

**Appendix D**  
**Campbell County, Kentucky SO<sub>2</sub> Monitor 21-037-3002**  
**2010-2014 Exceedance Analysis**  
**January 20, 2014**

**I. Background**

Between January 1, 2010 and August 31, 2014, 44 exceedances of the 2010 1-hour SO<sub>2</sub> National Ambient Air Quality Standard (NAAQS) of 75 ppb were recorded at the John's Hill Road Monitoring Site in Campbell County, Kentucky, Monitor ID 21-037-3002. This monitor, shown in Table 1, is located in the northern part of Campbell County, Kentucky, south of Cincinnati, Ohio (Figure 1).

In this report, data is analyzed to identify potential SO<sub>2</sub> sources contributing to the 1-hour NAAQS exceedances at Monitor 21-037-3002. Two major SO<sub>2</sub> emission sources were considered for the investigation, given their proximity to the monitors and the predominant wind directions potentially impacting the monitor in Campbell County. The sources, Duke Energy's W.C. Beckjord (Beckjord) and W. H. Zimmer (Zimmer) facilities in Clermont County, OH, are located east and south-east, respectively, of Kentucky monitor 21-037-3002 (Figure 2).

**II. Methodology**

A back trajectory analysis was performed for the exceedances at monitor 21-037-3002 using the National Oceanic and Atmospheric Administration's (NOAA) Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT)<sup>1</sup>. HYSPLIT is a complete system for modeling simple air parcel trajectories, both in forward and backward modes. The model calculation method is a hybrid between the Lagrangian approach, which uses a moving frame of reference as the air parcels move from their initial location, and the Eulerian approach, which uses a fixed 3-dimensional grid as a frame of reference.

For this report HYSPLIT back-trajectories were created using NOAA's archived North American Mesoscale Modeling System, 12 kilometer grid resolution meteorological dataset (NAM 12 kilometers). The back trajectories originated at the violating monitor location on each hour that corresponds to a measured exceedance of the 1-hr SO<sub>2</sub> NAAQS and were initialized at 500 meters above ground level with the "Model Vertical Velocity" model option. The main purpose of these analyses was to determine a probable cause of recorded exceedances by simulating the flow of 24-hour air trajectory patterns in the backward mode. Meteorological data used to create the HYSPLIT back trajectories was taken from the National Weather Service Station located at the Cincinnati Northern Kentucky Airport (KCVG).

Back-trajectories alone were not used for this analysis since they may not always be indicative of flow patterns during very short periods of time when exceedances occur

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<sup>1</sup> Draxler, R.R. and Rolph, G.D., 2012. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (<http://ready.arl.noaa.gov/HYSPLIT.php>). NOAA Air Resources Laboratory, Silver Spring, MD.

(e.g, single or few hours). In those cases, an analysis of hourly wind patterns aids in determining the flow of emissions from these sources for the hours around the exceedance.

Table 1. Summary of the 2010 1-hour SO<sub>2</sub> NAAQS exceedances at Monitor ID 21-037-3002.

<b>Year</b>	<b>Month</b>	<b>Day</b>	<b>Hour (EST)</b>	<b>Monitored Value (ppb)</b>
2010	April	14	9:00	106
2010	April	14	13:00	142
2010	April	14	14:00	140
2010	April	14	15:00	86
2010	April	14	16:00	86
2010	July	31	14:00	82
2010	August	27	9:00	118
2010	September	14	11:00	99
2010	November	24	11:00	105
2011	February	23	9:00	137
2011	March	3	10:00	86
2011	March	3	13:00	92
2011	March	7	12:00	82
2011	March	7	13:00	76
2011	March	7	15:00	87
2011	March	8	17:00	84
2011	March	20	7:00	89
2011	April	22	3:00	109
2011	June	3	10:00	102
2011	June	3	11:00	142
2011	July	5	10:00	91
2011	July	5	11:00	180
2011	July	15	17:00	76
2011	July	15	18:00	92
2011	August	30	10:00	86
2011	August	30	11:00	76
2011	August	30	12:00	84
2011	August	30	13:00	84
2011	August	30	14:00	80
2012	January	11	12:00	76
2012	January	25	12:00	85
2012	February	3	17:00	82
2012	February	20	12:00	117
2012	February	20	13:00	156
2012	February	28	12:00	77
2012	April	7	11:00	99

<b>Year</b>	<b>Month</b>	<b>Day</b>	<b>Hour (EST)</b>	<b>Monitored Value (ppb)</b>
2012	April	7	15:00	81
2012	May	6	18:00	93
2013	February	9	13:00	96
2013	February	9	14:00	124
2013	February	25	9:00	100
2013	February	25	10:00	125
2013	March	5	6:00	125
2014	March	6	12:00	93

