Ohio Environmental Protection Agency

**John R. Kasich**, Governor
**Mary Taylor**, Lt. Governor
**Craig W. Butler**, Director

JUN 28 2017

Mr. Robert Kaplan
Acting Regional Administrator
U.S. EPA, Region 5
77 West Jackson Blvd.
Chicago, Illinois 60604

Re: Update to Ohio's Recommended Cuyahoga County Designation for 2010 Sulfur Dioxide Standard – Round 3

Dear Administrator Kaplan:

I am writing to update and supplement Ohio's recommended Round 3 designation for the revised $SO_2$ standard for Cuyahoga County, Ohio in light of recent information. Ohio EPA submitted its recommendations for round three designations on January 13, 2017. The designation recommendations were developed in accordance with U.S. EPA's March 20, 2015 memorandum *Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standard*, and were informed by U.S. EPA's August 21, 2015 *Data Requirements Rule for the 2010 1-hr Sulfur Dioxide (SO2) Primary National Ambient Air Quality Standard (NAAQS); Final Rule* (herein referred to as the Data Requirements Rule). The Data Requirements Rule requires characterization of sources with actual emissions greater than 2,000 tons per year (TPY) through modeling or monitoring. Round three designations were based on a five-factor analysis, including refined dispersion modeling for those areas identified by Ohio EPA as meeting the 2,000 TPY emissions criteria established in the Data Requirements Rule.

In that submission, Ohio EPA recommended a designation of unclassifiable/attainment for all of Cuyahoga County. Excluding emissions from retired/retiring boilers and accounting for conversions, the total $SO_2$ emissions from facilities in Cuyahoga County in 2015 was 1,635.31 tons and all four monitors located in Cuyahoga County were attaining the standard, as described in Ohio's previous submission.

However, since our January 13, 2017 recommendations, additional monitoring data has become available for 2016, allowing Ohio EPA to evaluate the 2014 to 2016 air quality period. Inclusion of data from the four Cuyahoga monitors for 2016 has subsequently shown a violation of the standard at the Harvard Yards monitor (39-035-0065) for the 2014 to 2016 air quality period. An investigation of the data indicates that two extended events occurred in February of 2016 resulting in extremely high readings of $SO_2$ at that monitor, each of which spanned two calendar days, resulting in a highest-4$^{th}$-high $SO_2$ value of 370 ppb for 2016, and a 2014 to 2016 design value of 168 ppb for the Harvard Yards monitor. Excluding these four days from consideration,

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the 99th percentile maximum daily 1-hour value for all of 2016 at the Harvard Yards monitor would be 32 ppb, resulting in a 2014 to 2016 design value of 56 ppb, which would be much more in line with the trends demonstrated in the area.

Ohio EPA has subsequently performed an in-depth analysis in an attempt to understand these exceedance periods at the Harvard Yards monitor and determine an appropriate recommendation. Based upon this analysis, Ohio EPA believes that a combination of a malfunctioning large overhead door, the "west end door" of the melt shop at Charter Steel, and specific, infrequent meteorological conditions, was the cause of the exceedances. Ohio EPA believes that the issues leading to these exceedances have been determined and addressed, and that the monitors will continue to monitor attainment moving forward, as they have done in the past. Therefore, Ohio EPA continues to recommend a designation of unclassifiable/attainment for the entirety of Cuyahoga County

I appreciate the opportunity to provide this recommendation and will work cooperatively with U.S. EPA Region 5 staff moving forward. This submittal consists of one (1) hard copy of the required documentation. An exact duplicate electronic version of the submittal in PDF format is available at http://epa.ohio.gov/dapc/SIP/so2.aspx under the heading "Nonattainment Area Recommendation".

If you have any questions concerning this submittal, please feel free to contact Jennifer Van Vlerah of the Division of Air Pollution Control at (614) 644-3696.

Sincerely,

Craig W. Butler
Director

Enclosures

ec: Jennifer Van Vlerah, DAPC

# Supplement to the State of Ohio 2010 Revised Sulfur Dioxide National Ambient Air Quality Standard

## Recommended Area Designations

## Cuyahoga County, Round 3 Designation

Prepared by:

Ohio Environmental Protection Agency

Division of Air Pollution Control

June, 2017

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## Introduction and General Discussion

The United States Environmental Protection Agency (U.S. EPA) promulgated the revised National Ambient Air Quality Standard (NAAQS) for sulfur dioxide ($SO_2$) on June 2, 2010. U.S. EPA replaced the 24-hour and annual standards with a new short-term 1-hour standard of 75 parts per billion (ppb). The new 1-hour $SO_2$ standard was published on June 22, 2010 (75 FR 35520) and became effective on August 23, 2010. The standard is based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations.

On August 15, 2013, U.S. EPA published (78 FR 47191) the initial, first round, $SO_2$ nonattainment area designations for the 1-hour $SO_2$ standard across the country based upon areas with monitored violations (effective October 4, 2013). On March 2, 2015, the U.S. District Court for the Northern District of California accepted as an enforceable order an agreement between the U.S. EPA and Sierra Club and the Natural Resources Defense Council to resolve litigation concerning the deadline for completing designations. As explained in U.S. EPA's March 20, 2015 memorandum *Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standard* (herein referred to as $SO_2$ Designation Guidance), the court's order directs U.S. EPA to complete the remaining designations in three steps: round two by July 2, 2016; round three by December 31, 2017 and round four by December 31, 2020. On July 12, 2016, U.S. EPA published (81 FR 45039) final second-round designations.

Round three and round four designations are to be performed in accordance with U.S. EPA's August 21, 2015 *Data Requirements Rule for the 2010 1-hr Sulfur Dioxide ($SO_2$) Primary National Ambient Air Quality Standard (NAAQS); Final Rule* (herein referred to as the Data Requirements Rule). The Data Requirements Rule requires characterization of sources with actual emissions greater than 2,000 tons per year (TPY) through modeling or monitoring. Ohio EPA submitted its recommendations for round three designations on January 13, 2017. Ohio's round three recommended designations were performed based on modeling these larger sources and, for areas that do not contain $SO_2$ sources that would require further characterization, based on $SO_2$ emissions levels and available monitoring data for the 2013 to 2015 air quality period.

### <u>Cuyahoga County</u>

Following the method described in the section "Ohio EPA's Approach" under Chapter 1 of the January 13, 2017 document *State of Ohio 2010 Revised Sulfur Dioxide National Ambient Air Quality Standard Recommended Area Designations Round 3* (herein referred to as Ohio Round 3 Designations Document), Ohio EPA recommended a designation of unclassifiable/attainment for all of Cuyahoga County. Excluding emissions from retired/retiring boilers and accounting for conversions, the total $SO_2$ emissions from facilities in Cuyahoga county in 2015 was 1,635.31 tons and all four monitors located in

Cuyahoga County were attaining the standard, as described in the Ohio Round 3 Designations Document.

However, since our January 13, 2017 recommendations, additional monitoring data has become available for 2016, allowing Ohio EPA to evaluate the 2014 to 2016 air quality period. Inclusion of data from the four Cuyahoga monitors for 2016 has subsequently shown a violation of the standard at the Harvard Yards monitor (39-035-0065) for the 2014 to 2016 air quality period. An investigation of the data indicates two extended events occurred in February of 2016 resulting in extremely high readings of $SO_2$ at that monitor, each of which spanned two calendar days, resulting in a highest-4$^{th}$-high $SO_2$ value of 370 ppb for 2016, and a 2014 to 2016 design value of 168 ppb for the Harvard Yards monitor.

## Ohio EPA Assessment of Cause and Recommendation

Ohio EPA has subsequently performed an in-depth analysis in an attempt to understand these exceedance periods at the Harvard Yards monitor and determine an appropriate recommendation. Based upon this analysis, Ohio EPA believes that operating issues with a large overhead door, the "west end door" of the melt shop at Charter Steel, combined with specific, infrequent (see Section "Assessment of Exceedance Periods at Harvard Yards Monitor", subsection "High Winds Analysis") meteorological conditions, was the cause of the exceedances. Ohio EPA has considered, and will discuss in this document, the following in assessing these exceedances at the Harvard Yards monitor in Cuyahoga County:

- Historical monitoring data for the five most recent years of $SO_2$ monitor data for all monitors in Cuyahoga County
- Factors surrounding the exceedance period including operations of surrounding facilities - particularly the west end door at Charter Steel, wind direction analysis, modeling analyses, and infrequent high winds at the time of exceedances.
- Measures being taken to ensure attainment moving forward including the replacement of the west end door at Charter Steel and the current Charter Steel permit in progress to expand melt shop production capabilities, limit hourly $SO_2$ emissions, and place restrictions on the west end door of the melt shop

These analyses validate Ohio EPA's belief that these exceedances were unique, unlikely occurrences resulting from a combination of fugitive emissions due to Charter Steel's malfunctioning west end door and infrequent meteorological conditions. Restrictions are being included in a federally enforceable permit in progress for Charter Steel which will provide for attainment of the 2010 $SO_2$ NAAQS in the affected area. As a result, Ohio EPA believes that the issues leading to these exceedances have been determined and addressed, and that the monitors will continue to monitor attainment moving forward, as they have done in the past. Therefore, Ohio EPA continues to recommend a designation of unclassifiable/attainment for the entirety of Cuyahoga County.

## Historical Monitoring Analysis at Cuyahoga County Monitors

There are four $SO_2$ monitors in Cuyahoga County: 39-035-0038, 39-035-0045, 39-035-0060, and 39-035-0065, shown in Figure 1. As stated previously, 39-035-0065, just north of Charter Steel is the Harvard Yards monitor at which the exceedance periods in question occurred.

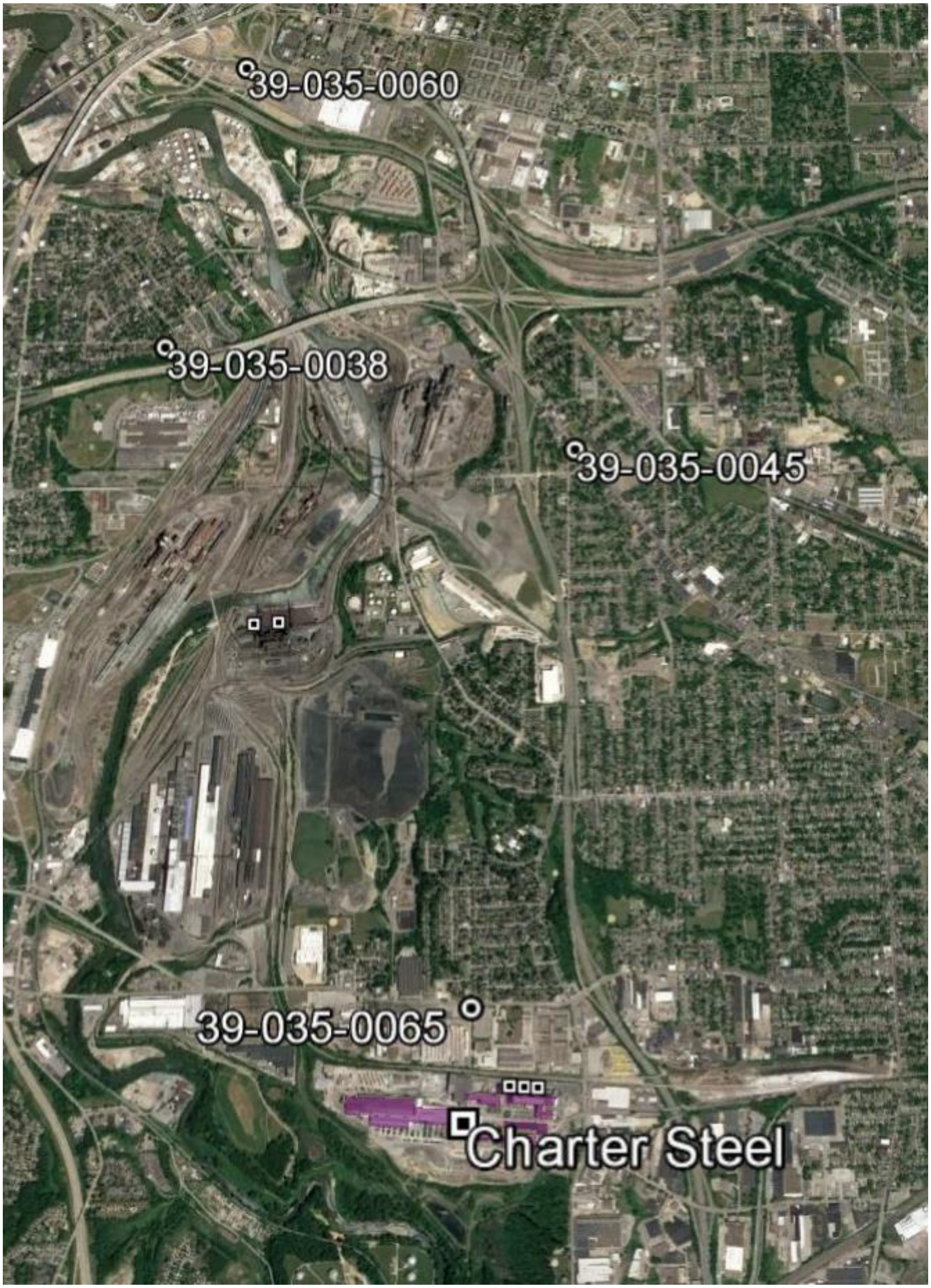


Figure 1: Cuyahoga Monitors and Charter Steel

The three most recent three-year design values (2012-2014, 2013-2015, 2014-2016), and past five years (2012 – 2016) 99$^{th}$ percentile concentration values, for all four monitors are shown in Table 1. The single-year 99$^{th}$ percentile values at all four monitors show that $SO_2$ values at these monitors have generally been decreasing over this time period, and have declined to mostly be below the 75 ppb NAAQS. This is clearly seen in the three-year design values at all four monitors which generally decrease or stay approximately the same for each successive design value at a given monitor for the three most recent design values shown. However, as Table 1 shows, the 2016 99$^{th}$ percentile value for the Harvard Yards monitor is 370 ppb, which is a clear outlier in this table, and results in the 2014-2016 design value of 168 ppb, which is also an outlier among design values at that, or any other, monitor in Cuyahoga County for any of the most recent three, three-year periods. No other three-year design value for any three-year period at any of the four monitors is above the 75 ppb NAAQS. This 2016 99$^{th}$ percentile value at the Harvard Yards monitor is extremely out of the ordinary for that monitor or any of the other monitors in Cuyahoga County, and is counter to the $SO_2$ value trends in Cuyahoga County over the past five years.

Table 1: Cuyahoga County monitors, maximum daily values and 3-year design values

| Cuyahoga County Sulfur Dioxide Monitor Design Values | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 99th Percentile Maximum Daily 1-hour Values (ppb) | | | | | 3-Year Design Values (ppb) | | |
| | 2012 | 2013 | 2014 | 2015 | 2016 | 2012-2014 DV | 2013-2015 DV | 2014-2016 DV |
| **39-035-0038** | 83 | 63 | 65 | 59 | 53 | 70 | 62 | 59 |
| **39-035-0045** | 88 | 18 | 17 | 32 | 19 | 41 | 22 | 23 |
| **39-035-0060** | 80 | 66 | 53 | 63 | 38 | 66 | 61 | 51 |
| **39-035-0065** | 104 | 30 | 80 | 55 | 370 | 71 | 55 | 168 |

This high value for 2016 at the Harvard Yards monitor is driven by the February exceedance periods in question. Clearly, based on the decreasing values from 2015 to 2016 at the other three monitors in Cuyahoga County, it is not the case that the $SO_2$ concentration levels in the area increased in general in 2016, but rather, something uniquely impacted only the Harvard Yards monitor to an extreme level. Indeed, considering the 2016 $SO_2$ data at the Harvard Yards monitor, the two extended exceedance events in question each spanned two days (February 20, 2016 – February 21, 2016, and February 28, 2016 – February 29, 2016). The 370 ppb value shown in Table 1, which is the 99$^{th}$ percentile value for 2016, is the 4$^{th}$-highest maximum daily value for the year, and since both of these extreme events spanned two calendar days, the 4$^{th}$-highest maximum daily value for the year is simply the lowest of the maximum daily values from these four days impacted by these two extreme events – February 28, 2016. Excluding these four days from consideration, the 99$^{th}$ percentile maximum daily 1-hour value for all of 2016 at the Harvard Yards monitor would be 32 ppb, resulting in a 2014-2016 design value of 56 ppb, which would be much more in line with the trends demonstrated in the area. Looking at the hourly $SO_2$ data from the monitor for the entire year, shown in Figure 2 below, the drastic extent to which these exceedance events in February of 2016 exceed typical concentrations at the monitor can be clearly observed. In fact, after these exceedance periods in February of 2016, the highest maximum daily values for the remainder of the year were 28 ppb on November 19th, 2016 and 16 ppb on November 15th, with most of the rest of the year far lower still.

