrates that emissions from William H. Zimmer do not impact the nonattainment area to a significant degree and that emissions from William H. Zimmer are not likely to cause exceedances both at the monitor location or in the entirety of the nonattainment area.

Modeling Approach

Per U.S. EPA's SO₂ nonattainment area SIP guidance,

“Appendix A of this document contains modeling guidance supplemental to that provided in the preamble to the final rulemaking promulgating the 2010 SO₂ NAAQS and in 40 CFR part 51, Appendix W. Appendix A of this document has also been updated to respond to issues raised during the comment period related

to the September 2011 draft SO₂ Guidance Document. This guidance clarifies the EPA's recommendations on how to conduct refined dispersion modeling under Appendix W to support the implementation of the 2010 SO₂ NAAQS.”

Per the SO₂ nonattainment area SIP guidance, five years of National Weather Service data is sufficient to represent attainment of the standard. The purpose of this demonstration, determining the location of maximum impact of emissions from William H. Zimmer and demonstrating that these emissions will not cause exceedances in the nonattainment area, necessitates that the limited period of time for which monitor data is available after the shutdown of the Walter C. Beckjord facility is replicated by the modeling analysis. As such, five years of meteorological data was not used, but a limited meteorological dataset from August 30, 2014 to February 28, 2015, inclusive, was modeled. This period of time represents the most recent period of time for which the Walter C. Beckjord facility is shutdown and data is available. As a full three years of data are not available, the modeled form of the standard is expressed as the 99th percentile of the available 192 maximum daily values. For a time period of 192 days, the form of the standard of both monitored and modeled values is represented by the second highest maximum daily value.

The recommended dispersion model for SIP modeling for SO₂ is the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) modeling system. There are two input data processors that are regulatory components of the AERMOD modeling system: AERMET, a meteorological data preprocessor that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, and AERMAP, a terrain data preprocessor that incorporates complex terrain using United States Geological Survey (USGS) Digital Elevation Data. Additionally, Ohio EPA utilized the AERMINUTE module to incorporate 1-minute ASOS meteorological data into the hourly surface input file. Ohio EPA utilized the most up-to-date versions of AERMOD and the associated preprocessors available at the time of the modeling analyses. These are as follows: AERMOD version 14134, AERMET version 14134, AERMINUTE version 14237, and AERMAP version 11103.

The intent of this supplemental modeling is to demonstrate that the William H. Zimmer facility does not cause or contribute to an exceedance of the standard not only at the violating monitor, but across the entirety of the nonattainment area. For this purpose, Ohio EPA collected monitor data for the August 30, 2014 through February 28, 2015 period, when the entirety of the Walter C. Beckjord facility is known to have zero emissions. Using this monitor data, Ohio EPA modeled all sources at the William H. Zimmer facility at 1 gram per second. Using the modeled impacts at receptors across the nonattainment area, as well as the location of the monitor, Ohio EPA scaled the 99th percentile of monitor data for this period to represent a maximum predicted impacted in the nonattainment area as a whole. As described below, this modeling is conservative in its treatment of constant emissions, the assumption that a one-to-one ratio between monitored concentrations and impacts in the nonattainment area is present, and its consideration of only the spatial, and not temporal, relationship between monitor and modeled values.

Meteorological Data

In order to generate meteorological input data for use with AERMOD, AERMET, along with AERMINUTE and AERSURFACE preprocessing for the modeling domain was conducted to generate the surface (.sfc) and profile (.pfl). Ohio EPA used the AERMINUTE pre-processing module. This module accepts as input 1-minute ASOS meteorological surface observations, calculates an hourly average for each hour in the modeled time period, and substitutes any missing values from the co-located ISHD surface data. Use of AERMINUTE reduces the number of calm hours present in the input files, and these enhanced hourly files are therefore considered more representative of local meteorological conditions.

Meteorological data from August 30, 2014 through February 28, 2015 from the Cincinnati, OH surface station (Station # 93814) located at the Covington/Greater Cincinnati Airport in Kentucky and the Wilmington, OH upper air station (Station # 13841) located at the Wilmington Airborne Park airport were used in these analyses. These sites were determined to be representative of the nonattainment area. AERSURFACE was run using twelve sectors and four seasons for the surface station location.