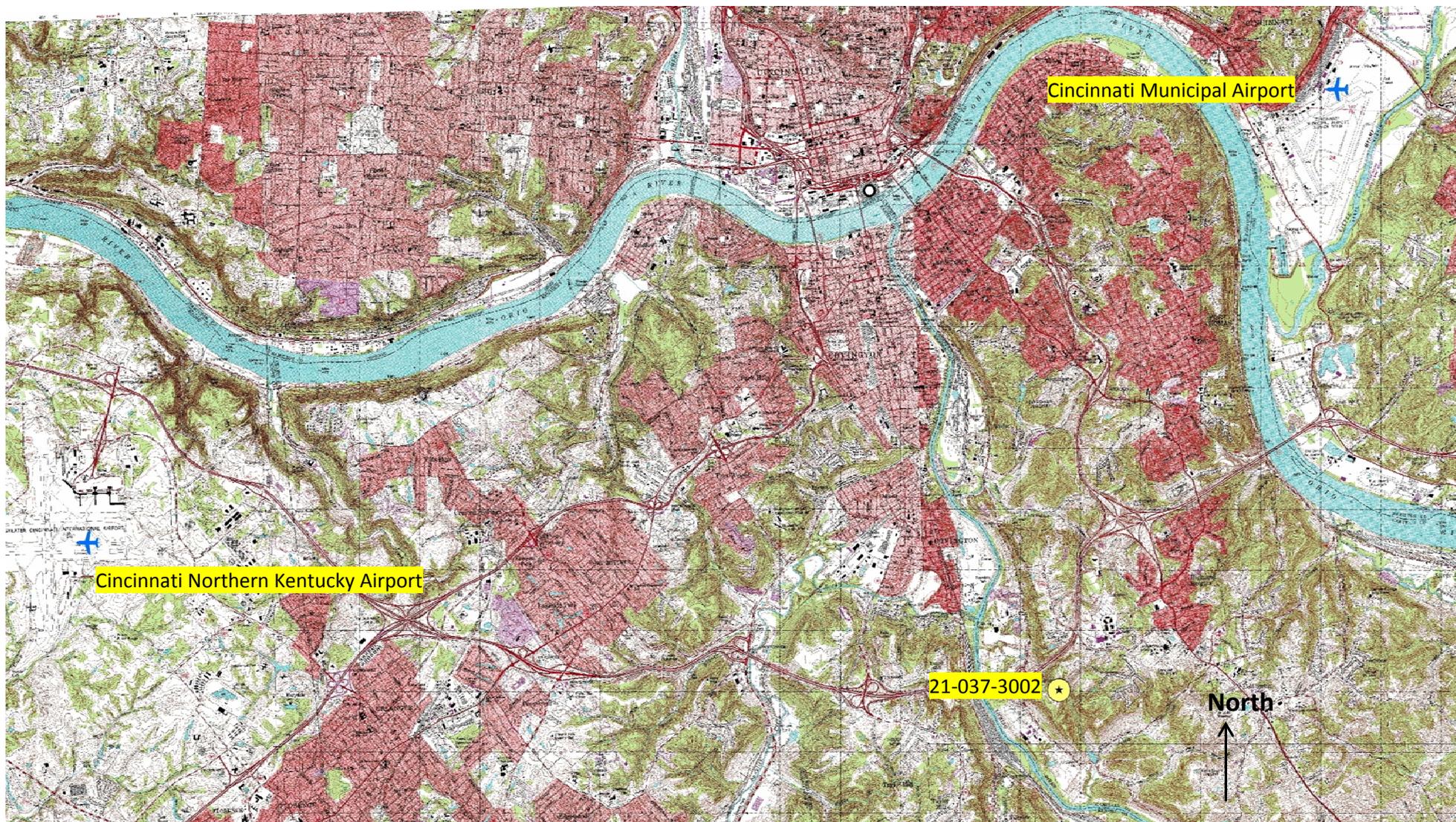


Figure 1. Topographic map of the Monitor ID 21-037-3002 and nearby Airports

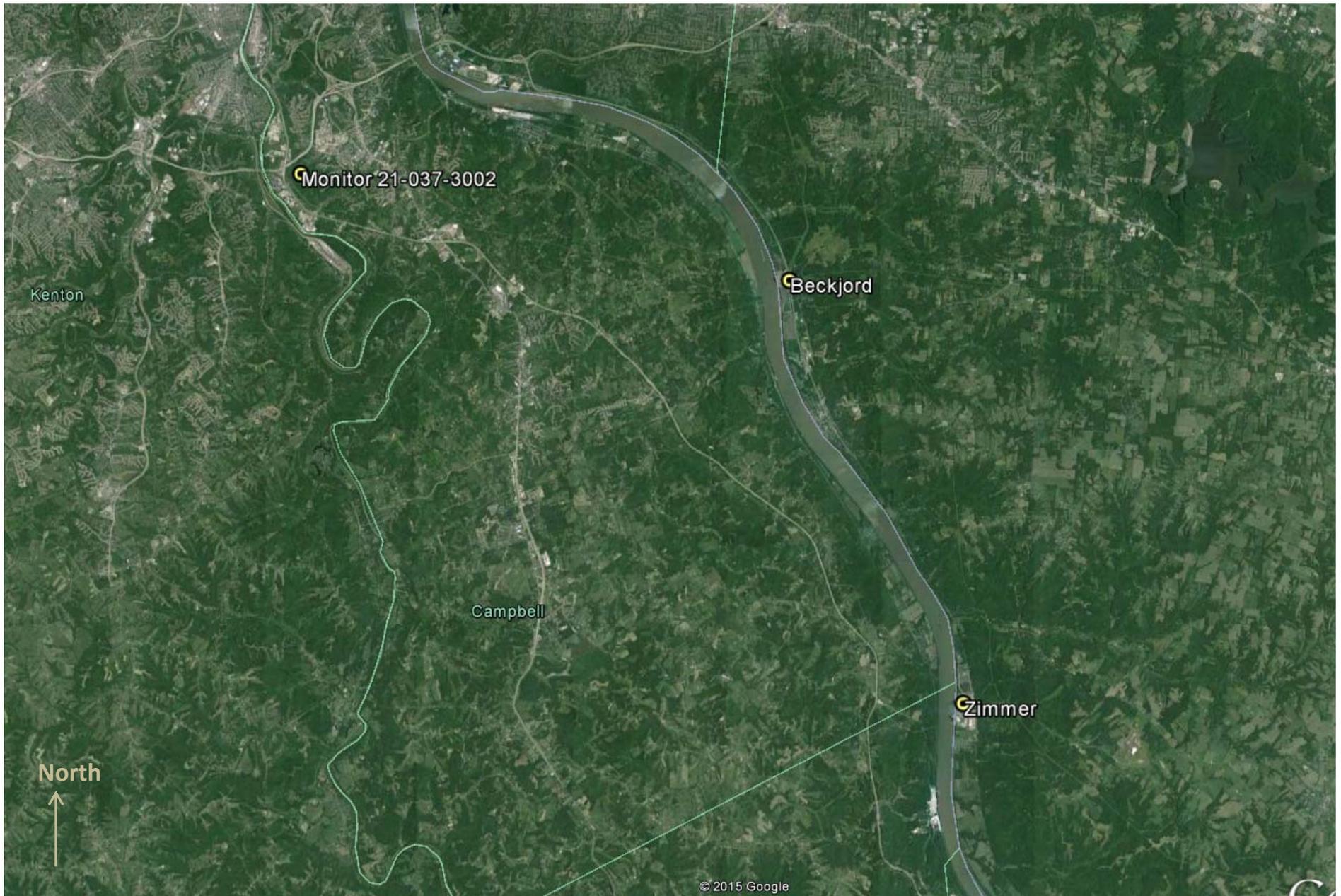


Figure 2. Locations of Duke Energy's W.C. Beckjord and William H. Zimmer facilities