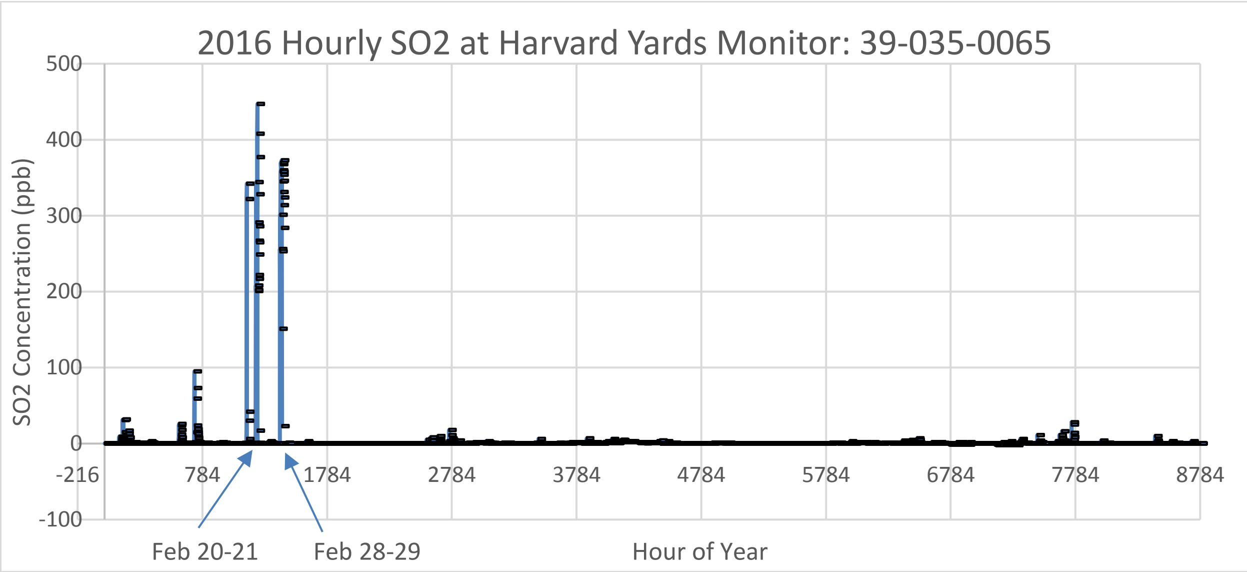


**Figure 2: Sulfur Dioxide at the Harvard Yards monitor for all hours in 2016**

Further, the abruptness and extreme magnitude over normal levels is clear when considering the concentrations just before and after these events. As shown in Table 2, $SO_2$ concentrations at the Harvard Yards monitor were 0 ppb for hours before and after both of these events. In each case, $SO_2$ concentrations went from 0 ppb one hour to over 200 ppb the very next, and the drop back to 0 ppb after the events was almost as abrupt, in each case with only one transition hour as concentrations dropped from over 300 ppb to 0 ppb over the course of two hours. This can also be seen later in this document in Figure 9 and Figure 13.

Table 2: Hourly $SO_2$ data during and surrounding exceedance periods

| First Exceedance Period | | | Second Exceedance Period | | |
|---|---|---|---|---|---|
| Date | Hour | $SO_2$ (ppb) | Date | Hour | $SO_2$ (ppb) |
| 20160220 | 4:00 | 0 | 20160228 | 9:00 | 0 |
| 20160220 | 5:00 | 0 | 20160228 | 10:00 | 0 |
| 20160220 | 6:00 | 0 | 20160228 | 11:00 | 0 |
| 20160220 | 7:00 | 0 | 20160228 | 12:00 | 0 |
| 20160220 | 8:00 | 0 | 20160228 | 13:00 | 256 |
| 20160220 | 9:00 | 0 | 20160228 | 14:00 | 151 |
| 20160220 | 10:00 | 0 | 20160228 | 15:00 | 301 |
| 20160220 | 11:00 | 208 | 20160228 | 16:00 | 253 |
| 20160220 | 12:00 | 201 | 20160228 | 17:00 | 345 |
| 20160220 | 13:00 | 202 | 20160228 | 18:00 | 358 |
| 20160220 | 14:00 | 344 | 20160228 | 19:00 | 360 |
| 20160220 | 15:00 | 291 | 20160228 | 20:00 | 368 |
| 20160220 | 16:00 | 217 | 20160228 | 21:00 | 370 |
| 20160220 | 17:00 | 222 | 20160228 | 22:00 | 358 |
| 20160220 | 18:00 | 267 | 20160228 | 23:00 | 354 |
| 20160220 | 19:00 | 249 | 20160229 | 0:00 | 331 |
| 20160220 | 20:00 | 265 | 20160229 | 1:00 | 346 |
| 20160220 | 21:00 | 286 | 20160229 | 2:00 | 314 |
| 20160220 | 22:00 | 328 | 20160229 | 3:00 | 284 |
| 20160220 | 23:00 | 408 | 20160229 | 4:00 | 373 |
| 20160221 | 0:00 | 447 | 20160229 | 5:00 | 324 |
| 20160221 | 1:00 | 377 | 20160229 | 6:00 | 23 |
| 20160221 | 2:00 | 17 | 20160229 | 7:00 | |
| 20160221 | 3:00 | 0 | 20160229 | 8:00 | |
| 20160221 | 4:00 | 0 | 20160229 | 9:00 | 0 |
| 20160221 | 5:00 | 1 | 20160229 | 10:00 | 0 |
| 20160221 | 6:00 | 0 | 20160229 | 11:00 | 0 |
| 20160221 | 7:00 | 0 | 20160229 | 12:00 | 0 |
| 20160221 | 8:00 | 0 | | | |
| 20160221 | 9:00 | 0 | | | |

The extreme magnitudes and infrequency of these exceedance periods, their abrupt beginning and ending amidst periods of normal very low concentrations, as well as the trend of decreasing $SO_2$ concentration values in Cuyahoga County in general, suggest that these periods are unique, outlying events that should be further investigated. If sufficiently accounted for and corrected, they should not bear on the designation for Cuyahoga County in spite of the exceeding 2014-2016 design value at the Harvard Yards monitor, as they are not representative of the current $SO_2$ conditions in Cuyahoga County. As such, Ohio EPA has performed a more detailed analysis of these exceedance periods.

It should be noted there was another event on February 17, 2016 with exceedance levels commensurate with the two events analyzed as a part of these analyses. However, this event only spanned a two-hour period and given such a small data set would not be as appropriate to analyze compared to the two longer spanning events. For over 24 hours prior to this smaller, February 17 event, the Harvard Yards monitor recorded 0 ppb as the $SO_2$ concentration. Then at 9:00 am the concentration was 30 ppb, followed by 322 ppb, 342 ppb, 42 ppb, and 6 ppb the subsequent hours before returning to 0 ppb at 2:00 pm February 17, 2016. Though nearly as large in magnitude, this duration of 2 hours with surrounding hours is incomparable to the other two events discussed in this document, each of which span over 15 hours. The types of analyses performed on these other exceedance events would be less meaningful and more difficult to apply to this small event. Further, as discussed above, even if this February 17 event were considered, but the other exceedance events removed from consideration, the 99$^{th}$ percentile maximum daily 1-hour value for all of 2016 at the Harvard Yards monitor would be 32 ppb. Given the magnitude of this event, it is likely its cause was the same as, or similar to, that of the other two exceedance periods, but for the reasons described here, further analysis of it will not be instructive. As such, this event is excluded from the further analyses.

## Assessment of Exceedance Periods at Harvard Yards Monitor

### <u>Introduction</u>

Charter Steel produces special bar quality coiled-rod and coiled-bar products using an electric arc furnace (EAF), ladle metallurgical refinement, deep vacuum tank degassing and an advanced billet caster. Charter Steel serves customers in the aerospace, bearing, cold heading, free-machining and high quality spring markets. Scrap metal is brought into the melt shop through the west end door, where it is added to the electric arc furnace. The general layout of the facility in relation to the monitor and the location of the west end door of the melt shop is shown in Figure 3 and Figure 4. Different grades of steel are produced, some of which require sulfur addition at either the EAF or at the ladle metallurgy/refining furnace; therefore, productions of certain grades of steel may result in greater $SO_2$ emissions. Emissions from the melt shop are controlled by a single dedicated positive pressure baghouse.

Due to the nature of EAFs, emissions from an EAF are essentially fugitive emissions within the melt shop as soon as they are created. Emissions must be captured and directed to the baghouse. As stated in the *Emission Factor Documentation for AP-42 Section 5.1, Iron and Steel Production – Steel Minimills Final Report*, "emissions from the steelmaking process are generally captured using direct shell evacuation supplemented with a canopy hood located above the EAF. In general, the captured gases and particulate from the EAF are routed to baghouses for PM control. Some minimills have a common baghouse through which emissions from the EAF as well as emissions from the ladle metallurgy process and/or continuous caster are ducted and subsequently controlled". This is the case at Charter Steel. Emissions from the EAF are essentially emitted into the melt shop, and while there, it is clear that disturbances in the necessary pressure drops to route emissions to the baghouse could drastically change where these essentially free-floating emissions would go. For instance, a large door like the west end door being open could affect the pressure within the building and significantly influence the flow of EAF emissions more than other types of sources since the emissions from the EAF must be captured rather than directly routed in the first place.


Figure 3: Charter Steel layout and proximity to Harvard Yards monitor

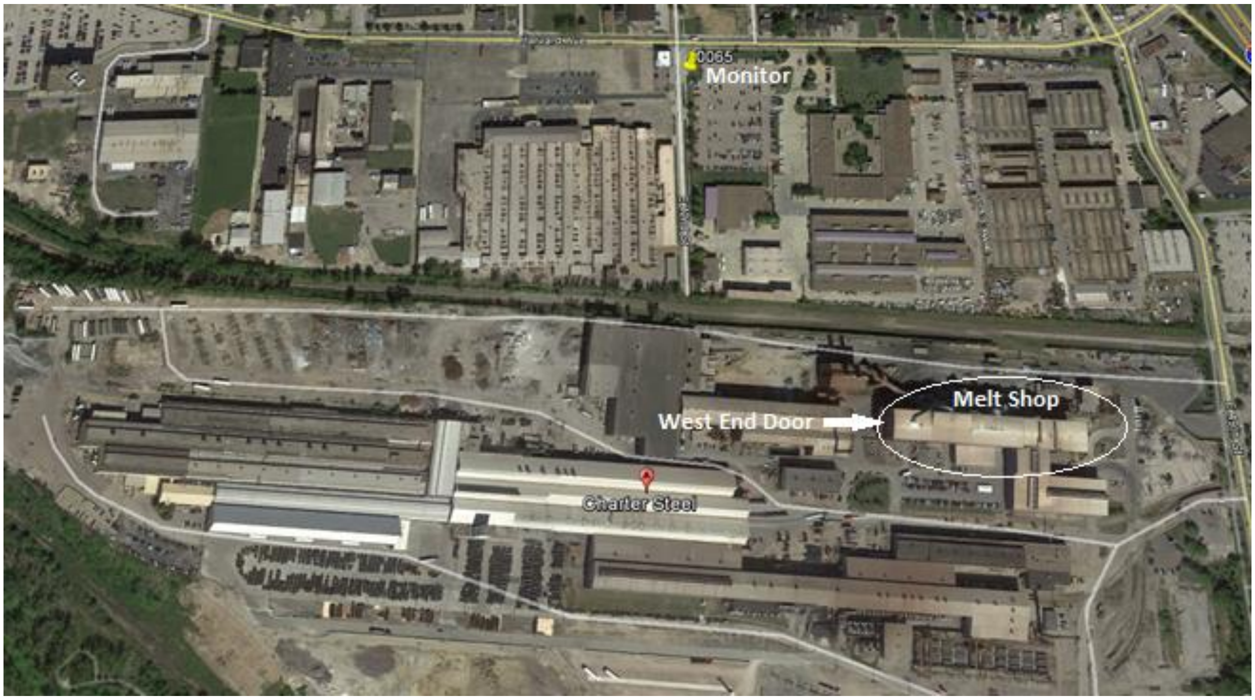


Figure 4: Overhead view of Charter Steel and Harvard Yards monitor location

Previously, AECOM provided a report to Charter Steel in December, 2009 concerning its emissions capture processes titled *Field Investigation Report and Process Design Final Design for Baghouse Improvements*. In this report, AECOM noted that "Significant fumes are escaping the EAF roof into the melt shop during the melting and refining processes", which "are continuous and contribute to poor melt shop air quality". It was stated additionally, however, that "fumes should not be escaping from the EAF roof, since the recorded EAF hood pressure during melting ranges from -2 to -7" W.C. The pressure transmitter may be providing false readings or it is located in a position conducive to providing false readings". Clearly, from these statements in AECOM's report, it can be seen that despite Charter Steel's control devices at the EAF, Charter Steel has a history of emissions escaping into the melt shop. Notably, if the hood pressure which should eliminate the escape of fumes into the melt shop is not what it should be, fumes escaping would be more expected. A door the size of the west end door being open would certainly have the potential to influence the needed pressure in such systems. In addition to the Direct Evacuation Control system which fumes were escaping, as described above, Charter Steel has, and had at the time, a Canopy Hood to capture and vent emissions within the melt shop. However, the AECOM report also states that, "although adequate flow is provided, fumes were observed to rise up to the canopy hood area and tended to drift westward. Most of the fumes were not contained in the hood storage area". Additionally, "fume emissions rising to the canopy hood area were not well contained and drifted across the structural steel of the building roof. Emissions escaping the tapping hood are also partially captured by the canopy hood with similar observations of poor containment and lateral drift”. AECOM noted, concerning these fumes in the melt shop that they “are generally contained within the melt shop because it is under negative pressure”. However, it is clear that if anything were to interrupt the melt shop from maintaining this negative pressure, emissions could escape. The west end door being open certainly could cause this to be the case, potentially leading to significant flux of emissions out the west end door. This would be especially true during weather conditions conducive to the flow of emissions out of the door, as may have been the case during the February 2016 exceedance periods, which will be discussed further later in this document. The fugitive nature of emissions from processes at Charter Steel, such as an EAF, make the escape of emissions from a large open door like the west end door possible.

Charter Steel was subject to the September 28, 2012 Consent Agreement and Final Order (CAFO) CAA-05-2012-0051 where U.S. EPA found Charter Steel to be in violation of the Ohio State Implementation Plan (SIP), in part, for requirements related to the six percent opacity limitation from the melt shop building. The CAFO required a supplemental environmental project to be completed by December 31, 2013 in the form of a new roof ventilation hood and ducting to collect fumes from the west end of the melt shop. This new roof ventilation hood was largely intended to assist in remedying the issues described in the AECOM report mentioned previously by better collecting the fumes that escape from the EAF roof and other components which end up near the roof at the west end of the melt shop, as described in that report, and route them to the baghouse. However, this new hood is still just another device to better capture what are essentially fugitive emissions already in the melt shop, and which could certainly escape through the west end door before being able to be captured by the hood. In addition to the CAFO, Charter Steel was subject to the September 28, 2012 Administrative Consent Order (ACO) EPA-5-12-113(a)-OH-03. In this ACO, U.S. EPA required Charter Steel to implement best management practices, as an interim measure, designed to maintain compliance with the six percent opacity limitation. Specifically, Charter Steel was required to keep the west end door closed at all times except for times when a scrap card was entering or exiting the melt shop. Clearly, during U.S. EPA’s investigation it was apparent fugitive emissions capable of exceeding the six percent opacity limitation could escape the west end door when it was in the open position.

