

Appendix K

Analysis of Monitored Concentrations and Wind Direction

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.

In support of this conclusion, Ohio EPA conducted an analysis of hourly SO₂ concentrations recorded at monitor 21-037-3002, wind direction data from the Cincinnati weather station located at the Cincinnati Northern Kentucky Airport, and emissions from both the Walter C. Beckjord and William H. Zimmer facilities for years 2012 through February 28, 2015. This time period is henceforth referred to as the study period. The analysis presented in this document further demonstrates that emissions from William H. Zimmer and other sources within and outside of the nonattainment area are not likely to cause exceedances both at the monitor and in the entirety of the nonattainment area

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.

and that the shutdown of the Walter C. Beckjord facility will result in attainment of the standard.

Methodology

Hourly SO₂ emissions data from the Walter C. Beckjord and William H. Zimmer facilities were collected from the U.S. EPA Clean Air Markets Database for the study period. Hourly and one-minute wind data were collected from the National Weather Service station located at the Cincinnati Northern Kentucky Airport. To ensure that the most complete meteorological record possible was used, Ohio EPA processed the hourly meteorological data and one-minute ASOS data using the most recent versions of the AERMOD preprocessors AERMET and AERMINUTE. In addition to eliminating missing periods in the meteorological data, this processing provided hourly outputs that were more easily paired with hourly emission and monitor data. Hourly monitoring data for monitor 21-037-3002 were obtained from U.S. EPA's Air Quality System.

After compiling the above hourly data, Ohio EPA binned all data based on wind direction data, in ten degree increments. This was done for the entirety of the study period. The same binning of the data by wind direction was also done for only those periods in which the Walter C. Beckjord facility had zero SO₂ emissions. This yielded a substantial dataset of 10,231 hours monitoring data not impacted by emissions from the Walter C. Beckjord facility. It should be noted, however, that no accounting for any temporal overlap between any hour of zero emissions from the Walter C. Beckjord facility and monitor values was performed. Thus, it is likely that this dataset represents some impacts from Walter C. Beckjord at the monitor location. Ohio EPA believes that by not accounting for this overlap, any subsequent analysis of this dataset will be conservative.

Within each of the above datasets, Ohio EPA determined for each wind direction bin the highest and second-highest monitored concentration, the percentage each wind direction bin represents to the total, and the number and percentage of monitor values of 0 ppb.

Analysis and Results

To determine the primary wind directions in which monitored concentrations are elevated, Ohio EPA evaluated those bins for which either the first or second highest monitored value represented an exceedance of the standard. Further, Ohio EPA included in its evaluation any bin for which the sum of the first and second highest monitored values within that bin exceeded the average plus the sample standard deviation of this value, across all bins. For the full study period, which includes impacts from the Walter C. Beckjord facility, Ohio EPA determined that winds originating from between 31° and 140° and from between 151° and 170° had the greatest impact on monitor concentrations. The results of this analysis are consistent with those presented in Appendix D of the redesignation request. The maximum concentration recorded at the monitor during the study period, 156 ppb, was the result of winds originating between 121° and 130°. This result is again consistent with the results presented in

Appendix D of the redesignation request, which details this exceedance as the February 20, 2012 exceedance, and is attributed to emissions from the Walter C. Beckjord facility.

The same binning analysis described above was performed for the dataset compiled from hours in which emissions from the Walter C. Beckjord facility were zero. It should be noted that this data set of 10,231 hours encompasses 1,445 hours of 2012, 2,542 hours of 2013, 4,828 hours of 2014, and 1,416 hours of 2015. Additionally, no exceedances of the standard were monitored during these hours, and the highest maximum hourly concentration recorded during these hours was 34 ppb. Using the same procedure as described above, Ohio EPA determined that for this dataset, winds originating between 211° and 220°, as well as those originating between 251° and 300° had the greatest impact on monitor concentrations. This represents a significant shift in impacting wind directions with respect to the results of the full study period. Further, these wind direction bins resulted in no exceedances at the monitor over the full 2012 to February 28, 2015 study period. Ohio EPA contends that this is strong evidence that the shutdown of the Walter C. Beckjord facility will result in the attainment of the standard both at the monitor and across the entirety of the nonattainment area. This is supported by the supplemental modeling and extrapolation analysis described in Appendix J of the redesignation request.