The results of the exceedance day HYSPLIT back trajectory modeling were divided into the following categories:

Section III: Beckjord Trajectories - HYSPLIT trajectories passed over or near Beckjord (29 exceedances);

Section IV: Zimmer Trajectories - HYSPLIT trajectories passed over or near Zimmer (1 exceedance);

Section V: Intermediate Trajectories (4 exceedances);

Section VI: Other Trajectories – HYSPLIT trajectories do not clearly indicate either Beckjord or Zimmer (10 exceedances).

This report is organized in accordance with the above categories.

For all exceedance days, a further examination of the surface meteorology was conducted. There are two surface meteorology stations located near the Kentucky Monitor 21-037-3002. To determine the best station to use for this analysis, a windrose of all days in which an exceedance was recorded at monitor 21-037-3002 during the 2010 to 2014 period is shown for both Cincinnati Northern Kentucky Airport (KCVG Station #93814) and Cincinnati Municipal Airport (KLUK Station # 93812) in Figure 3 and Figure 4, respectively. It is readily apparent from the windrose data in Figure 4 that the river valley close to Cincinnati Municipal Airport influences the local wind direction.

Meteorological data from the Cincinnati Northern Kentucky Airport was selected based on the similar topography of the airport location and the monitor station location (Figure 1). Although the weather station located at Cincinnati Municipal Airport is closer in proximity to the monitoring station location, the closeness of this airport to the river valley channels local winds in a northeast to southwest or southeast to northeast direction. This channeling is not expected to be present at the monitoring station location.

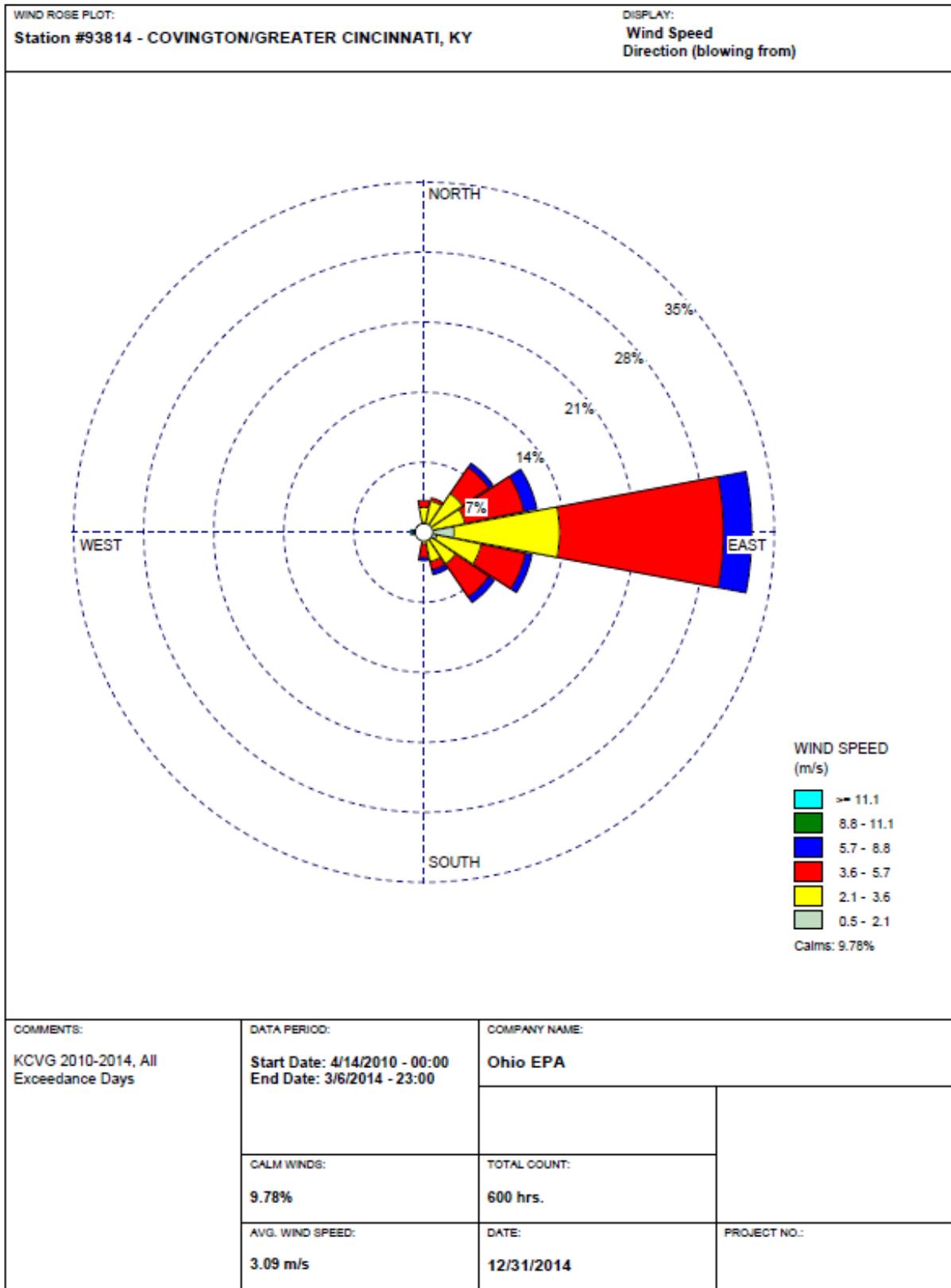


Figure 3: Cincinnati Northern Kentucky Airport (KCVG) wind rose for all exceedance days, 2010 to 2014