Additionally, the City of Cleveland Department of Air Quality (CDAQ) performed a check of visible emissions (VE) (via U.S. EPA Test Method 22) from the melt shop building at Charter Steel on four occasions in October of 2016. CDAQ made a total of 240 minutes of VE observations over the four days and observed a total of 10 minutes and 36 seconds of VEs at the west end door during periods of time when the door was open. CDAQ did not observe VE for any other egress points of the building. As such, fugitive emissions still occur from the west end door when open despite improvements made as part of the CAFO’s supplemental environmental project, as would be expected if the open west end door impacts the needed pressure in the melt shop for the proper capture of emissions by the ventilation hoods.

## Investigation of Exceedance Periods

CDAQ identified high sustained $SO_2$ readings at the $SO_2$ monitor at 4600 Harvard Ave, monitor number 39-035-0065, from 11:00 AM February 20, 2016 until 2:00 AM February 21, 2016. These high readings prompted investigation into what the potential reasons could be for the high concentrations. It was determined that the wind was predominantly coming from the West and Southwest over that time period. CDAQ promptly contacted facilities in the area with $SO_2$ emissions to inquire about operations and potential malfunctions during that time period. In response to this inquiry by CDAQ, no facilities in the area, except Charter Steel, reported any unusual operational events or malfunctions over this time period. Charter, however, communicated that over that weekend (February 20-21, 2016) they were operating the melt shop, with no unusual operational events, however, they did communicate that the large overhead door on the west end of the melt shop building malfunctioned and was stuck open the entire weekend due to high winds. Charter Steel reported that high winds can disengage the door from its guide tracks and the west end door is the only way to transport scrap inside the melt shop building via the scrap car. Charter Steel also noted when the west end door is up, it is possible for fugitive emissions to escape the building through that opening.

Further communication with Charter Steel revealed that the overhead door was closed by at least February 25, 2016, when it was repaired during a maintenance outage. However, the west end door again malfunctioned under high wind conditions and was stuck in the open position sometime during the night of February 26, 2016 and remained open until 10:30 AM March 1, 2016 – a time span which encompasses the extent of the second major exceedance period in question. CDAQ identified high sustained $SO_2$ readings at the Harvard Yard monitor from 1:00 PM February 28, 2016 until 5:00 AM February 29, 2016. It was determined that the wind was predominantly coming from the West and Southwest over that time period and Charter Steel was operating the melt shop

A number of analyses have been performed which determine the probability, and likelihood, of emissions from the west end door at Charter Steel impacting the Harvard Yards monitor to the level of the $SO_2$ exceedance periods in question. As the monitor data for the previous years at the monitors in this region show, the high $SO_2$ readings at the Harvard Yards monitor during the exceedance periods in question are noticeably distinct across all four monitors in the area over the previous four years of collected $SO_2$ data. A distribution of the SO2 concentration values from the Harvard Yards monitor for all of 2016 is shown in Figure 5. This data reveals that the vast majority (96.5%) of $SO_2$ hourly readings are less than 50 ppb. Additionally, a gap is present such that only three hours had concentrations between 50 and 100 ppb, and there were no hours with a concentration between 100 and 150 ppb. However, there are a number of outlying hours with very high concentrations, centered on the 300-350 ppb range. These occurrences of high concentrations are entirely from hours during the exceedance periods in question except for two which occurred on February 17, 2016[1], which was a smaller but similar exceedance period to the two main periods.

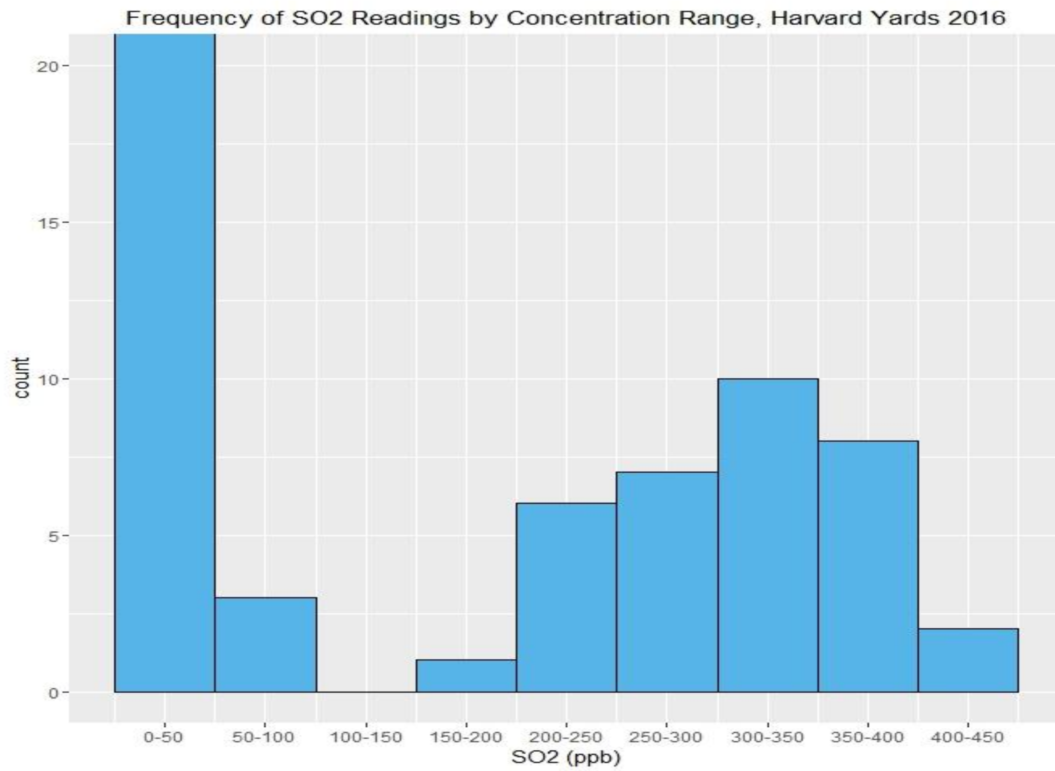


**Figure 5: Frequency of SO2 concentration readings at the Harvard Yard monitor in different concentration ranges. Note, the 0-50 column in this figure is truncated, as every hourly reading in 2016, less those shown in the other ranges, falls into the 0-50 range. Showing the entirety of the 0-50 column dwarfs all other columns at all monitors.**

The large gap between the typical concentration at this monitor and the high values, as well as the inconsistent distribution show the extent to which these concentrations are outliers from distinct, specific events, rather than just the high end of normal conditions one would see under normal operating scenarios. Further demonstrating how anomalous concentrations in the range of these exceedance events are, not a single concentration above 150 ppb was recorded at any of the other monitors in Cuyahoga County at any point from 2012 to 2016, as Figure 6 shows.

[1] As discussed in the Historical Monitoring Analysis section above, this event only spanned a two-hour period and given such a small data set would not be as appropriate to analyze compared to the two longer spanning events.

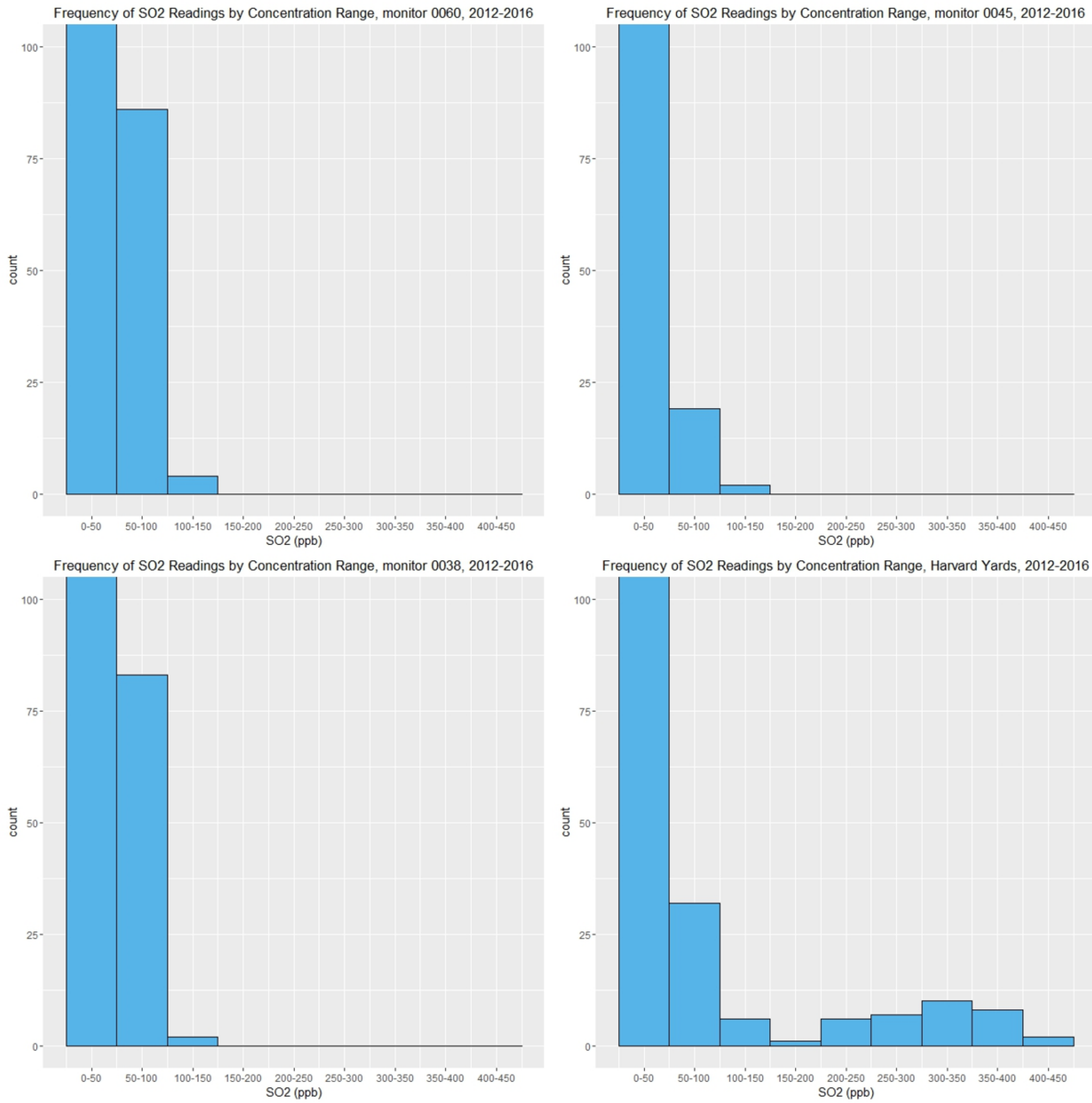


**Figure 6: Cuyahoga County monitors, frequency of SO2 readings by concentration range over 5 years: 2012-2016. Note, the 0-50 column in each figure is truncated, as every hourly reading over the 5-year period, less those shown in the other ranges, falls into the 0-50 range for all monitors. Showing the entirety of the 0-50 column dwarfs all other columns at all monitors.**

Additionally, no readings above the 100-150 ppb range occurred at the Harvard Yards monitor for the entirety of the years 2012-2015, as Figure 7 shows. As such, the exceedance periods in question, along with the two hours on February 17, 2016 discussed previously, represent the only hours across five years of data from all four monitors in Cuyahoga County which exceeded 150 ppb. These events, therefore, are not a normal occurrence from any standard operations of any facilities in the area, but instead must have been unique events caused by a specific and rare incident.

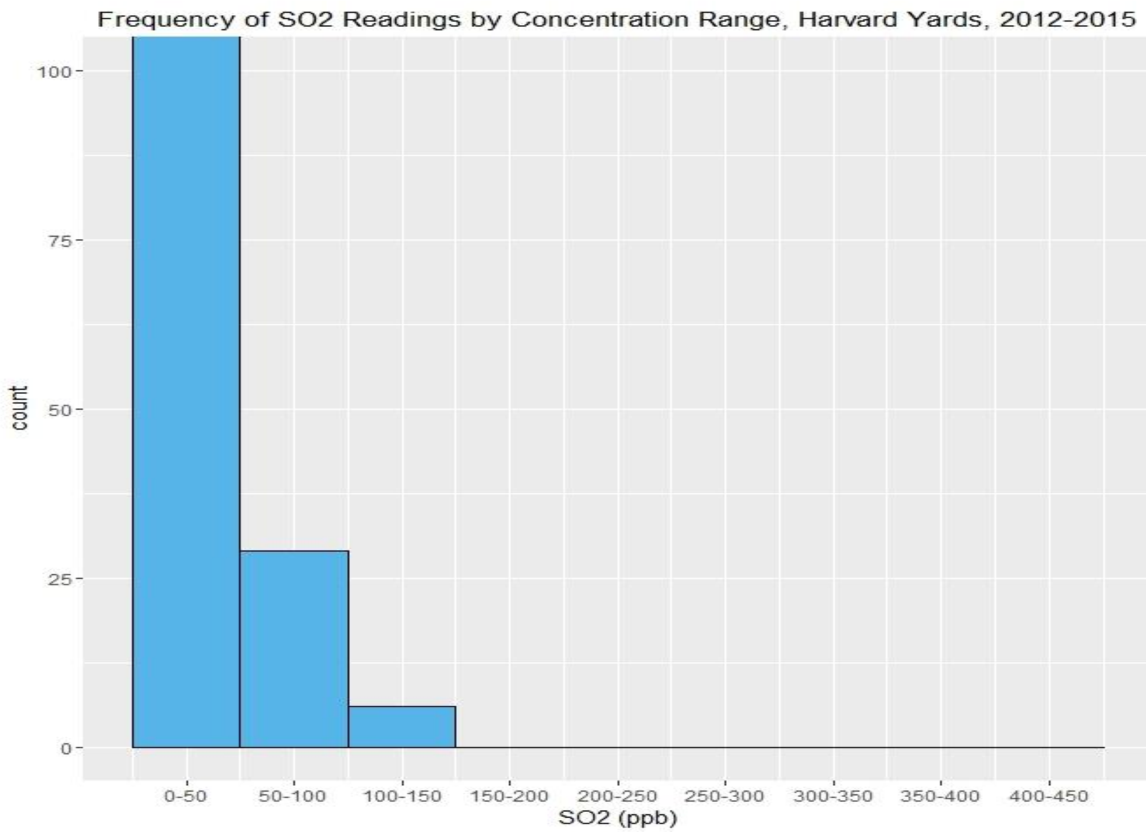


**Figure 7: Harvard Yards monitor $SO_2$ concentration range frequency, excluding 2016 and the exceedance periods therein. Note, the 0-50 column in this figure is truncated, as every hourly reading over the 4-year period, less those shown in the other ranges, falls into the 0-50 range. Showing the entirety of the 0-50 column dwarfs all other columns.**

## Wind Direction Analysis

Meteorology data from Cleveland Hopkins International Airport (Station ID: 14820) for all hours from 2014 to 2016 reveals the strongest prevailing wind components coming from the South and Southwest, with a smaller, but still dominant, component from the Northeast, as shown in Figure 8. This also shows that much of the time, the wind blows in a direction roughly from Charter Steel toward the Harvard monitor, and as such the likelihood that Charter Steel may affect the concentrations at the monitor is high.