Emission Sources

Three emission sources (two egress points) from William H. Zimmer were included in the modeling analysis. The relevant release point parameters for the two egress points included in the analysis are presented in Table 1, below. As described previously, the emission rate of all units was set to 1 gram/second to allow for a straightforward scaling of modeled values to monitored concentrations. All emissions sources included in the modeling analysis were treated as point sources.

Source ID	Source Description	Easting (X) (m)	Northing (Y) (m)	Base Elevation (m)	Stack Height (m)	Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)	SO2 (g/s)
B006_ZM	Main Boiler Unit 1 Stack	740462.3	4305892	155.4	174	328	16.971	12.8	1
AUX_AB	Aux Blr AB Comn Stack	740391.7	4305630	155.3	91	604	26.3	3.35	1

Table 1: Modeled SO2 emission sources, William H. Zimmer.

Receptors

A receptor grid of 1000 meter spacing was placed within the boundaries of the nonattainment area. Initial screening-level modeling indicated that the maximum impact of William H. Zimmer occurs within approximately 1 km of the facility. The center of the nonattainment area itself is located approximately 20 km (11.5 km at the closest point) from the William H. Zimmer emission units, and as such, a fine receptor grid was deemed unnecessary to capture significant concentration gradients. Limiting the number of receptors was also necessary to maintain reasonable file sizes to conduct

post-processing and analysis of modeled outputs. In addition to this grid, a single receptor was placed in the monitor location. A second modeling grid, using 50 meter spacing to 3 km, was performed to determine the location of Zimmer's maximum impact. This finer grid was placed based on screening level modeling analysis.

Results

As stated previously, the modeling analysis was conducted to determine the location of maximum impact from emissions originating from the William H. Zimmer facility and to conservatively demonstrate, using monitored values, that emissions from William H. Zimmer will not cause an exceedance of the standard anywhere within the nonattainment area. The 2nd highest modeled maximum daily value for the time period (99th percentile) at the receptor representing the monitor was 0.18731 $\mu\text{g}/\text{m}^3$. Ohio EPA determined that the 2nd highest maximum modeled value across all receptors in the nonattainment area was 0.40866 $\mu\text{g}/\text{m}^3$, and used this value for the extrapolation analysis.

To extrapolate these values based on monitor data, Ohio EPA determined that the 2nd highest maximum daily value recorded during the August 30, 2014 to February 28, 2015 period to be 24 ppb. Using the modeled impacts above, Ohio EPA used a simple ratio to scale this value to the point of maximum impact in the nonattainment area, as follows:

$$\frac{0.18731}{24 \text{ ppb}} = \frac{0.40866}{X}$$

Using the 2nd highest maximum daily value across all receptors in the nonattainment area, 0.40866 $\mu\text{g}/\text{m}^3$, in the ratio above yields a maximum concentration of 52.4 ppb. The conservatively extrapolated value is below the standard.

Ohio EPA considers this demonstration highly conservative for several reasons. Firstly, the modeling assumed continuous operation of all units at the William H. Zimmer facility, which is not reflective of normal operating conditions, in particular the two auxiliary boilers. These units operated only 676 hours in 2013 and 1,167 hours in 2014. Secondly, the extrapolation implicitly assumes that all ambient SO₂ recorded at the monitor location originates from William H. Zimmer. Lastly, the temporal relationship between the monitor data and modeled data was not considered. By accounting only for the spatial relationship between modeled and monitor values, the extrapolation assumes that the 99th percentile impacts occur simultaneously across the entirety of nonattainment area, including at the monitor location. This provides an additional layer of conservatism to the analysis. When modeled values and monitor values are paired in time, the first-highest maximum extrapolated impact was determined to be 30 ppb.