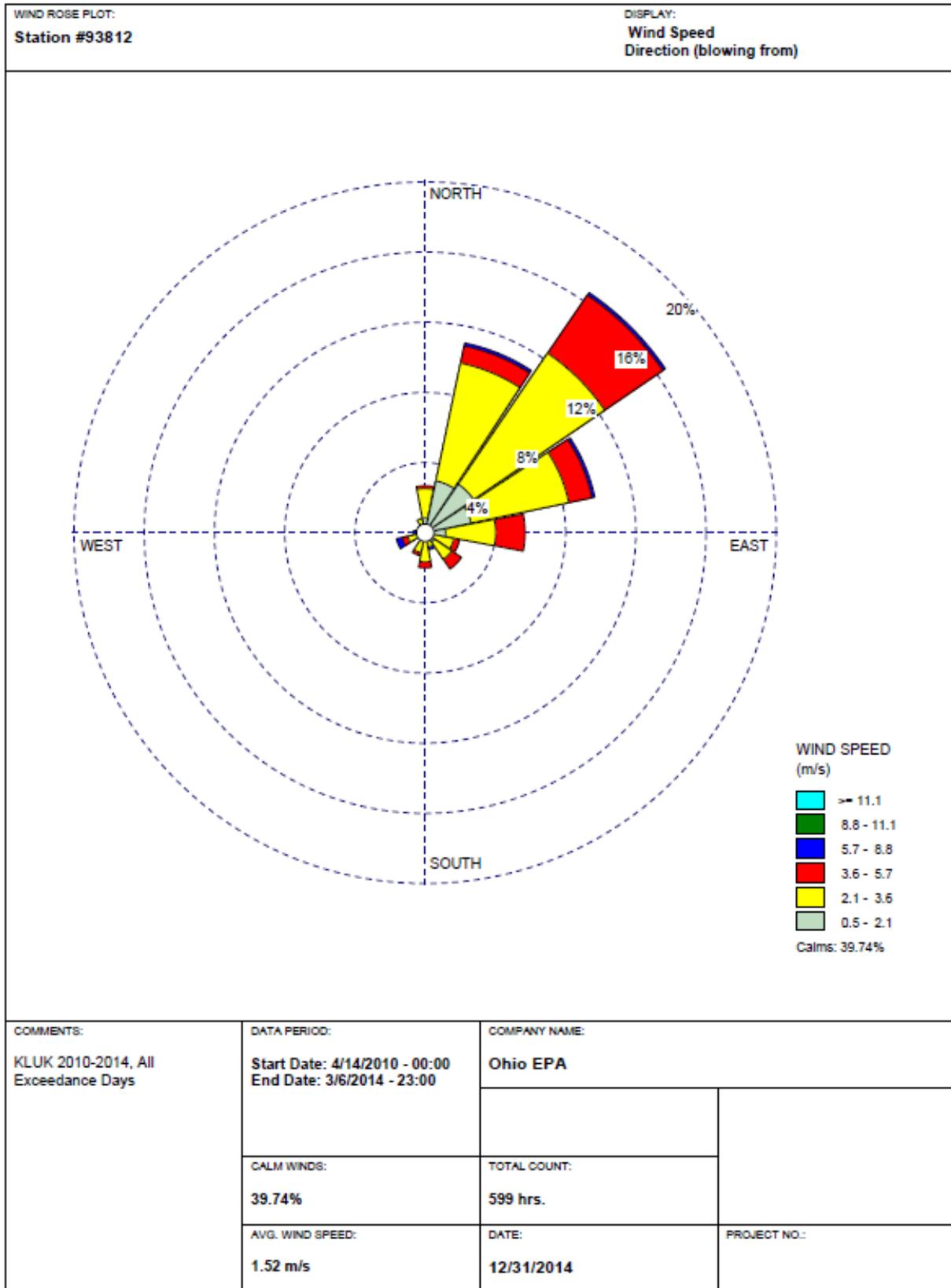


Figure 4: Cincinnati Municipal Airport (KLUK) wind rose for all exceedance days, 2010 to 2014

In some instances, the hourly emissions data were also reviewed in addition to the meteorological and HYSPLIT back trajectories. Hourly emissions data were downloaded from the U.S. EPA's Clean Air Markets Database (CAMD) and analyzed in comparison with the monitor exceedances.

The annual 2010-2014 emissions, shown in

Table 2

Table 2. Annual emissions summary for Beckjord and Zimmer, indicate that the Beckjord facility emitted significantly more SO<sub>2</sub> than the Zimmer facility during the time period 2010-2014. It should be noted that the Zimmer facility was fitted with flue gas de-sulfurization controls in December of 1990, which operate continuously by permit. The Beckjord facility does not have similar, advanced pollution controls for SO<sub>2</sub>.

Table 2. Annual emissions summary for Beckjord and Zimmer

Facility	Annual SO <sub>2</sub> Emission (tons)				
	2010	2011	2012	2013	2014
W H Zimmer Generating Station	19,388	18,044	11,975	18,457	9,780
W C Beckjord Generating Station	69,156	90,835	67,069	51,900	32,627

Note: Emissions for Jan. 1, 2010-Aug. 31, 2014

The following sections of this report describe the results of the findings of the above described analyses.