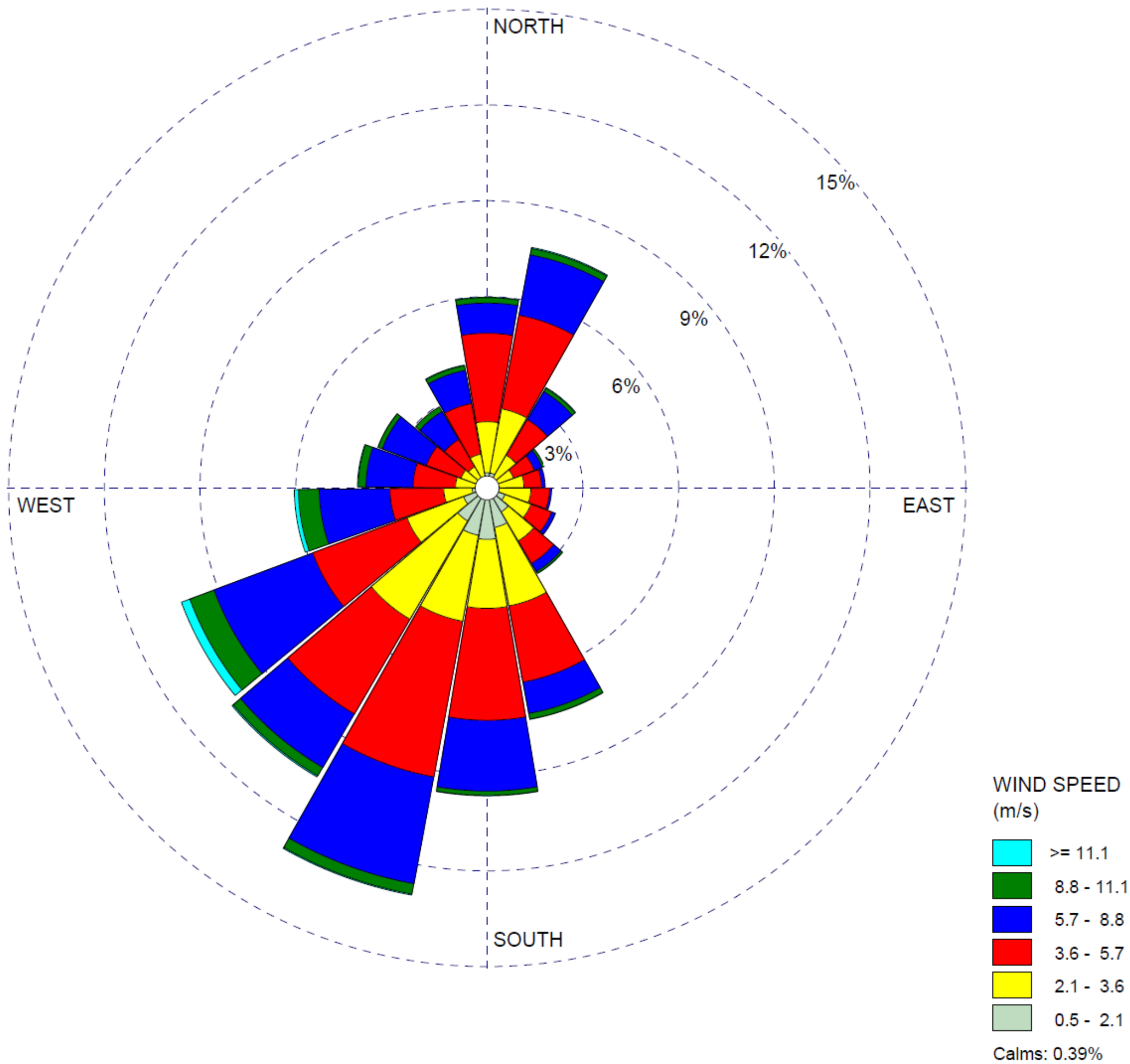


**Figure 8: Windrose for all hours of 2014 through 2016 at Cleveland Hopkins International Airport Meteorological Station**

To begin to investigate the likelihood of the malfunctioning west end door at Charter Steel contributing to the high $SO_2$ concentrations for the exceedance periods in question, an analysis was performed using the $SO_2$ concentration data and meteorology data for these periods. As mentioned above, and shown in Figure 9, $SO_2$ concentrations were very high most of February 20, 2016, and fell to typical levels just after midnight February 21, 2016.

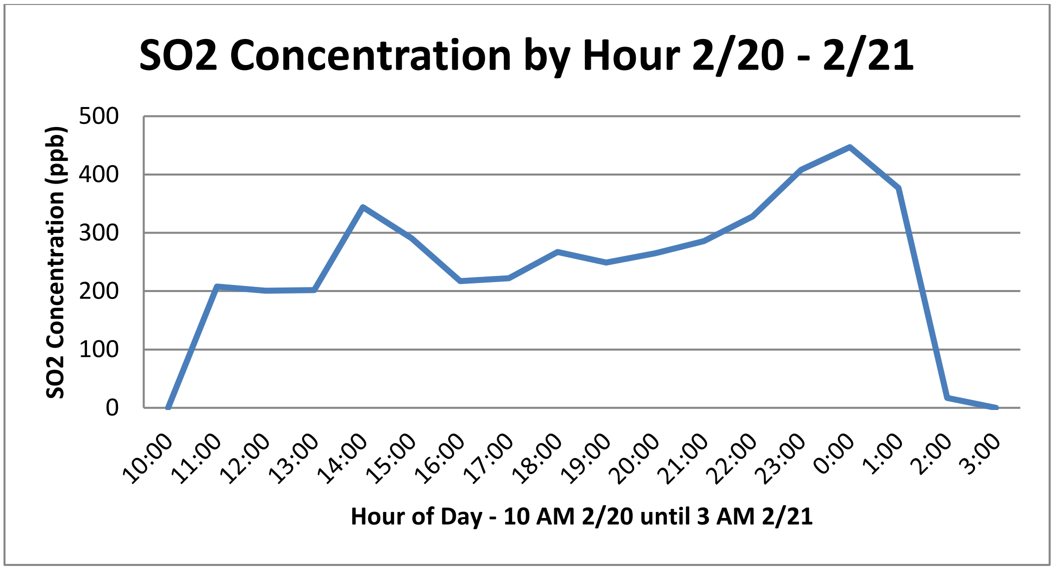


**Figure 9: Period of High $SO_2$ concentration during February 20, 2016 and early February 21, 2016**

During the entirety of February 20, 2016 and February 21, 2016 the west end door was open, as stated previously. However, the meteorology data shows that the wind behaved very differently on February 20, 2016 as compared to February 21, 2016 if a 24-hour windrose is viewed. Figure 10 and Figure 11 show the 24-hour windroses for February 20, and February 21, 2016, respectively. Figure 12 shows the windrose for the entirety of the exceedance period (February 20, 2016 at 11:00 AM through February 21, 2016 at 1:00 AM). On February 20, 2016 and more specifically during the exceedance period, the wind came almost exclusively from the South and Southwest, close to the direction of Charter Steel, while on February 21, 2016, or essentially just after the exceedance period, the wind came almost exclusively from the North and Northeast.

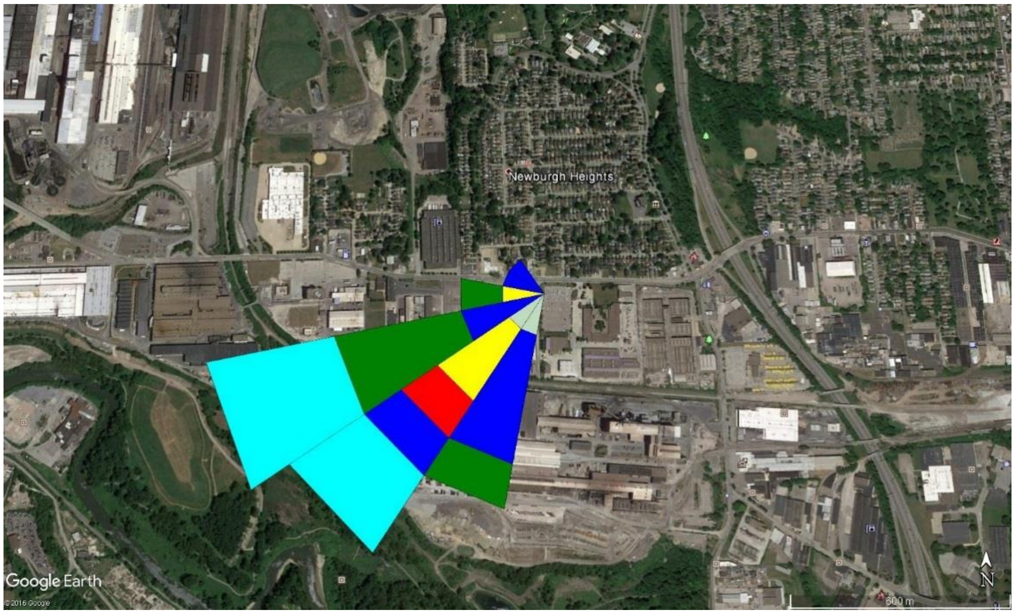


Figure 10: Windrose for all hours of February 20, 2016

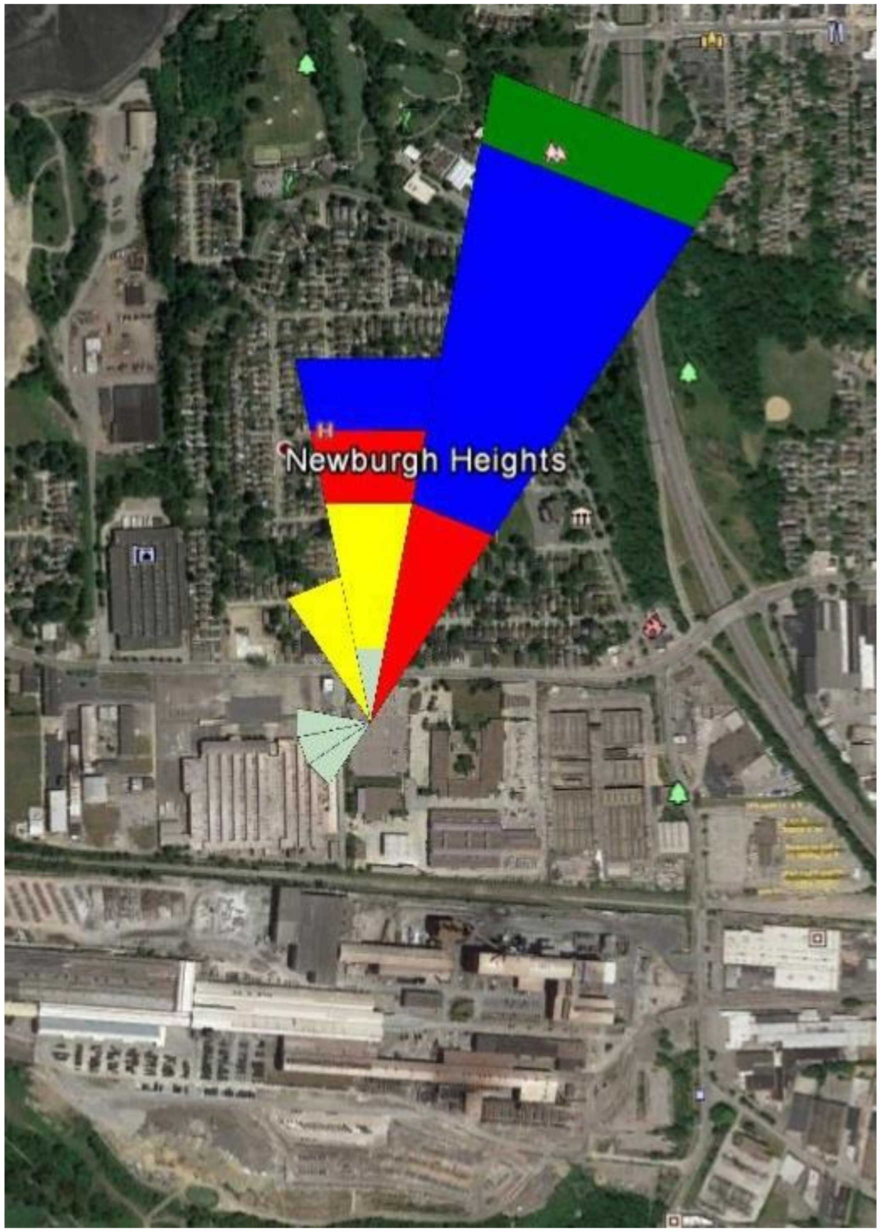


Figure 11: Windrose for all hours of February 21, 2016

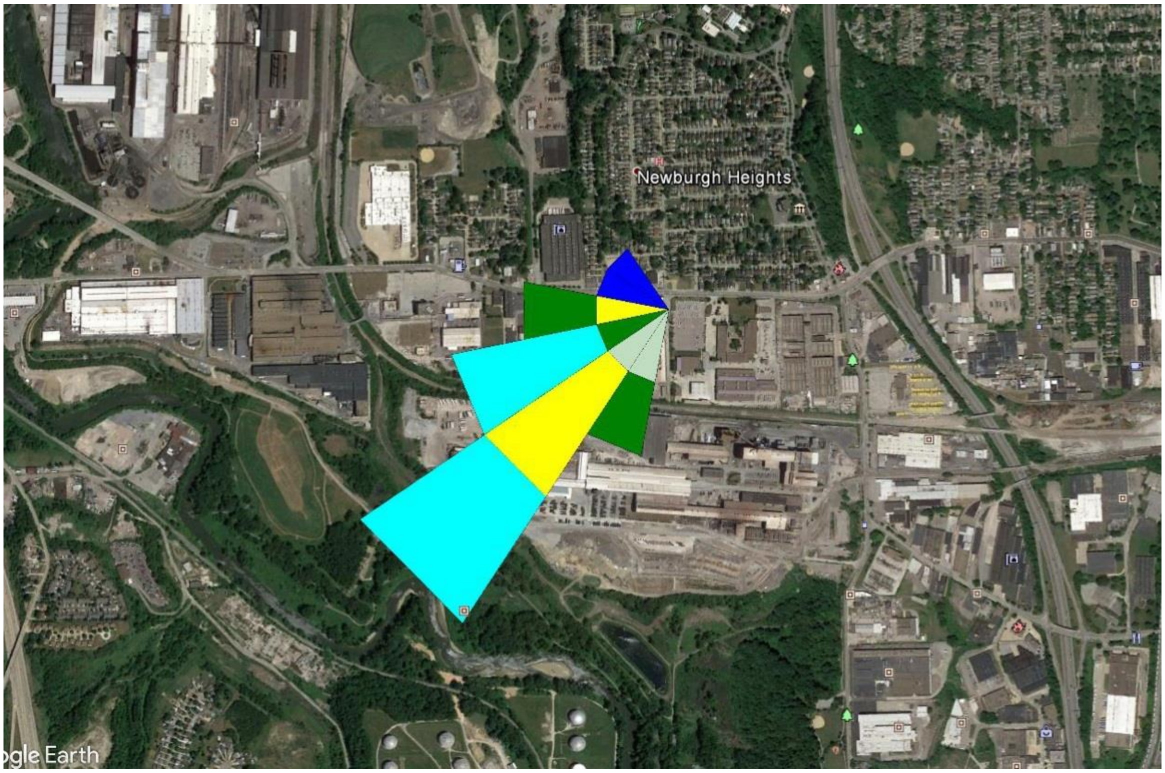


Figure 12: Windrose for February 20, 2016 through February 21, 2016, exceedance period hours only

The substantial drop in $SO_2$ concentration starting after the1:00 AM hour on February 21, 2016, combined with the drastic shift in wind direction from the exceedance period to the remainder of February 21, 2016 demonstrates that the source of $SO_2$ must be from the South-Southwest, the direction of Charter Steel. This, in combination with the knowledge of the malfunctioning west end door at Charter Steel forcing it to remain in the open position for this full time period, strongly suggested that the door being open contributed to heightened $SO_2$ concentrations in the area surrounding the monitor.

The status of the door from February 22, 2016 until it was fixed on February 25, 2016, and the operational status of Charter Steel is unclear, but it seems likely that it remained open for this time period as February 25, 2016 is when it is stated as having been fixed. However, no high $SO_2$ concentrations occurred again until February 28, 2016, at which time it is known the door was open again (from sometime late February 26, 2016 until 10:00 AM March 1, 2016).

The second extended period of high $SO_2$ concentration occurred on February 28, 2016 and February 29, 2016, as shown in Figure 13. The windrose for the hours during this exceedance period is shown in Figure 14.