The shift in impacting wind directions observed between the datasets is significant, and warrants further analysis. Figure 1, below, shows the location of monitor 21-037-3002 and facilities within a 50 km radius with SO₂ emissions greater than or equal to 1,000 TPY in 2014.

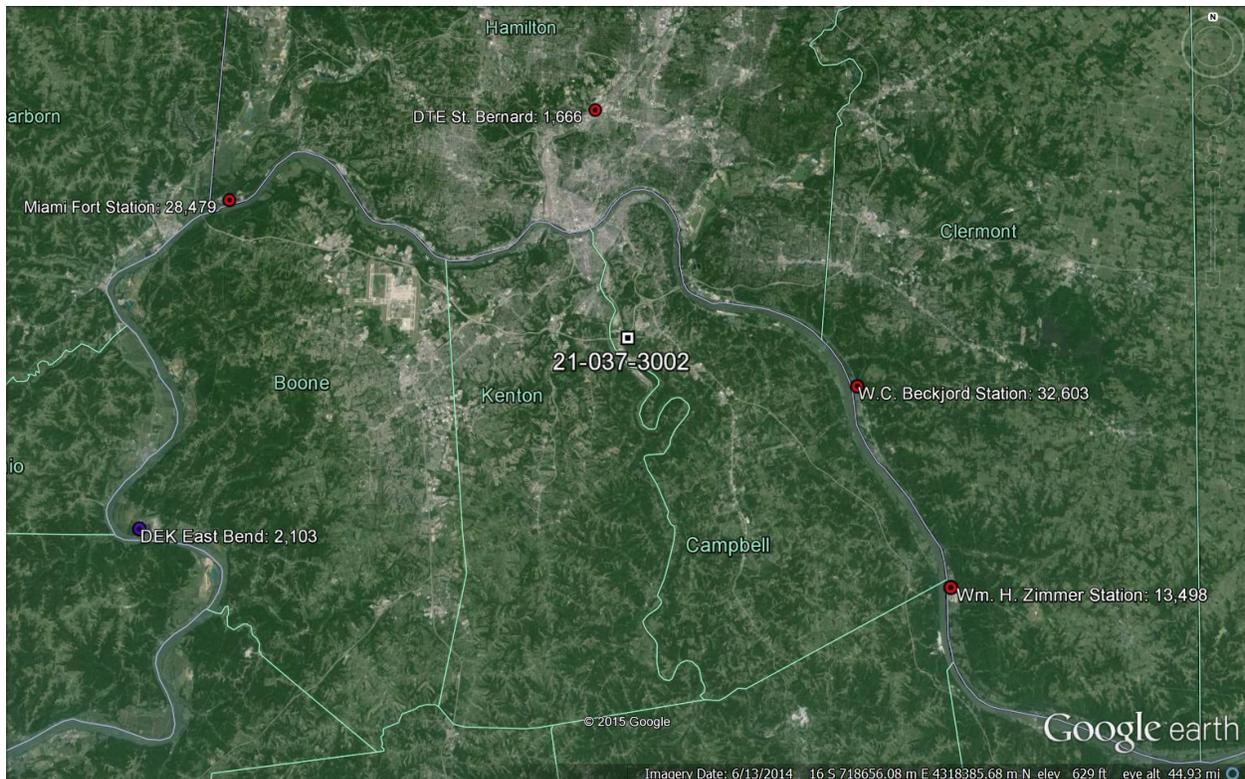


Figure 1: Facilities within 50 km of monitor 21-037-3002 with 2014 emissions >1,000 tons SO₂.

As stated above, Ohio EPA determined that for the dataset excluding periods when the Walter C. Beckjord facility was emitting SO₂, winds originating between 211° and 220°, as well as those originating between 251° and 300° had the greatest impact on monitor concentrations. Figure 1 above suggests that these wind directions would bring emissions from the Miami Fort Station, 30.3 km away from the monitor, and from the Duke Energy Kentucky East Bend facility, located 35.3 km distant from the monitor. Given these large distances, Ohio EPA believes that the impact of these facilities will be relatively uniform across the nonattainment area. Dispersion screening tests for Miami Fort Station would suggest that over this distance, there would be an approximately 86% decrease from the point of maximum concentration, located within approximately 1 km of the facility, to a point 30 km distant, and an 89% decrease at 40 km. This indicates that there is little concentration gradient across the nonattainment area associated with sources located 30 to 35 km distant. Further, as demonstrated above, the highest concentration recorded at the monitor with winds originating from the above directions is 34 ppb. Ohio EPA believes that it is highly unlikely that a future exceedance of the standard will be observed at the monitor location due to emissions from these facilities, and given the significant distances between these facilities and the nonattainment area it is unlikely that a significant concentration gradient across the nonattainment area from these facilities is present. Additionally, Ohio EPA anticipates a further reduction in SO₂ emissions from those facilities potentially impacting the monitor in the future.