### III. Beckjord Trajectories

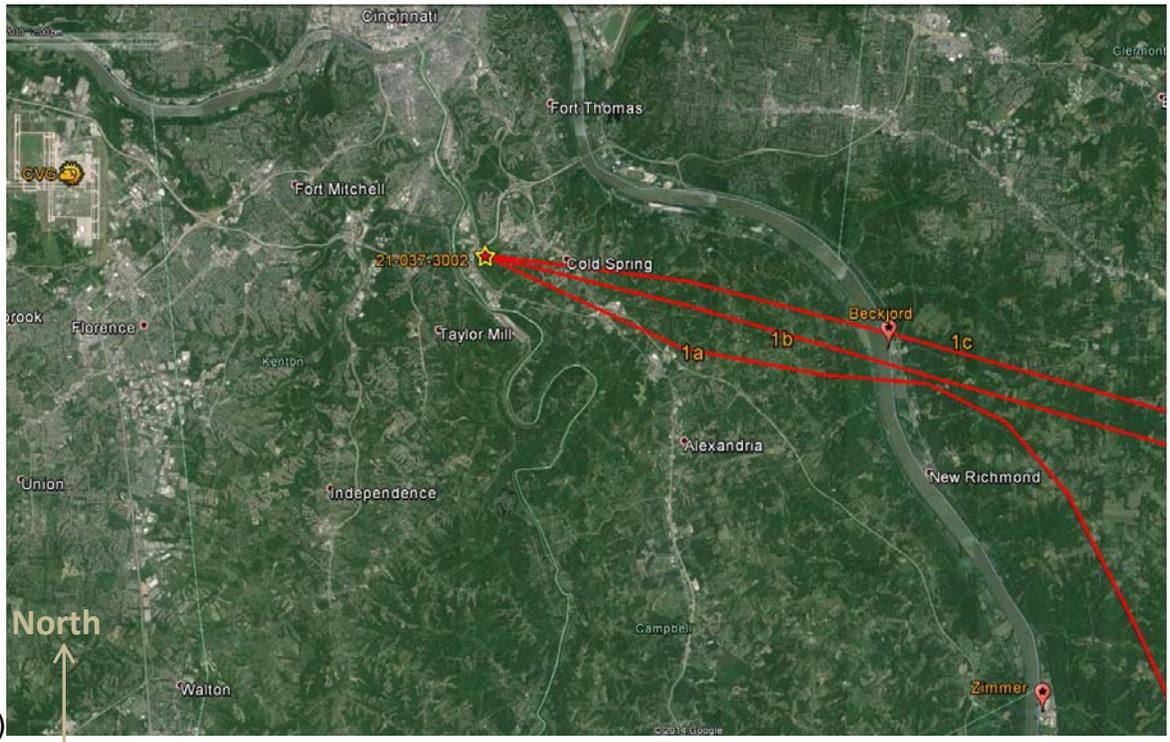
This section includes exceedance days in which the HYSPLIT back trajectories pass directly over or in close proximity to the Beckjord facility indicating a high probability of Beckjord contributing to the exceedances reported at the monitor. In this Section surface level wind data is also discussed in relation to the exceedance time and dates.

#### April 14, 2010

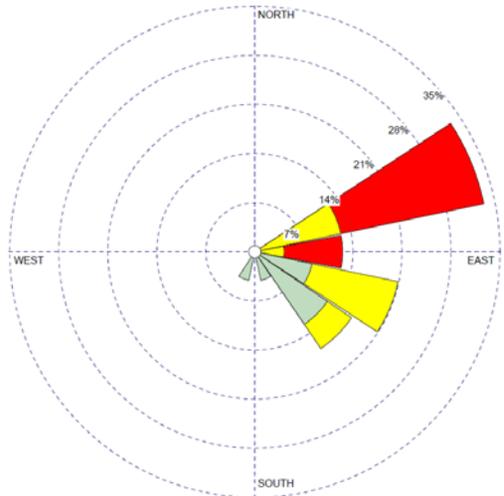
On April 14, 2010, five exceedances were reported at Monitor ID 21-037-3002 between 9:00 and 16:00. The exceedance values ranged from 86 to 142 ppb. Three HYSPLIT back trajectories were modeled as shown in Figure 5a to represent the five exceedances in the table below. The surface level meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 5b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 5c and 5d show the windrose data around the time of the 9:00 hour and 13:00 to 16:00 hour exceedance periods, respectively.

All three back trajectories pass directly over or in close proximity to the Beckjord facility. This indicates a high probability of Beckjord contributing to the exceedances reported at the monitor. In addition, the windrose data at the time of the exceedances shows the wind was blowing predominantly from the eastern direction, where the Beckjord facility is located. The April 14, 2010 exceedances are attributable to the Beckjord facility.

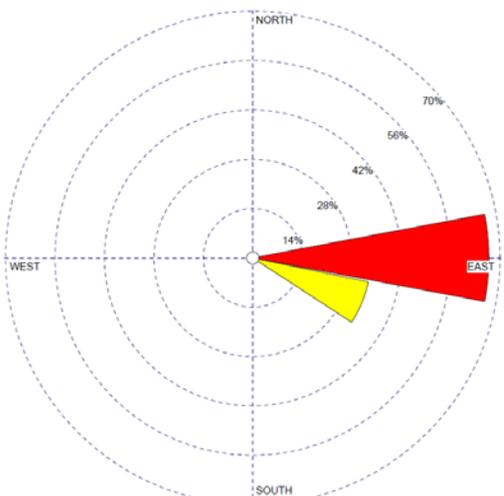
Trajectory ID	Year	Month	Day	Hour	Monitored Value (ppb)
1a	2010	4	14	9:00	106
1a	2010	4	14	13:00	142
1b	2010	4	14	14:00	140
1c	2010	4	14	15:00	86
1c	2010	4	14	16:00	86



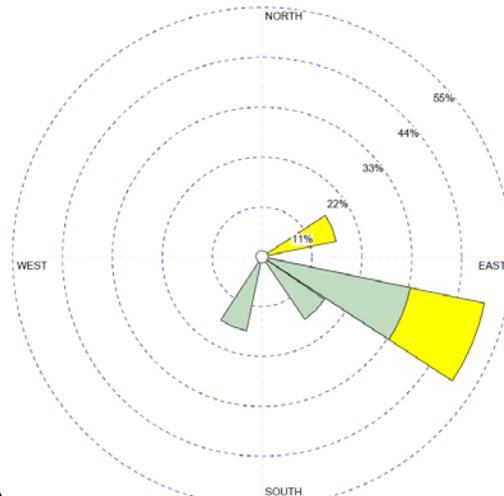
a)



b)



c)



d)

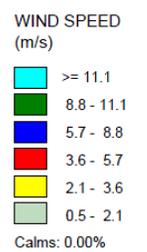


Figure 5. a) HYSPLIT back trajectory modeling for April 14, 2010; b) 24-hour windrose data at KCVG Station on April 14, 2010; c) 3-hour windrose data from 8:00 to 10:00 at KCVG Station on April 14, 2010; d) 6-hour windrose data from 12:00-17:00.