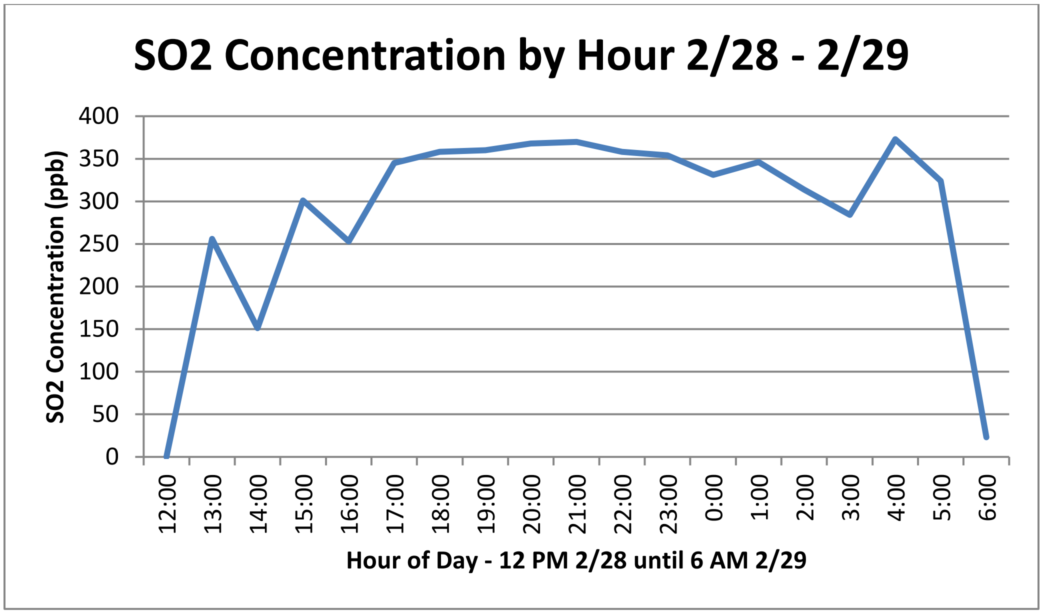


Figure 13: Period of High SO2 concentration during February 28, 2016 and early February 29, 2016

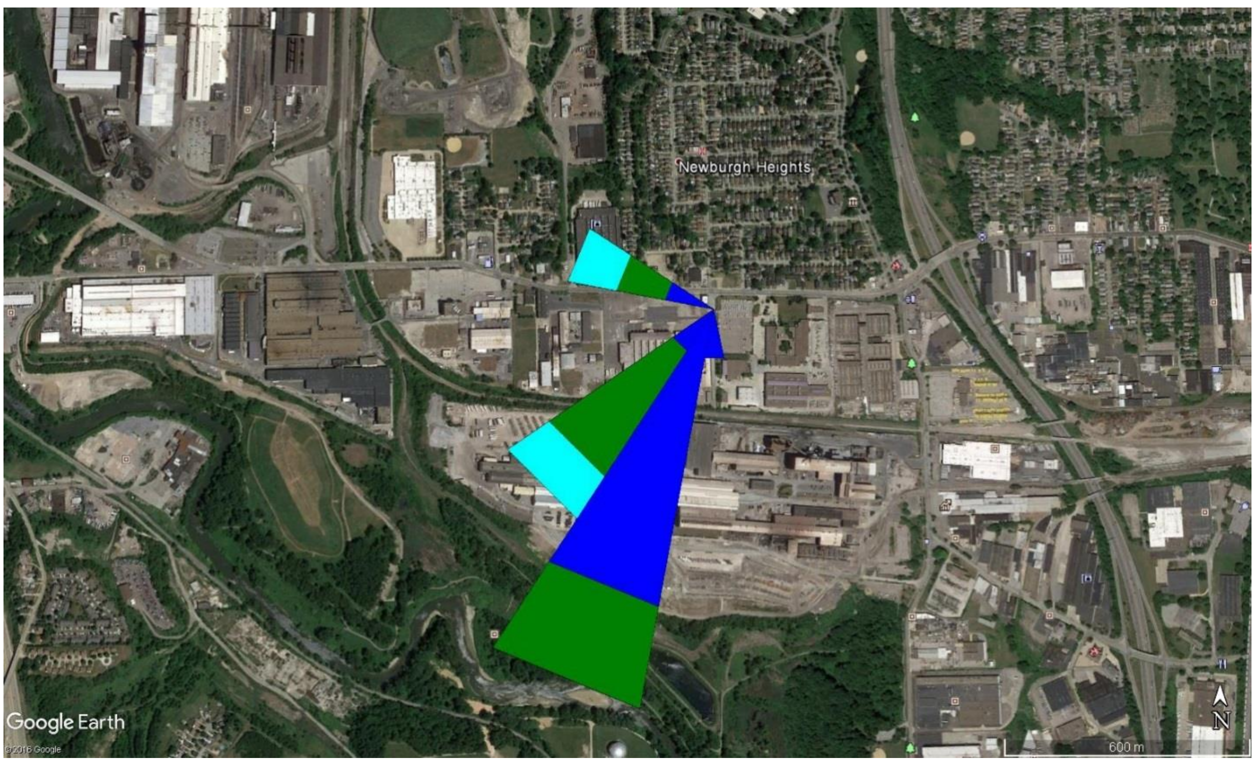


Figure 14: Windrose for exceedance period hours February 28 and February 29, 2016

Again, as shown by the windrose, this period of high $SO_2$ concentration occurs during a time period over which the malfunctioning west end door at Charter Steel was stuck open, and the wind was coming predominantly from the South-Southwest toward the Harvard Yards monitor. The wind direction for most of these hours is between 180 – 220 degrees. However, as shown in the windrose, there is a small component of wind coming more from the West-Northwest. This component is from the last three hours of the exceedance period, from 300 AM to 6:00 AM on February 29, 2016. For each of these three hours the wind direction was 290 degrees. It should be noted that this wind direction was not present at any other time during this exceedance event, and in fact the $SO_2$ concentration decreased back to zero while the wind was coming from this direction. After the $SO_2$ concentration had fallen back to 0 at 7:00 AM on February 29, 2016, the wind continued to come from the West for another 4 hours until 11:00 AM, at which point the wind direction was 240 degrees – still more from the West than during most of the exceedance period. This suggests that wind coming from the West only occurred at the tail end of the exceedance period and as such, sources in that direction would not be expected to be likely sources that contributed to the cause of the exceedance. Rather, the wind direction analyses in all cases further suggest Charter Steel as the likely cause of the exceedances.

## **Modeling Analyses**

Two modeling analyses have been performed to investigate the impact of fugitive emissions escaping from Charter Steel on $SO_2$ concentrations in the surrounding area and particularly at the Harvard Yards monitor. The first modeling analysis presented was performed as an initial and quick response to first discovering the exceedance periods at the Harvard Yards monitor and recognizing that the combination of wind direction and door malfunction suggested Charter as a possible cause. Given the quick response time, some typically relevant modeling information, such as the exact location and characteristics of the west end door and emission rates were not available at that time. Instead, this modeling provides a sensitivity analysis of relative change in $SO_2$ concentrations at the Harvard Yards monitor caused by various percentages of total $SO_2$ emissions escaping from the melt shop as fugitives. This analysis was performed over a somewhat limited timeframe using meteorological data from January 1 – February 29, 2016, because of the rapid turnaround in producing this analysis in response to the events. This was all of 2016 for which meteorological data was available at the time of beginning this analysis.

The second modeling analysis includes, as the only source, the west end door as a modeled fugitive volume source. This analysis investigates resulting $SO_2$ concentrations at the Harvard Yards monitor and the surrounding area as a result of various actual amounts of $SO_2$ emissions coming from the west end door of the Melt Shop at Charter Steel. Both of these analyses are presented here, and the methodology used in performing these analyses was largely the same, as described in the next section. Additionally, a separate modeling analysis was performed for the permitted limits in the forthcoming permit for Charter Steel. This analysis is presented in a later section in this document as it is not part of the analysis of the exceedance events, but the common methodology and background concentration for that analysis as well are presented in the following subsections.

## ***Methodology***

The modeling analyses presented in this document share a largely common methodology. Those elements of performing the various analyses in this document which are shared are presented here, and apply to multiple modeling analyses presented.

*Models Used*

Dispersion modeling was conducted using the most recent regulatory version of AERMOD and associated modules at the time that modeling was performed:

- AERMOD v 16216r
- AERMOD v 15181[2]
- AERMET v 16216
- AERMET v 15181[3]
- AERMINUTE v 15272
- AERMAP v 11103
- AERSURFACE v 13016
- BPIPPRM v 04274

The adjust u* option in AERMET was not used for these analyses for the sake of consistency, since that option was not used for any other modeling for the Data Requirements Rule already submitted by Ohio EPA.

*Meteorological Data and Processing*

Surface meteorological data from the National Weather Service (NWS) station located at the Cleveland Hopkins International Airport (WBAN 14820) and upper air data from the Buffalo International Airport (WBAN 14733) were processed using the AERMET preprocessor. AERMINUTE was utilized to supplement hourly meteorological data ensuring as complete a meteorological data set as possible. Monthly surface characteristics for 12 sectors were determined using the AERSURFACE module. Bowen ratios were informed by comparing the monthly precipitation data collected at the Cleveland surface station to 30-year precipitation norms. Data from these stations for various time periods were used for all modeling analyses.

*Building and Source Data*

Building downwash was accounted for in the model using the BPIPPRM algorithm with building and stack parameter data supplied by TRC Environmental Inc. on behalf of Charter Steel, in support of permit-to-install (PTI) application #A0055464, submitted to

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[2] Monitor Sensitivity to Fugitives Modeling Analysis only

[3] Monitor Sensitivity to Fugitives Modeling Analysis only

Ohio EPA on March 28, 2016. The baghouse and two associated stacks are the primary egress points of $SO_2$ emissions from Charter Steel under normal operating conditions. Two stacks are associated with the baghouse and can be seen adjacent to the west end door in Figure 3. The baghouse controls those emissions associated with units located within the melt shop, which houses the EAF, Ohio EPA ID P900. Emissions from the EAF represent the vast majority of reported $SO_2$ emissions at the Charter Steel facility. These two baghouse stacks are sources in the sensitivity modeling analysis and the attainment modeling for the forthcoming permitted limits presented in this document. Characteristics for volume sources representing fugitive emissions escaping from the melt shop as a whole are also derived for the various modeling analyses in this document from the modeling supplied in support of PTI #A0055464. The coordinates of the sources were updated to the North American Datum (NAD) 83 coordinate system for these analyses. The location and size of the west end door determined its characteristics as a volume source. It was a source only for the West End Door Modeling Analysis. The relevant egress point parameters for all sources are shown in Table 3.

**Table 3: Charter Steel SO2 egress point parameters**

| Point Sources | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Source ID | Source Description | Easting (X) | Northing (Y) | Base Elevation | Stack Height | Temperature | Exit Velocity | Stack Diameter |
| | | (m) | (m) | (m) | (m) | (K) | (m/s) | (m) |
| S50A | Baghouse Stack A | 444810.1 | 4588217.9 | 214.6 | 45.7 | 338.5 | 14.37 | 4.57 |
| S50B | Baghouse Stack B | 444801.4 | 4588217.4 | 214.6 | 45.7 | 338.5 | 14.37 | 4.57 |

| Volume Sources | | | | | | | |
|---|---|---|---|---|---|---|---|
| Source ID | Source Description | Easting (X) | Northing (Y) | Base Elevation | Release Height | Init. Horizontal Dimension | Initial Vertical. Dimension |
| | | (m) | (m) | (m) | (m) | (m) | (m) |
| S51A | Melt Shop Fugitives | 444870.1 | 4588165.5 | 214 | 14 | 37 | 13 |
| S51B | Melt Shop Fugitives | 444937.2 | 4588161.4 | 214 | 14 | 37 | 13 |
| S51C | Melt Shop Fugitives | 444998.9 | 4588157.7 | 214 | 14 | 37 | 13 |
| West End Door | Door Fugitives | 444832.4 | 4588156.0 | 214 | 3.6576 | 2.1336 | 1.700784 |

The layout of the sources in Table 3 and building locations are shown in Figure 15.

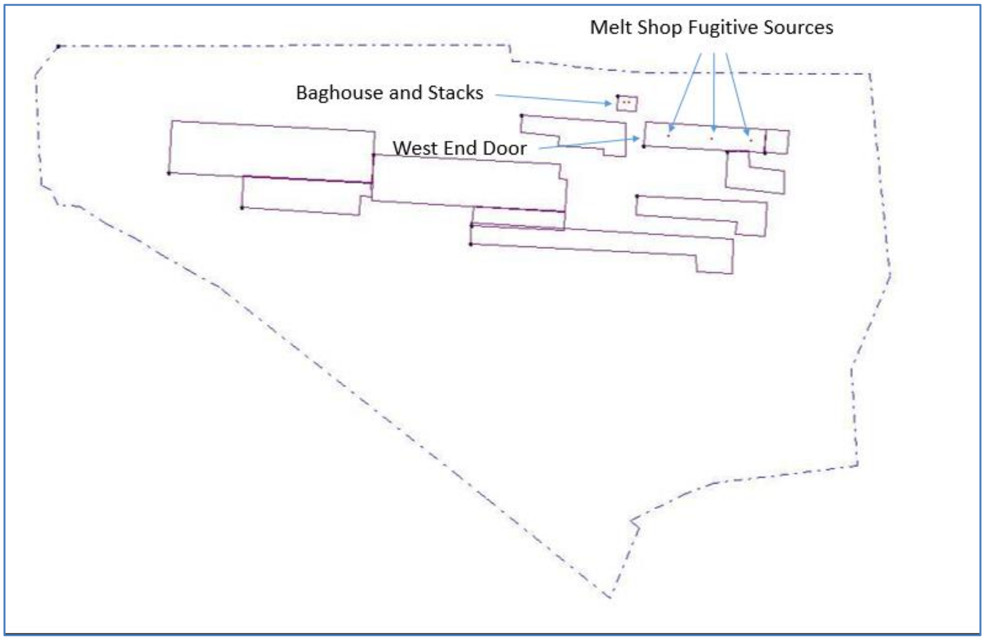


Figure 15: Layout of buildings and sources at the Charter Steel Facility

*Receptors*

The elevations of all receptors for all analyses were determined using the AERMAP module using digitized National Elevation Data with a resolution of 1 arc-second.

## ***Background Concentration Analysis***

For some of the forthcoming modeling analyses to be presented, determining an appropriate background $SO_2$ concentration value was necessary. Ohio EPA performed an extensive analysis of meteorology, emissions and monitor data to derive a background $SO_2$ concentration representative of those sources not explicitly included in the analyses. Ohio EPA conducted this analysis based on hourly $SO_2$ concentrations recorded at monitors in the area and wind direction data from the Cleveland weather station located at the Cleveland Hopkins International Airport. Years 2014 to 2016, were considered for this analysis, and this period of record is henceforth referred to as the study period.

Hourly and one-minute wind data were collected from the National Weather Service station located at the Cleveland Hopkins International 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 American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) preprocessors AERMET and AERMINUTE.

Hourly monitoring data for monitors 39-035-0038, 39-035-0045, 39-035-0060, and 39-035-0065 were obtained from U.S. EPA's Air Quality System.

The location of all $SO_2$ sources, air quality monitors, and wind-roses (years 2014-2016), were mapped to determine a representative air quality monitor.

Figure 16, below, shows the location of monitors 39-035-0038, 39-035-0045, 39-035-0060, and 39-035-0065 and those facilities whose emissions potentially impact ambient air quality recorded at the monitoring location. Also shown is a composite wind rose, years 2014-2016, from the meteorological station located at the Cleveland Hopkins International Airport.