An additional extrapolation of modeled impacts was performed based on actual emissions data from the William H. Zimmer facility. The highest annual emissions from years 2010-2014 occurred in 2010, when the William H. Zimmer facility emitted 19,388.1 tons of SO₂. This annual emission rate was converted to an average emission

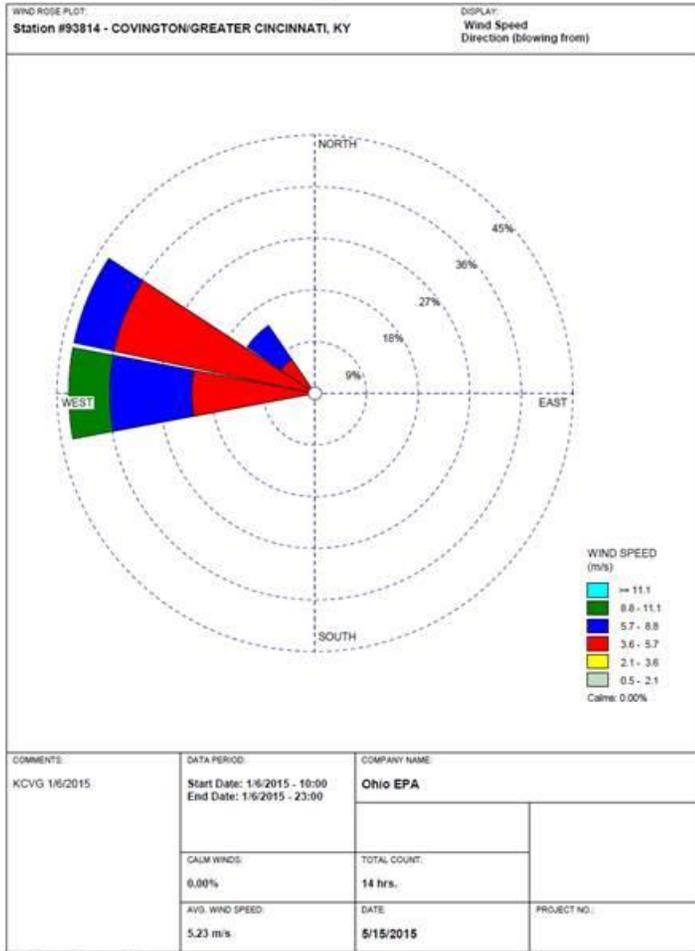
rate of 557.73 grams/second. Using this value, and the results of the extrapolation demonstration above, Ohio EPA used the following ratio to estimate the impacts of emissions from the William H. Zimmer plant at both the receptor location and at the point of highest impact in the nonattainment area:

$$\frac{2 \text{ grams/second}}{0.40866 \text{ ug/m}^3} = \frac{557.73 \text{ grams/second}}{X \text{ ug/m}^3}$$

The solution to this equation, 113.96 $\mu\text{g}/\text{m}^3$ (43.56 ppb) is well below the standard of 75 ppb and indicates that emissions from the William H. Zimmer facility are unlikely to cause an exceedance of the standard across the entirety of the nonattainment area. Substituting the modeled results at the monitor location, 0.18731 $\mu\text{g}/\text{m}^3$, into the above ratio yields an estimated impact of 52.23 $\mu\text{g}/\text{m}^3$ (19.96 ppb). This extrapolation is remarkable in its consistency with the monitor data for periods when the Walter C. Beckjord facility was not operational and with the previous extrapolation based on monitor data. These results, as well as the consistency of these analyses with monitor values, provide strong additional support for Ohio EPA's contention that the closure of the Walter C. Beckjord facility will provide for attainment of the standard in the entirety of the nonattainment area and that emissions from William H. Zimmer will not cause or contribute to an exceedance of the standard.

Analysis of wind rose data from the Covington/Greater Cincinnati Airport for the first highest and second highest maximum daily concentrations recorded at the monitor during the August 30, 2014 through February 28, 2015 period support the conclusion that the analysis conducted by Ohio EPA is highly conservative and indicates that emissions from William H. Zimmer are not contributing to elevated monitor readings. The first highest maximum daily value recorded during this period was 34 ppb, occurring on January 14, 2015 at 9:00 AM. Monitor values remained elevated until 12:00 PM on the same day. The second highest maximum daily value of 24 ppb occurred on January 6, 2015 at 7:00 PM. Concentrations recorded at the monitor were elevated from January 6, 2015 at 5:00 AM until 12:00 AM on January 7, 2015. The wind roses for these periods are shown in Figure 2, below.