### November 24, 2010

On November 24, 2010, one exceedance was reported at Monitor ID 21-037-3002 at 11:00. The exceedance value reported was 105 ppb as shown in the table below. The exceedance was modeled by one HYSPLIT back trajectory in Figure 6a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 6b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 6c shows the windrose data around the time of the exceedance hour.

The HYSPLIT back trajectory passes in close proximity to the Beckjord facility. This indicates a high probability of Beckjord contributing to the exceedances reported at the monitor. In addition, the windrose data at the time of the exceedances shows the wind was blowing predominantly from the eastern direction, where the Beckjord facility is located. The November 24, 2010 exceedances are attributable to the Beckjord facility.

Trajectory ID	Year	Month	Day	Hour	Reading
5	2010	November	24	11:00	105

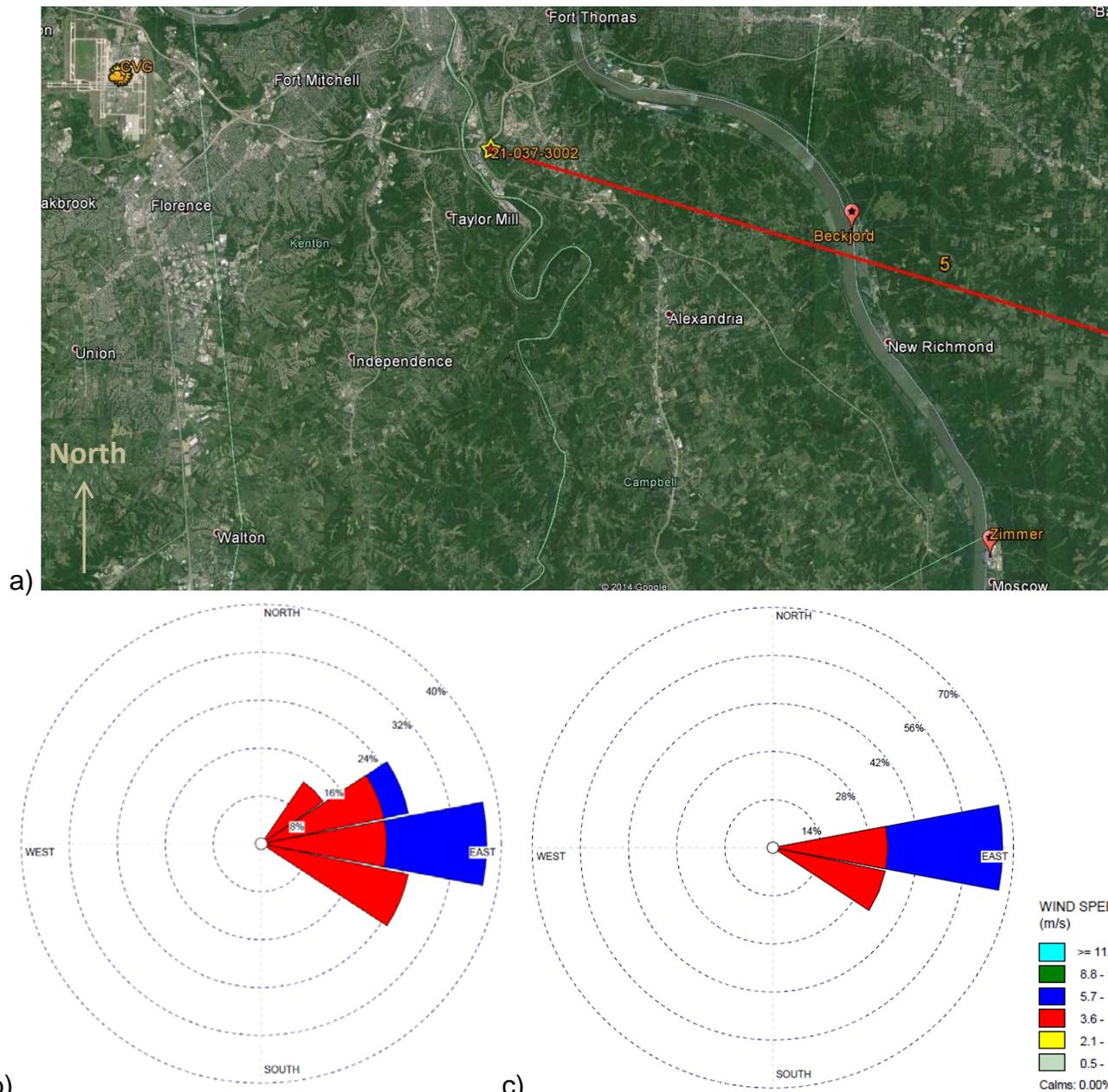


Figure 6. a) HYSPLIT back trajectory modeling for April 14, 2010; b) 24-hour windrose data at KCVG Station on November 24, 2010; c) 3-hour windrose data from 10:00 to 12:00 at KCVG Station on November 24, 2010.

March 3, 2011

On March 3, 2011, two exceedances were reported at Monitor ID 21-037-3002 at 10:00 and 13:00. The exceedance values reported were 86 and 92, respectively. The exceedances were modeled by one HYSPLIT back trajectory in Figure 7a. The surface level meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 7b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 7c and 7d show the windrose data around the time of the exceedance hours.