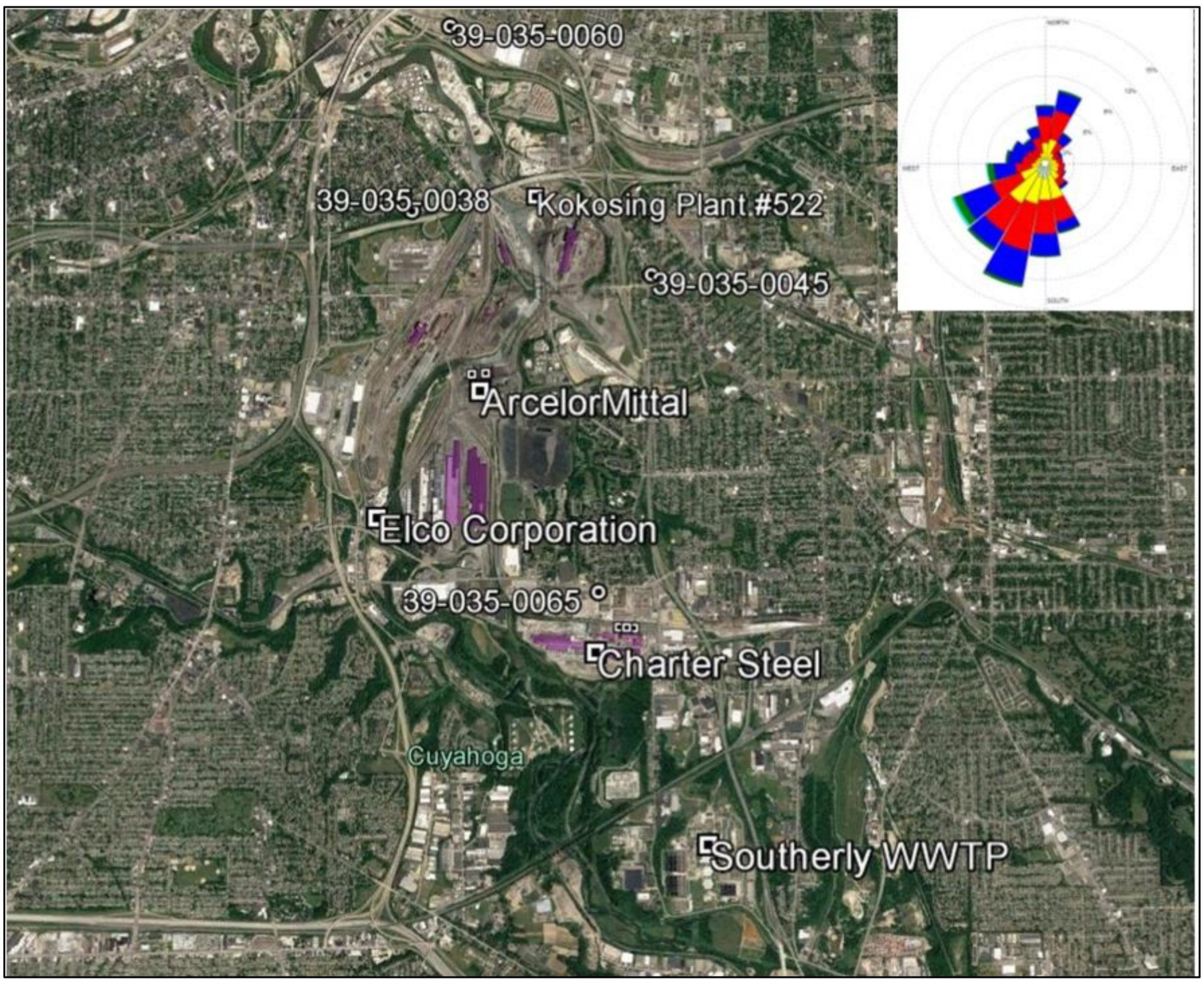


Figure 16: SO2 sources, SO2 monitors and Windrose surrounding the area of the Harvard Yards monitor

In addition to the Charter Steel facility, there are several other sources of $SO_2$ in the region not explicitly modeled and therefore must be considered in the background. Using the 2015 reported emissions, these include ArcelorMittal Cleveland (982 TPY), Southerly Wastewater Treatment Plant (5.6 TPY), ELCO Corporation (37 TPY), and Kokosing Plant

#522 (8.7 TPY). As shown in Figure 16, the prevailing winds originate primarily in the Southwest but also often in the South, Southeast. Based on this, it is likely that monitors 39-035-0038 and 39-035-0060 are most strongly impacted by emissions from all sources in the area, including Charter Steel. The orientation of the facilities with respect to these two monitors would preclude elimination of monitoring data based on wind direction, as such a manipulation would eliminate impacts from those facilities not included in the modeling analyses, including ArcelorMittal Cleveland. Monitor 39-035-0065, located approximately 360 meters to the North of Charter Steel, is strongly impacted by emissions from Charter Steel, and is therefore not considered an appropriate location from which to derive a background concentration. Ohio EPA does not have a complete record of door malfunctions from the Charter Steel facility. As such, it is not possible to eliminate from these data those instances of enhanced impacts from Charter Steel due to door malfunctions with any degree of confidence. Further, based on the prevailing winds, it is unlikely that this monitor is frequently or strongly impacted by the other sources in the area. As background concentrations are to represent the impact of those sources not explicitly included in the modeling domain, it is believed that monitor 39-035-0065 is not an appropriate representation of those sources and should not be considered a background monitor.

Monitor 39-035-0045, located to the Northeast of ArcelorMittal and to the North-Northeast of Charter Steel (see Figure 16), would represent the most likely location for a background monitor. This location, based on the composite wind rose, would be strongly and frequently impacted by emissions from those sources not explicitly modeled. Concentrations recorded at this location are likely impacted by emissions from Charter Steel but, similar to monitors 39-035-0600 and 39-035-0038 Ohio EPA does not believe that removal of monitoring data based on hourly wind data is possible at this location based on the number and orientation of sources in this area. As such, the 2014-2016 design value of 23 ppb at this monitor was chosen as a conservative background concentration for these analyses.

Ohio EPA believes that the 23 ppb selected as the background is conservative and representative of those facilities not explicitly included in the modeling domain. This is the value which will be used in conjunction with those modeling analyses to be presented in this document for which a background concentration value is needed.

## ***Monitor Sensitivity to Fugitives Modeling Analysis***

The first analysis conducted to assess the likelihood that fugitive emissions from Charter Steel were the primary cause of the exceedance periods in question, was a sensitivity modeling analysis, as described above. This analysis was a first-response modeling analysis after being alerted to the exceedance events, and involved performing modeling using relative emission rates to investigate the importance of fugitive emissions from Charter on concentrations at the Harvard Yards monitor. A single receptor, placed at the location of ambient air quality monitor 39-035-0065, the Harvard Yards monitor, was included in the modeling.

*Modeled Scenarios:*

To explore the possibility that a reduction in capture efficiency and an increase in fugitive emissions from the melt shop could lead to heightened concentrations of $SO_2$ at the monitor, Ohio EPA modeled three theoretical scenarios:

> Scenario 1: 100% of emissions from baghouse stacks
>
> Scenario 2: 95% of emissions from baghouse stacks, 5% of emissions as melt shop fugitives
>
> Scenario 3: 90% of emissions from baghouse stacks, 10% of emissions as melt shop fugitives

Rather than attempt to use or characterize actual emissions in this analysis, Ohio EPA utilized an emission rate of 100 grams per second, which was distributed amongst the baghouse stacks and melt shop fugitives per the scenarios described above. All results were normalized to the maximum hourly value obtained from Scenario 1, so that the relative increase due to fugitive emissions could be examined. The period January 1, 2016 to February 29, 2016 was modeled for this study.

*Model Setup and Source Characterization:*

Ohio EPA modeled the two baghouse stacks, S50A and S50B and the melt shop fugitive emissions from S51A, S51B, and S51C, as described in the above methodology subsection for this analysis

It should be noted that the fugitive emissions modeled in this analysis were not specifically representative of the west end door of the melt shop at Charter Steel, but rather of fugitive emissions from the melt shop overall, in order to gauge the sensitivity of concentration levels at the monitor from potential fugitive emissions from Charter's melt shop in general. Specific investigation of emissions from the west end door are discussed further, later in this document.

*Results:*

Modeled hourly concentrations for each scenario, January 1, 2016 through February 29, 2016, were generated using the POSTFILE output option of AERMOD, which provides the hourly concentration modeled at the receptor location. These data for each scenario were compiled and sorted by magnitude. The same sorting was performed for concurrent monitored concentrations recorded at monitor site 39-035-0065. During this phase, Ohio EPA noted strong agreement between those concentrations modeled under Scenario 1 (100% baghouse emissions) and monitored concentrations for the vast majority of hours modeled in the study period. Ohio EPA also noted that the highest concentrations recorded at the monitor were closely matched by the modeled results obtained for Scenario 2, or 95% baghouse/5% fugitive emissions. Figure 17 shows the results of the modeled scenarios and the monitored data. All data, including the monitored concentrations, were normalized by the highest 1-hour concentration obtained from Scenario 1 modeling.

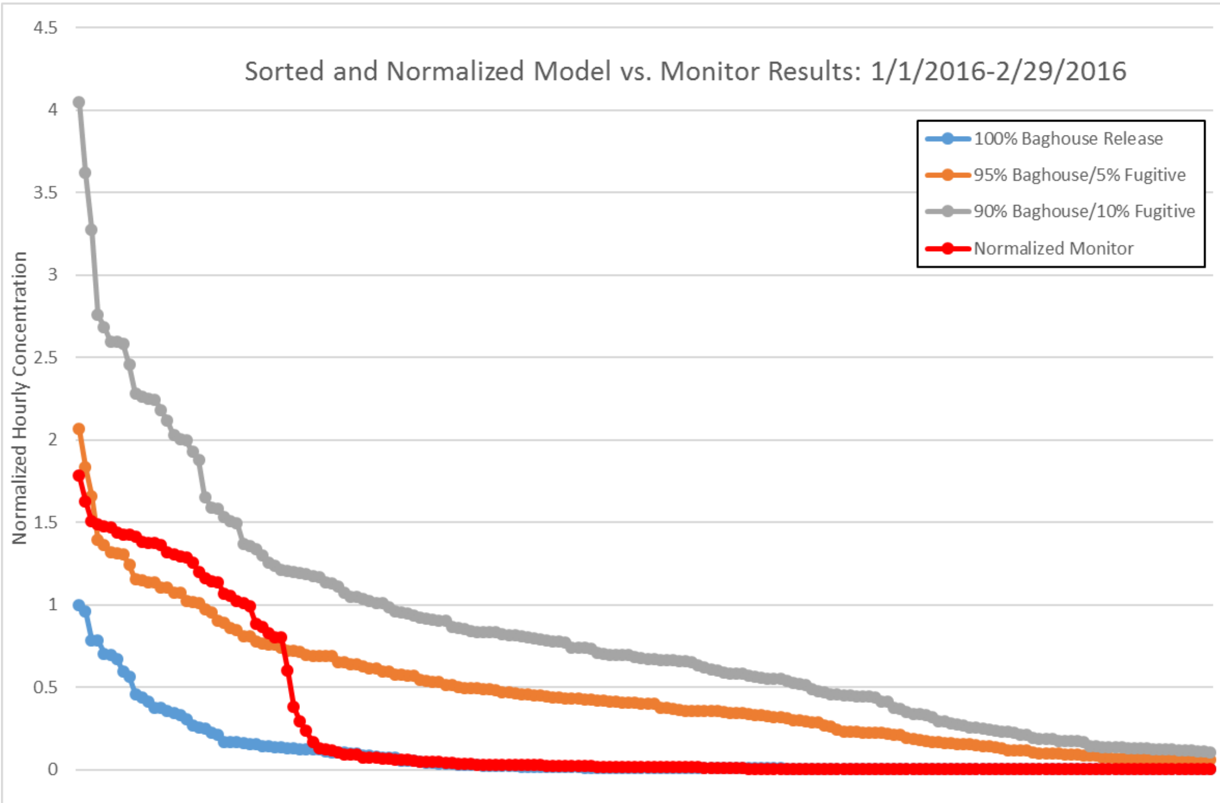


**Figure 17: Model vs. monitor sensitivity analysis results**

As seen in Figure 17, there is a strong degree of agreement for the vast majority of hours when the normalized monitor values are compared to normalized model results from Scenario 1. During the period in question, the exceedance periods of February 2016 with elevated $SO_2$ concentrations, there is strong agreement between the normalized monitor results and those results obtained from Scenario 2 modeling. The results shown in Figure 17 indicate that the model is highly sensitive to increased fugitive emissions at the monitor location. A relative increase of 5% fugitive emissions is reflected at the monitor location by increases in modeled concentrations of two to six times greater than those obtained under Scenario 1. Furthermore, Figure 18 and Figure 19 show the spatial distributions of the impacts with 100% capture efficiency and 95% capture efficiency, respectively. As shown, a small amount of fugitive emissions substantially changes the distribution of the modeled concentration impacts, adding a hotspot just south of the monitor, and including the monitor within a fairly heightened concentration range for the domain. This suggests that fugitive emissions are more likely to heavily impact the Harvard Yards monitor than typical emissions from the stacks. This further demonstrates the likelihood that not just an increase in emissions from Charter Steel, but specifically fugitive emissions released, such as from the west end door, would strongly impact the monitor, while concentrations elsewhere in the domain (such as the hotspot that remains just to the Northeast of Charter Steel) are even higher than at the monitor.


Figure 18: Isopleths of $SO_2$ concentration when 100% of emissions from Charter Steel are emitted from the baghouse stacks

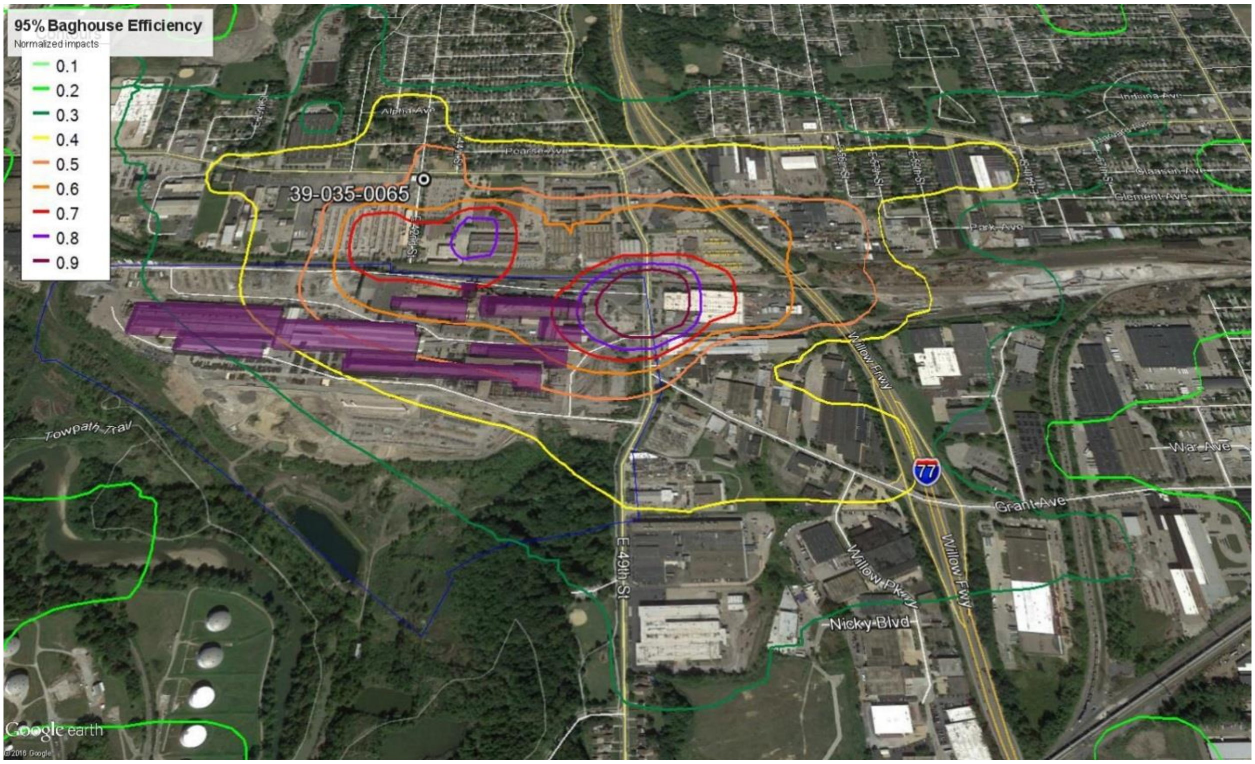


Figure 19: Isopleths of $SO_2$ concentration when 95% of emissions from Charter Steel are emitted from the baghouse stacks, and 5% of emissions from Charter Steel are emitted from the melt shop as fugitives

*Summary*

The greatest agreement between normalized monitor values and normalized modeled values was obtained for the majority of hours when emissions were modeled exclusively from the baghouse stacks. The period of elevated monitor concentrations, the exceedance periods of February 2016, was best replicated by modeling a 5% increase in fugitive emissions from the melt shop. Modeled concentrations, specifically at the monitor location as the figures above show, are highly sensitive to relatively small increases in fugitive emissions from the melt shop. This would indicate that there is a strong possibility that even a small reduction in capture efficiency and therefore increase in fugitive emissions could lead to relatively high concentrations at the monitor location.