January 6, 2015



January 14, 2015

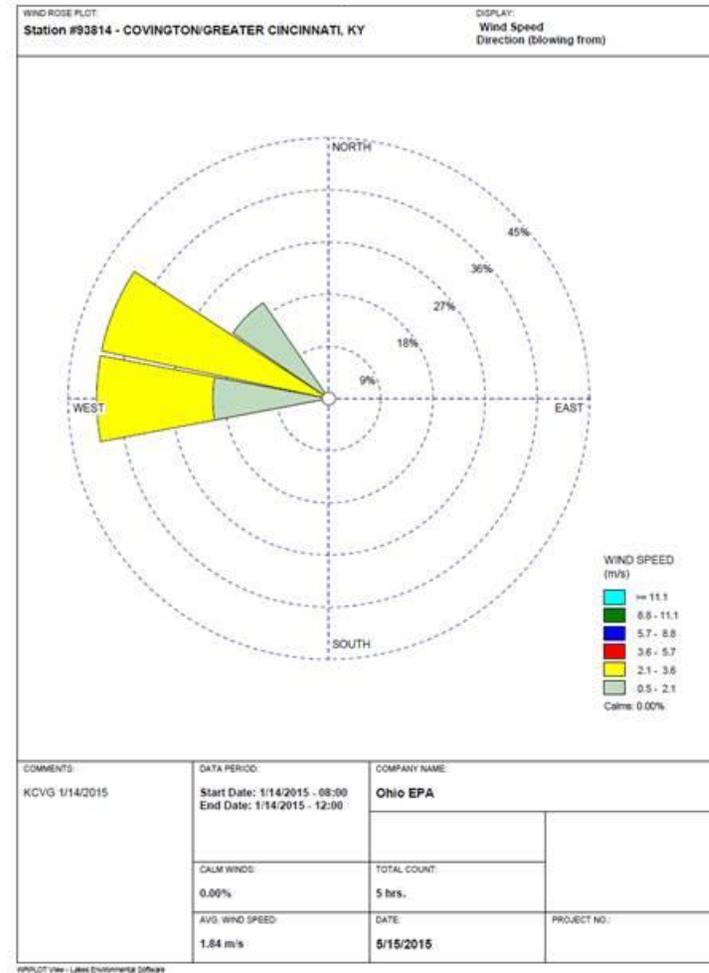


Figure 2: KCVG wind roses, January 6 and January 14, 2015.

The data shown in Figure 2 indicates that winds were primarily from the West and Northwest during the times when the highest and second highest monitored values were recorded. This suggests that emissions from William H. Zimmer were not impacting the monitor, or the nonattainment area, during these times. An analysis of hourly emissions, monitor values, and wind directions, presented in Appendix K of this redesignation submittal confirms that when emissions from the Walter C. Beckjord facility are eliminated from analysis, the wind directions primarily impacting the monitor are from the West and Northwest, and that at no time when the Walter C. Beckjord facility was not operating was an hourly monitor value above 34 ppb recorded. Thus, the extrapolation analysis performed based on modeled impacts represents a highly conservative estimate of the impact of emissions from William H. Zimmer on both the monitor and the nonattainment area as a whole. Further, Ohio EPA determined that point of maximum impact of emissions from Zimmer during the modeled time period was located approximately 1.4 km to the southeast from the largest source at the William H. Zimmer facility. From the point of this maximum impact to the point of maximum impact within the nonattainment area, there is a decrease in concentration of 84%.

These analyses, as well as the analysis presented in Appendix K, further support the results of the trajectory analysis presented in Appendix D, and demonstrate that the impacts of Zimmer are minimal at both the monitor location and the entirety of the nonattainment area. These results are consistent with the predominant winds in the area, which originate primarily from the south and southwest. Additional wind rose data is presented in Appendix K.