In 2014, the facilities above emitted 78,349 tons of SO₂. The shutdown of the Walter C. Beckjord facility, which Ohio EPA has demonstrated in detail is the primary cause of monitored exceedances, will result in a 32,603 ton decrease in SO₂ emissions. Miami Fort Unit 6 (Ohio EPA unit ID B007), an uncontrolled unit, is shutdown as of June 1, 2016 to comply with the Mercury and Air Toxics Standards. (Appendix L of the redesignation request) This will result in a further 18,796 ton reduction from 2014 levels. In total, this represents a reduction in SO₂ emissions of approximately 66% from 2014 levels. As previously demonstrated, no hourly SO₂ values were above the standard have been recorded when emissions from the Walter C. Beckjord facility are eliminated from analysis, and the highest recorded monitor value across this dataset is 34 ppb. When this is considered in light of the substantial reduction in SO₂ emissions in and around the nonattainment area, it is highly unlikely that an exceedance of the standard will be monitored in the future, nor is there likely to be a significant concentration gradient in the nonattainment area given the significant distances between SO₂ emission sources and the nonattainment area.

Lastly, Ohio EPA compiled the first through 30th highest hourly monitored SO₂ concentrations for all hours during the 2012-February 28, 2015 period for which SO₂ emissions from the Walter C. Beckjord facility were zero. These data are presented in Table 1, below.

Monitor 21-037-3002		
Date	Hour	Monitor Value (ppb)
January 14, 2015	10	34
September 2, 2013	7	29
January 14, 2015	9	26
January 6, 2015	19	24
September 4, 2013	17	20
January 14, 2015	11	20
May 17, 2013	12	19
August 22, 2014	11	19
January 8, 2015	1	19
September 22, 2012	9	18
September 2, 2014	17	18
January 5, 2015	9	18
January 6, 2015	21	18
September 2, 2013	6	17
January 6, 2015	18	17
August 27, 2014	15	15
January 9, 2015	22	15
January 6, 2015	17	14
January 6, 2015	20	14
January 9, 2015	21	14
September 30, 2012	10	13

May 17, 2013	11	13
November 12, 2014	16	13
January 5, 2015	13	13
January 22, 2015	16	13
September 14, 2012	11	12
October 9, 2013	10	12
October 28, 2014	15	12
September 30, 2012	11	11
May 25, 2013	11	11

Table 1: Highest hourly monitored SO₂ concentrations, 2012-February 28, 2015, monitor 21-037-3002, Walter C. Beckjord impacts removed.

To maintain conservatism, Ohio EPA eliminated monitor values of zero from the percentile calculation, giving a total of 2,939 non-zero monitor values for which SO₂ emissions from the Walter C. Beckjord facility were zero. Thus, the 99th percentile value of these data is the 29th highest hourly value. This value, 11 ppb, was recorded on September 30, 2012 and is highlighted in Table 1, above.

Ohio EPA has demonstrated that a significant shift in wind directions which impact monitor 21-037-3002 are observed when emissions from the Walter C. Beckjord facility are eliminated from hourly wind and monitor data. From amongst this dataset, the highest monitor value recorded was 34 ppb, and the 99th percentile of the non-zero values is 11 ppb. Further, those sources impacting the monitor in the absence of emissions from the Walter C. Beckjord facility are located 30 to 35 km distant from the monitor and are therefore unlikely to cause a significant concentration gradient across the nonattainment area. Thus, monitor values are considered representative of ambient SO₂ concentrations across the entire nonattainment area. Additionally, a significant reduction in SO₂ emissions is anticipated for those sources in and around the nonattainment area. Taken together, Ohio EPA contends that the monitor is representative of the nonattainment area, that the shutdown of the Walter C. Beckjord facility will bring the monitor and nonattainment area into attainment of the standard, and that no hourly monitored value for the January 1, 2012 to February 28, 2015 study period associated with periods of zero emissions from the Walter C. Beckjord was above the standard.