The HYSPLIT back trajectory passes in close proximity to the Beckjord facility. This indicates a high probability of Beckjord contributing to the exceedances reported at the monitor. In addition, the windrose data at the time of the exceedances shows the wind was blowing exclusively from the eastern direction, where the Beckjord facility is located. The March 3, 2011 exceedances are therefore expected to be attributable to the Beckjord facility.

Trajectory ID	Year	Month	Day	Hour	Reading
7	2011	March	3	10:00	86
7	2011	March	3	13:00	92

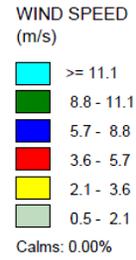
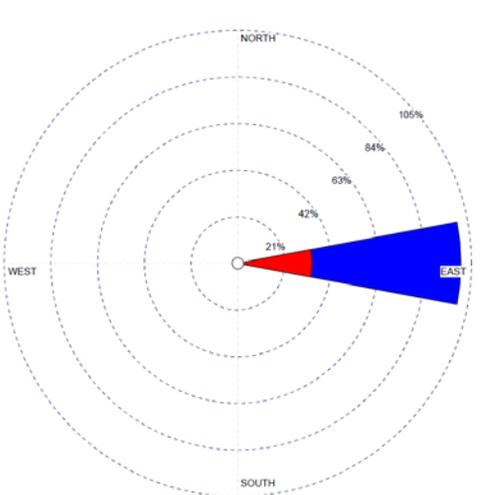
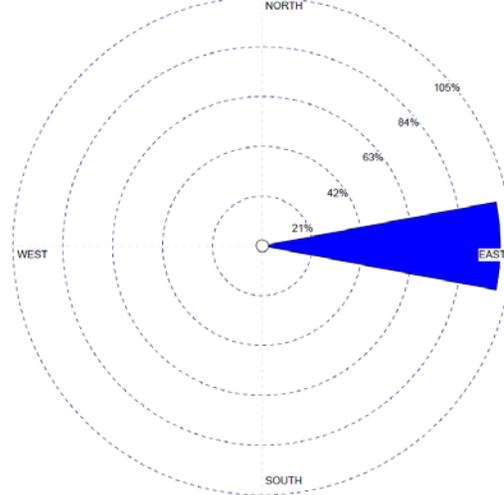
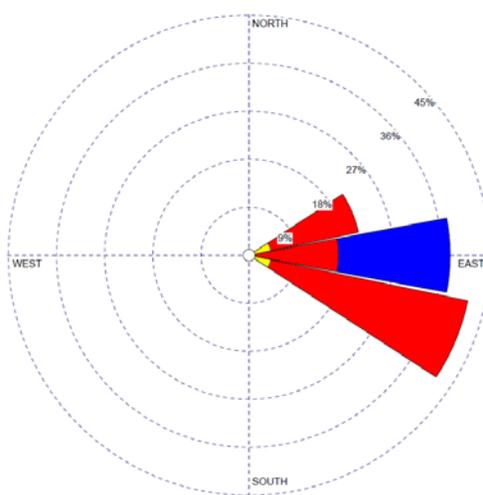
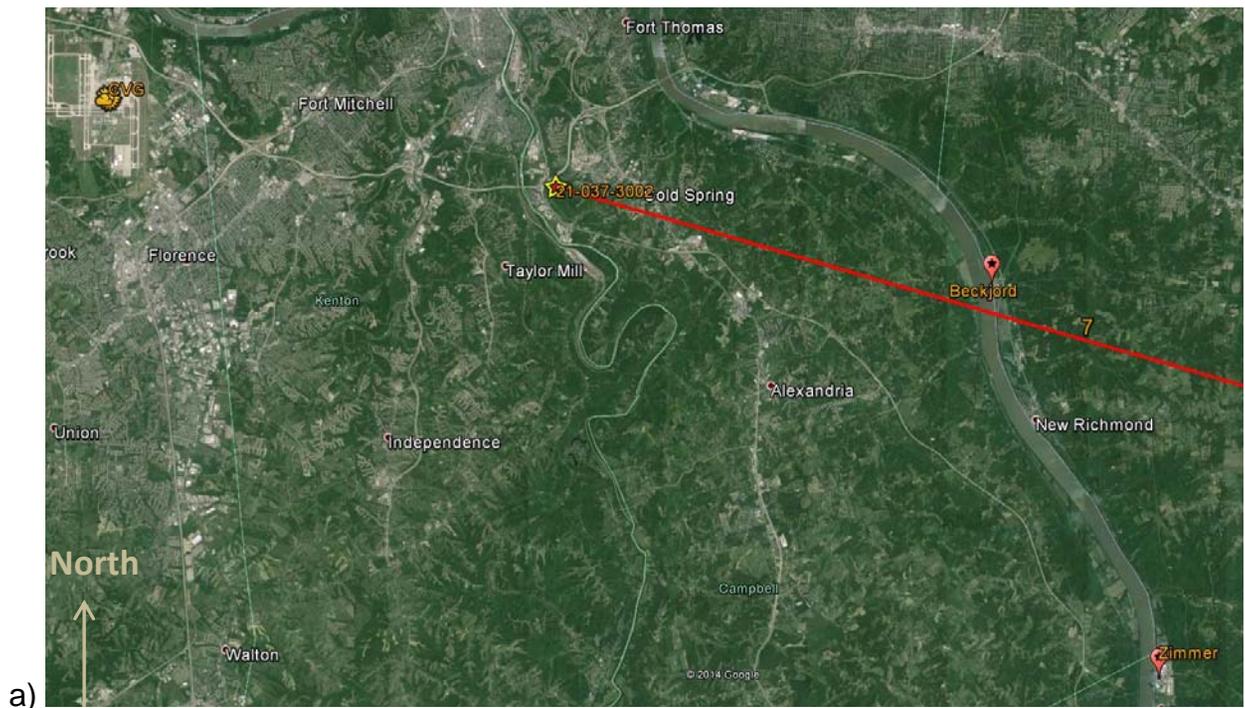