***<u>West End Door Modeling Analysis</u>***

The second modeling analysis includes the west end door of the melt shop as a fugitive volume source of $SO_2$ to assess how strongly fugitive emissions from the door would impact surrounding air quality in general, and concentrations at the monitor specifically. Whereas the previous modeling analysis was a sensitivity analysis to quickly assess how sensitive concentrations at the monitor may be relative to percentage differences of emissions of arbitrary amount from Charter Steel being emitted as fugitives, this modeling assesses what actual emission amounts from the west end door will result in specific concentrations, such as the highest recorded hour from the February 2016 exceedance periods, at the location of the Harvard Yards monitor and in the surrounding area. The modeling performed was refined dispersion modeling, as described previously in the methodology subsection above, using three years of actual meteorological data from 2014 through 2016. Results were assessed both at the location of the monitor and over the rest of the receptor grid in general. The primary focus of this analysis is to assess what level of fugitives from the west end door will result in specific concentrations at the Harvard Yards monitor. However, concentrations in the rest of the domain under these scenarios are informative for consideration of what may result elsewhere in the surrounding area from such fugitive emissions. Additionally, as will be discussed below, dispersion models such as AERMOD are not typically effective at producing concentrations paired in space and time, and so concentrations elsewhere in the domain can be helpful for informing a range of possible results.

*Modeling Approach*

In this analysis, single-hour impacts over three years were produced and assessed for comparison to the exceedance hours during the exceedance periods of February 2016. Longer-term averages and metrics like $99^{th}$ percentile maximum daily values, such as what was used in the background analysis, were not considered in this analysis as the purpose was to investigate individual hourly impact on concentrations as a result of emissions from the west end door. Three years of meteorological data were used to ensured that a wide range of meteorological conditions would be represented in the modeling such that the possibility of many different weather conditions interacting with emissions from the west end door and impacting the transport of $SO_2$ to the monitor and surrounding areas would be present in this analysis.

*Meteorological Data*

Surface meteorological data from 2014-2016 from the Cleveland Hopkins International Airport (WBAN 14820) and upper air data for the same time period from the Buffalo International Airport (WBAN 14733) was selected and processed as described in the methodology subsection.

*Background*

Ohio EPA applied background concentrations of $SO_2$ to all modeled results in this analysis. As described above, Ohio EPA utilized a conservative background of 23 ppb (60.168 ug/m3) determined by data from monitor 39-035-0045.

*Emission Source*

This modeling scenario involved modeling only the west end door as a fugitive volume source (source parameters and characterization as discussed previously in the methodology section) at 1 lb/hr. Since AERMOD is a linear model, with only one emission source, emission rates and concentrations can be scaled linearly. This modeling scenario was used, then, to investigate the impacts of various amounts of possible fugitive emissions from the west end door on the surrounding air quality and at the monitor location by scaling the emissions and concentration values appropriately. It should be noted that this analysis did not include any emissions from the baghouse stacks at Charter Steel. It can be assumed that concentrations resulting from typical emissions from Charter Steel would be captured in the added background value. However, it is possible that impacts from the baghouse stacks could interact with concentrations modeled here, increasing the resulting concentrations modeled in this analysis, and further reducing the amount of fugitive emissions that would need to be emitted from the west end door to produce the modeled concentrations shown here at the Harvard Yards monitor.

*Receptors*

A total of 4,479 receptors were included in the modeling domain for the purposes of this modeling analysis. At the fenceline, and extending 400 m to the North and East of the facility, and 300 m to the west of the facility receptors were spaced at 50 m intervals. The highest impacts from all modeling were near the facility to the North and East, and so maximum impacts were captured by this dense grid. 100-meter grid spacing was then used for receptors extending 400 meters south of this grid, and extending 600 meters in all other directions outside this grid. 200-meter grid spacing was used outside this grid extending another four kilometers in all directions. The facility and receptor grid are shown in Figure 20.

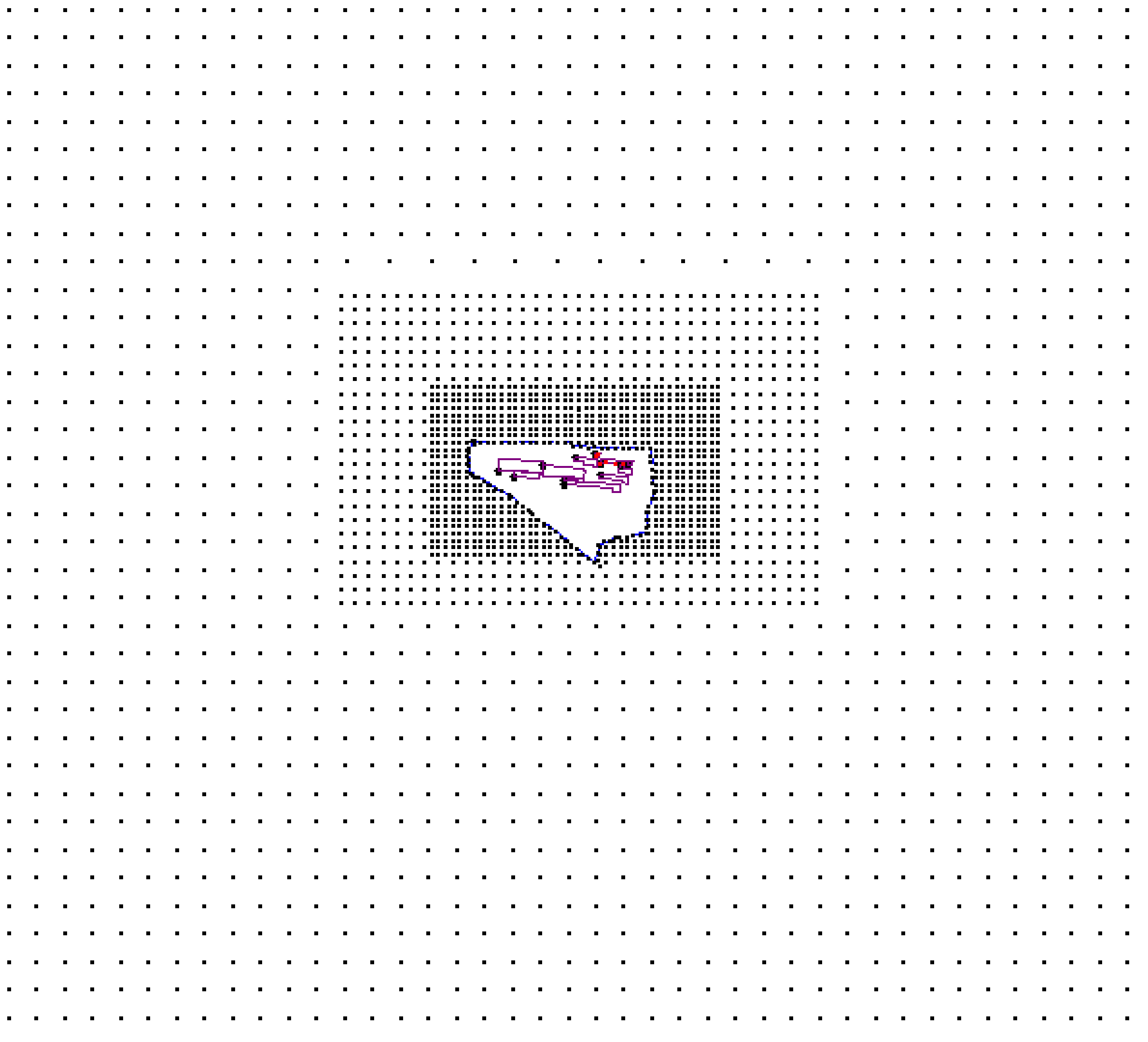

Figure 20: Charter Steel facility layout and surrounding receptor grid

*Results*

The results of this modeling analysis are yearly maximum highest-first-high modeled values over the entire domain as well as at the location of the Harvard Yards monitor, since the primary concern was considering the possible impact of isolated, fugitive $SO_2$ release events such as those that occurred in the February exceedance events. The highest hourly value at any receptor during the three years modeled for 1 lb/hr emissions from the west end door fugitive source was 210.168 ug/m3 including background, which occurred at the fenceline to the North of the facility. The highest hourly value at the receptor representing the Harvard Yards monitor was 82.688 ug/m3 including background. This result demonstrates that concentrations surrounding Charter Steel would be very sensitive to emissions from the west end door. At 210.168 ug/m3, the modeled emission rate of only 1 lb/hr would result in exceedances of the standard. As previously stated, since AERMOD is linear, these results can be scaled to reflect other emission rates from the door and concentrations, factoring in background appropriately. During the February 2016 exceedance periods in question, the highest 1-hour $SO_2$ value recorded at the Harvard Yards monitor was 447 ppb, or 1168 ug/m3. Factoring in background and scaling this highest one-hour modeled value, to produce a modeled concentration of 447 ppb at the highest modeled impact would require an emission rate of 7.387 lb/hr. To produce a modeled one-hour concentration of 447 ppb at the receptor representing the Harvard Yards monitor would require an emission rate of 49.202 lb/hr. It is not unreasonable to assume that under the right operating and meteorological conditions 49.202 lb/hr could feasibly escape through the west end door at Charter Steel potentially causing the high exceedances as seen in February of 2016. As stated above, if emissions from the baghouse stacks also interacted with emissions from the west end door at a magnitude higher than captured in the background value, this emission rate from the west end door would be lower still to produce this concentration of 447 ppb. However, Ohio EPA further notes that predicting concentrations at specific locations and at specific times is generally not the appropriate use of AERMOD. As stated in the U.S. EPA document, *AERMOD: Description of Model Formulation,*

> AERMOD is a steady-state plume model in that it assumes that concentrations at all distances during a modeled hour are governed by the temporally averaged meteorology of the hour. The steady state assumption yields useful results since the statistics of the concentration distribution are of primary concern rather than specific concentrations at particular times and locations

In their paper *Probability Analyses of Combining Background Concentrations with Model Predicted Concentrations,* Murray and Newman (2014) further assert this conclusion, saying

> AERMOD demonstrates little prediction skill (correlation coefficient r 2 = 0.02) in matching the location and time of the observed concentrations.

As such, it is very likely possible that an emission rate less than the 49.202 lb/hr which would result in a modeled concentration of 447 ppb right at the location of the Harvard Yards monitor could result in such a concentration in reality. For example, at the receptor less than 100 m south of the location of the Harvard Yards monitor, a modeled emission rate of 30.51 lb/hr would result in such a maximum modeled concentration. As already stated, a modeled emission rate of only 7.387 lb/hr would result in this maximum modeled concentration at a location elsewhere in the domain. As such it is clear that under the right conditions sufficient emissions could reasonably be expected to escape from the west end door at Charter Steel and cause elevated concentrations of $SO_2$ in the surrounding areas at the magnitude of the February 2016 exceedance periods in question.

## High Winds Analysis

A brief analysis was done involving the 2012-2016 meteorological data (including one-minute data) from the Cleveland Hopkins International Airport station beyond a wind direction analysis to determine if there was anything unique or unusual about the meteorology during and around the exceedance periods of February 2016 that might have contributed to the elevated $SO_2$ concentrations. Upon investigating the one-minute wind data over these exceedance periods, it became apparent that there were a number of minutes during those time periods that had very high wind speeds, coming from the South-Southwest. 48 minutes during the 20$^{th}$-21$^{st}$ had wind speeds which exceeded 30 knots, and three minutes during the 28$^{th}$-29$^{th}$ had wind speeds which exceeded 27 knots. Only 49, or 2.7 percent of days from 2012-2016 contained any minutes where winds exceeded 30 knots, as shown in Figure 21. Only 104, or 5.7 percent of days exceeded 27 knots, as shown in Figure 22. No other days in 2016 prior to February 20$^{th}$ exceeded 30 knots. As such, both of the exceedance events coincided with rare, high winds. It is unclear exactly what these high winds may do but it is certainly possible that these winds could contribute to heightened concentrations. It is beyond the scope of modeling tools like AERMOD to very specifically, and at high resolution, address and simulate the following, but it is possible that the high winds could contribute to elevated concentrations at the monitor in the following ways: high winds could create a pressure differential at the location of the west end door whereby the pressure just outside the door is significantly lower than inside, forcing out more $SO_2$ than usual; high winds could generate a lot of turbulent, cyclical air movement, especially at heights low to the ground as the wind interacts with obstacles, which could push $SO_2$ in chaotic ways and circulate it by the same location, such as the monitor, for more extended periods of time; high winds could generate stronger building downwash than expected, pushing $SO_2$ downward toward ground level and the monitor at a stronger rate and keep $SO_2$ concentrated at lower heights for longer periods of time. The AERMOD modeling exercise discussed previously demonstrates that fugitive emissions from the west end door certainly could cause exceedances of the magnitude of the exceedance periods of February 2016, and the presence of these high winds introduces potential, specific interactions with the buildings and pollutants that may not be fully captured by AERMOD, which could exacerbate elevated concentrations, and would only rarely occur in conjunction with the west end door being open and other conditions being favorable to fugitive emissions escaping through the west end door. The presence of rare, high winds, coming from a direction conducive to $SO_2$ traveling from Charter Steel toward the Harvard Yards monitor, in combination with Charter Steel operating the melt shop with the malfunctioning west end door open represents a very rare situation which all combined could lead to such extreme and unpredicted exceedances as those of the exceedance periods of February 2016.

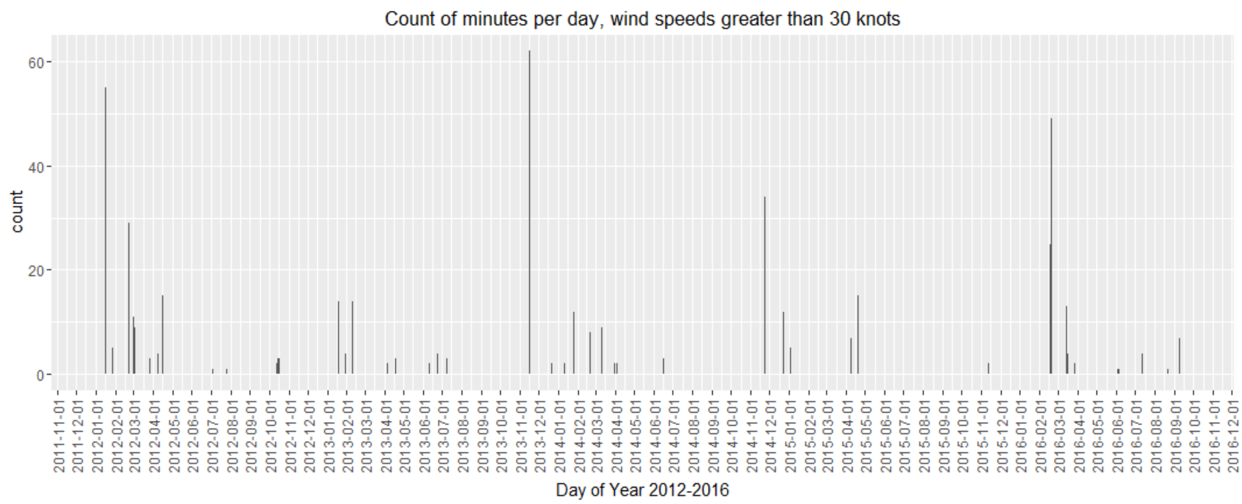


**Figure 21: High wind speeds (>30 knots) from 2012-2016**

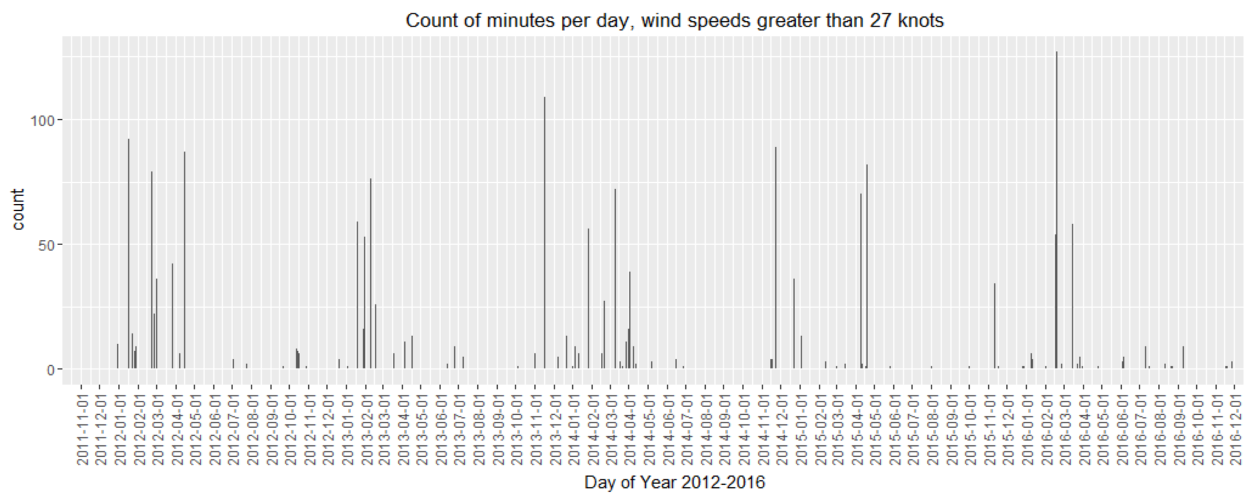


**Figure 22: High wind speeds (>27 knots) from 2012-2016**

## **Analyses Conclusions**

Taken collectively, the analyses presented here demonstrate that it is very possible, under the right conditions, for fugitive emissions from the west end door of the melt shop at Charter Steel to lead to highly elevated $SO_2$ concentrations, of comparable magnitude to those observed during the February 2016 exceedance periods in question. The first modeling analysis presented demonstrates a very heightened sensitivity of $SO_2$ concentrations at the monitor to even small fugitive emissions from Charter Steel. It further shows that when fugitive emissions are introduced from Charter Steel the distribution of $SO_2$ concentration impacts from those emissions shifts to heighten the concentrations at and around the Harvard Yards monitor in particular. The second modeling analysis presented demonstrates that $SO_2$ emissions from the west end door, well within a magnitude that could reasonably escape from it under Charter Steel's operating limits, are sufficient to produce hourly concentration values of comparable magnitude to the maximum hour recorded at the monitor during either of the February 2016 exceedance periods. Further, the baseline conditions were in place for such exceedances to occur including winds blowing in the right direction at the right times as shown in the wind direction analysis, and high winds during the exceedance periods which may even further heighten elevated concentrations in ways that aren't fully captured by the other analyses. The west end door was known to be open during these exceedance periods due to a malfunction of the west end door itself. Considering all of these factors, along with the fact that no other facilities in the area are known to have had any unusual operations of any kind, strongly suggests that fugitive emissions from the west end door at Charter Steel were responsible for the elevated $SO_2$ concentrations during these exceedance periods.

## Measures Providing for Attainment

### Melt Shop Expansion Permit

Ohio EPA is currently in the process of issuing a federally enforceable prevention of significant deterioration (PSD) permit for Charter Steel to expand their melt shop operations. The permit terms will allow 314 TPY of $SO_2$. The existing permit limit is 99.34 TPY. Charter Steel, as part of this project, will be acquiring approximately 324 tons/year of $SO_2$ offset emissions from the surrounding area as the area is currently nonattainment for the 2012 annual PM2.5 NAAQS, and so the acquired offset emissions will more than cover the increase. Despite this increase in annual emissions, Charter Steel will be reducing their short-term $SO_2$ emission limit. The existing hourly $SO_2$ emission limit for the baghouse stacks is 242.07 lb/hr, and will be reduced to 166.16 lb/hr. Additionally, the permit emissions are based on an assumption of a capture efficiency of 99.95%, so .05% or 0.08 lb/hr of the total $SO_2$ emissions can escape as fugitive emissions from the melt shop. This represents a significant decrease in hourly allowable emissions, thus improving the potential impact of Charter Steel on the short term hourly $SO_2$ NAAQS.

### Attainment Modeling at Allowables

Modeling was performed at these allowable limits to be made federally-enforceable in the forthcoming permit, described in the previous section, to ensure Charter Steel will attain the NAAQS at allowable limitations consistent with the modeling standards of the Data Requirements Rule. The averaging period for the 2010 $SO_2$ NAAQS is the 99th percentile of maximum monitored daily values, averaged over three years. Per U.S. EPA's guidance for $SO_2$ modeling for the Data Requirements Rule (February 2016 Draft $SO_2$ NAAQS

Designations Modeling Technical Assistance Document (herein referred to as “Modeling TAD”), three years of National Weather Service data is sufficient to allow the modeling to simulate a monitor. Thus, the modeled form of the standard is expressed as the 99th percentile of maximum daily values averaged over three years (herein referred to as “design value”) for the purposes of designation. Additionally, the Modeling TAD states that “It also remains acceptable to use allowable emissions instead of actuals for designations purposes because allowable emissions would provide a more conservative estimate. When using allowable emissions, the most recent permitted or PTE rate should be used along with the most recent three years of meteorological data”. With the forthcoming permit allowable emissions being modeled here, this stipulation in the Modeling TAD is met here. Since the forthcoming permit specifically deals with limiting emissions from the west end door, as described in subsequent sections, modeling attainment in this scenario satisfies characterization of the most current air quality once the forthcoming permit takes effect. Thus the monitored three-year design value which includes the exceedance events of February 2016 would no longer be an accurate characterization of the current air quality.

This modeling included emissions from both baghouse stacks and the three melt shop fugitive sources, S51A, S51B, and S51C, (sources and stack parameters detailed previously in the methodology subsection of the Modeling Analyses section) at the maximum allowable levels in the forthcoming permit. The value for total maximum short term emissions in the forthcoming permit is 166.16 lb/hr, with 99.95% of these emissions coming from the two baghouse stacks. The remaining 0.05%, or 0.08 lb/hr, of emissions are considered fugitive emissions potentially from the melt shop. As such, in this modeling scenario, each baghouse stack was modeled with 83.04 lb/hr emissions of $SO_2$, and the three fugitive sources each were modeled at 0.02667 lb/hr emissions of $SO_2$.

The same meteorological data and receptor grid as detailed in the West End Door Modeling analysis within the Modeling Analyses section were used for this analysis. As detailed previously, a background value of 23 ppb (60.168 ug/m3) was added to the results of this modeling.

***Results***

The modeled design value, including the background, was 165.4 ug/m3. Any maximum impact exceeding 196.4 $\mu g/m^3$ would represent a modeled exceedance. As such, no exceedance of the standard was modeled. Thus, if operating under the conditions the forthcoming federally-enforceable permit requires, modeled here, Charter Steel would not cause any exceedance to the $SO_2$ NAAQS.

Further, as discussed more fully below, terms are being included in this federally-enforceable permit specifically to address fugitive emissions from the west end door of the melt shop. This will help to eliminate the possibility of emissions escaping from the west end door and leading to exceedance events in the future, ensuring Charter Steel does not cause or contribute to any exceedances of the NAAQS, as demonstrated in this modeling.

## Charter Steel West End Door Replacement

As mentioned during the Investigation of Exceedance Events subsection of the Analyses section, high winds could at times cause a malfunction that would disengage the door that was in place at the west end of the melt shop from its guide tracks. The door that was in place at the west end door at the time of the exceedances did not operate well, malfunctioning on a somewhat regular basis. During periods of high winds, the door was particularly prone to blowing off track and being stuck in the "up" position, often for extended periods of time until it could be restored to its track. However, it remained vulnerable to malfunction once returned to the closed position.

In July of 2016, Charter Steel replaced the malfunctioning door with a new door system that is designed to withstand high winds. Since that time the door has not experienced such a malfunction. This replacement is critical in ensuring extended periods of fugitive emissions can be kept from escaping through the west end door.

## West End Door Restrictions

While replacement of the malfunctioning door is sufficient to provide for attainment in conjunction with the new short-term $SO_2$ allowables, to ensure that the new door is being utilized properly to minimize the probability of fugitive emissions from escaping through the west end door, federally enforceable terms and conditions relating to the west end door are being included in Charter Steel's permit. These restrictions are modeled after the concepts included in the September 28, 2012 federal Administrative Consent Order (ACO) requiring Charter Steel to implement best management practices, as an interim measure, designed to maintain compliance with the six percent opacity limitation. Specifically, Charter Steel was required to do the following as part of the ACO:

a. The door at the west end of the melt shop shall remain closed (i.e., open no more than 8 feet from grade), except for times when the scrap car needs to enter or exit the melt shop.
b. Charter Steel shall operate sensors at the west end melt shop door that alert the melt shop operator as to when the door is open or closed. If the west end melt shop door remains open for more than 5 minutes while the EAF is in operation, an automated alarm notification (email or text message) shall be sent to the melt shop operator and environmental engineer. The melt shop operator or environmental engineer shall take immediate action to ensure that the door is closed immediately after the scrap car enters or exits the melt shop.
c. Charter Steel has installed a system that electronically records the period of time whenever the melt shop door remains open for more than 6 minutes while the EAF is in operations. The system records start time, end time and date.

The following is being included as “Additional terms and conditions” in the federally enforceable permit:

b)(2)g. The permittee shall employ the lowest achievable emission rate (LAER) measures for fugitive sulfur dioxide emissions escaping the melt shop building. Escaping visible fugitive dust emissions shall be used as the indicator for the existence of conditions that are also conducive to the escape of fugitive sulfur dioxide emissions, if present. The LAER measures shall be sufficient to minimize or eliminate visible emissions of fugitive dust from the door opening at the west end of the melt shop. The permittee shall operate the west end door when the EAF (P900) is in operation such that it remains closed to 6 feet above grade or less except when scrap cars are entering or exiting the melt shop. The presence of visible emissions of fugitive dust escaping the west end door is not a deviation of the LAER requirement provided the permittee complies with this additional term and condition and the operating restrictions, monitoring and recordkeeping, and reporting requirements set forth in, c)(8), d)(17) through d)(19), and e)(7) and e)(8) below.

Additionally, the following federally enforceable “Operational restrictions” are being included:

c)(8) When the EAF (P900) is in operation, the permittee shall restrict the periods of time during which the door at the west end of the melt shop is open more than 6 feet above grade to the shortest period of time practicable (both in duration and frequency) to allow scrap cars to enter or exit the melt shop, including the following:

a. If the west end melt shop door remains open more than 6 feet above grade for more than five minutes while the EAF is in operation, then an automated alarm notification shall be sent to the melt shop operators. The permittee shall take prompt action to have the west end door closed to 6 feet above grade or less.

b. In the event the west end melt shop door becomes inoperable or is obstructed such that it is stuck open more than 6 feet above grade and cannot be closed, the permittee shall comply with the malfunction provisions of OAC rule 3745-15-06, as well as the following:

i. If the west end door remains open more than 6 feet above grade for one hour or more, during normal business hours, the permittee shall notify within one hour the Ohio EPA, DAPC, Central Office SIP Manager via email and the Cleveland Division of Air Quality Enforcement Chief via the malfunction hotline. During periods other than normal business hours, the foregoing notifications may be made the next business day.

ii. The permittee shall perform visible emission inspections once per heat (during melting or refining) for a minimum of five minutes in duration. If visible fugitive dust emissions are escaping through the west end door, and the door is unable to be closed to 6 feet above grade or less, the permittee shall implement corrective action(s) to eliminate or minimize the fugitive dust emissions in accordance with the permittee's malfunction abatement plan. The plan shall include provisions for the cessation of sulfur addition at the EAF as soon as practicable consistent with the orderly transition away from the production of high-sulfur grades of steel, unless the Director of Ohio EPA has approved the addition of sulfur while the west end door is inoperable.

Additionally, the following federally enforceable "Monitoring and/or Recordkeeping Requirements" are being included:

d)

(8) The permittee shall install, operate, and maintain sensors at the west end melt shop door that alert the melt shop operators as to when the door is open more than 6 feet above grade for more than five minutes.

(9) The permittee shall install, operate, and maintain a system that electronically records the period of time (date, start time and end time) whenever the west end melt shop door remains open more than 6 feet above grade for more than five minutes while the EAF is in operation.

(10) The permittee shall maintain daily records of the following information when the door at the west end of the melt shop remains open more than 6 feet above grade for more than five minutes while the EAF is operating:

a. If visible emissions of fugitive dust are escaping through the west end door, the date and time of the visual emissions observations, the corrective action(s) taken to eliminate or minimize the fugitive dust emissions, and the dates such action(s) were implemented; and

b. If the permittee did not implement any necessary corrective action(s) to eliminate or minimize the fugitive dust emissions, the permittee shall note the reason why such corrective actions were not implemented.

Additionally, the following federally enforceable "Reporting Requirements" are being included:

e)

(7) The permittee shall submit quarterly deviation reports that identify all periods of time when a visible emissions inspection was required for the west end melt shop door but not conducted, and when a corrective action was determined to be necessary but was not implemented in accordance with d)(19).

(8) The permittee shall submit quarterly reports that identify:

a. all periods of time when the west end melt shop door was open more than 6 feet above grade for more than five minutes while the EAF was operating due to an inoperable door or obstruction that prevented the door from being closed;

b. all periods of time when the west end melt shop door remained open more than 6 feet above grade for more than five minutes for any other reason while the EAF was operating, but was not closed to 6 feet above grade or less within 10 minutes after it was opened; and

c. all periods of time when visible emissions of fugitive dust were observed escaping through the west end door during the inspections required in accordance with c)(8)b.ii..

(9) Unless other arrangements have been approved by the Director, all notifications and reports shall be submitted through the Ohio EPA's eBusiness Center: Air Services online web portal.

As can be readily seen, the terms being included in the forthcoming Charter Steel permit strongly reflect the language that was included in this ACO and are actually more protective in many respects. As stated above, the ACO deemed the included requirements to be best management practices designed to maintain compliance with the 6 percent opacity limitation and hence reduce the likelihood of fugitive emissions. It is necessary for Charter Steel to open the door during melting operations as it is the only route for scrap cars to enter and exit the building. Ohio EPA recognizes, as did U.S. EPA as part of the ACO, that it is not necessary, or realistic, for the door to remain fully closed during operations. However, Ohio EPA is further restricting the height at which the door can remain open and still be considered in the closed positions, from eight feet to six feet.

In order to provide make up air, no more than six feet opening has been determined reasonable.

In order to address the possibility of a malfunction, although unlikely, of the replaced door in the future, Ohio EPA has also included requirements to comply with Ohio's EPA's SIP approved malfunction provisions and also to develop a malfunction abatement plan.

The new door that Charter Steel has installed along with these federally enforceable terms concerning the operation of the door and the new reduced short-term $SO_2$ emission rates will eliminate future emissions of the magnitude and duration that led to violation of the 1-hour $SO_2$ NAAQS for the 2014 to 2016 air quality period. As a result of these actions, Ohio EPA expects that $SO_2$ concentrations will remain at, or below, the low levels that were consistently experience before and after these exceedance events.

## Summary and Designation Recommendation

As stated at the beginning of this document, Ohio EPA continues to recommend a designation of unclassifiable/attainment for all of Cuyahoga County, consistent with its recommendation in the Ohio Round 3 Designations Document. The analyses presented in this document sufficiently demonstrate the uniqueness of the $SO_2$ exceedance events of February 2016, the determination of Charter Steel as the likely cause of the exceedances, and that sufficient measures have been taken to ensure future attainment.

Ohio EPA notes that the language in the permit for Charter Steel includes federally enforceable requirements correcting the problems that had occurred at the previously malfunctioning west end door of the melt shop, and includes federally enforceable hourly $SO_2$ emission limits for the facility which, as shown in the modeling analysis included in this document, clearly provide for attainment with a highly conservative background value. Ohio EPA's strategy for Charter Steel and addressing the violation at the Harvard Yard monitor is analogous to the enforceable emissions limits providing for attainment option provided under U.S. EPA's Data Requirements Rule at 40 CFR 51.1204. Under that option, a state may submit federally enforceable $SO_2$ emissions limits for one or more applicable sources that provide for attainment of the 2010 $SO_2$ NAAQS in the area affected by such emissions. U.S. EPA requires the submittal include associated air quality modeling and other analyses that demonstrate that all modeling receptors in the area will not violate the 2010 $SO_2$ NAAQS, taking into account the updated allowable emission limits. Ohio EPA has provided such a demonstration. As described previously, this modeling demonstration which takes into account updated allowable emission limits is a more acceptable characterization of current air quality than the previous three-year design value, which was impacted by events which are now accounted for by the forthcoming permit allowables. Therefore, Ohio EPA continues to recommend a designation of unclassifiable/attainment for all of Cuyahoga County.

Ohio EPA has demonstrated that the exceedances of the $SO_2$ monitor at Harvard Yards was an unusual event that is highly unlikely to reoccur. Ohio EPA has taken additional precautions to ensure that an event of this magnitude cannot happen again. Furthermore, subsequent air quality monitoring demonstrates that the monitor is maintaining compliance with the air quality standards.