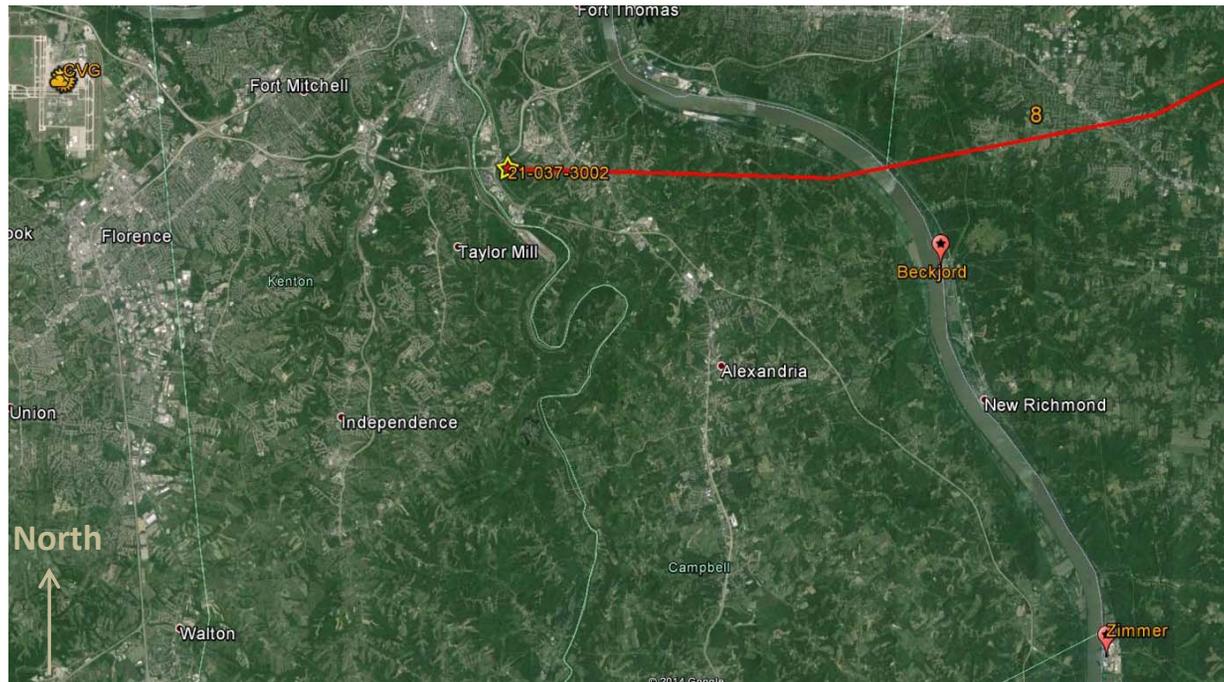
Figure 7. a) Beckjörd and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on March 3, 2011; b) 24-hour windrose data at KCVG Station on March 3, 2011; c) 3-hour windrose data from 9:00 to 11:00 at KCVG Station on March 3, 2011; d) 3-hour windrose data from 12:00 to 14:00 at KCVG Station on March 3, 2011.

March 7, 2011

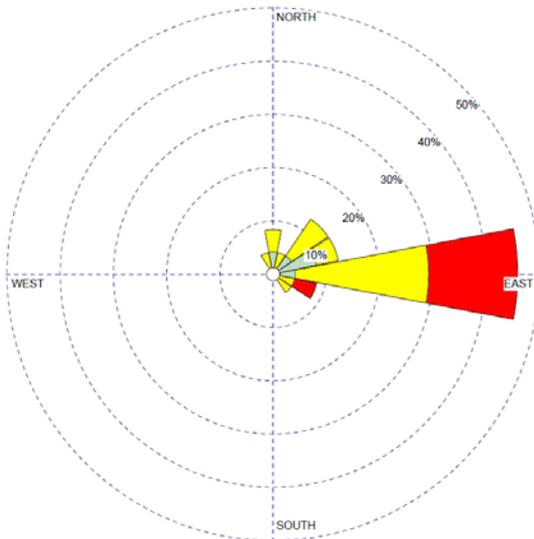
On March 7, 2011, three exceedances were reported at Monitor ID 21-037-3002 between 12:00 and 15:00. The exceedance values reported ranged from 76 to 87 ppb. The exceedances were modeled by one HYSPLIT back trajectory in Figure 8a. The surface level meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 8b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 8c and 8d show the windrose data around the time of the exceedance hours.

The HYSPLIT back trajectory passes in close proximity to the Beckjord facility indicating a high probability of Beckjord contributing to the exceedances reported at the monitor. In addition, the windrose data at the time of the exceedances shows the wind was blowing predominately from the eastern direction, where the Beckjord facility is located. The March 7, 2011 exceedances are therefore predicted to be attributable to the Beckjord facility.

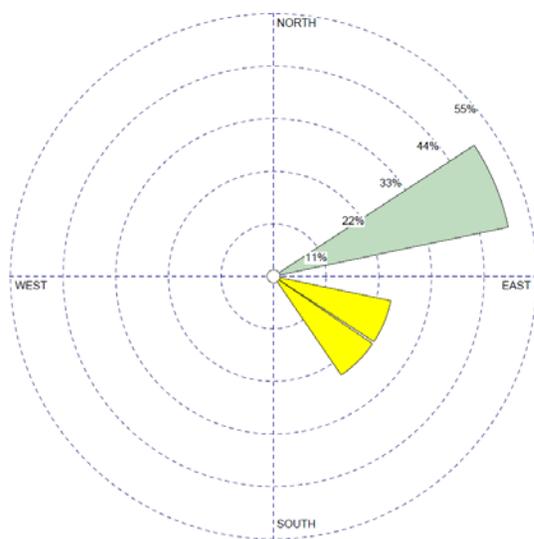
Trajectory ID	Year	Month	Day	Hour	Reading
8	2011	March	7	12:00	82
8	2011	March	7	13:00	76
8	2011	March	7	15:00	87



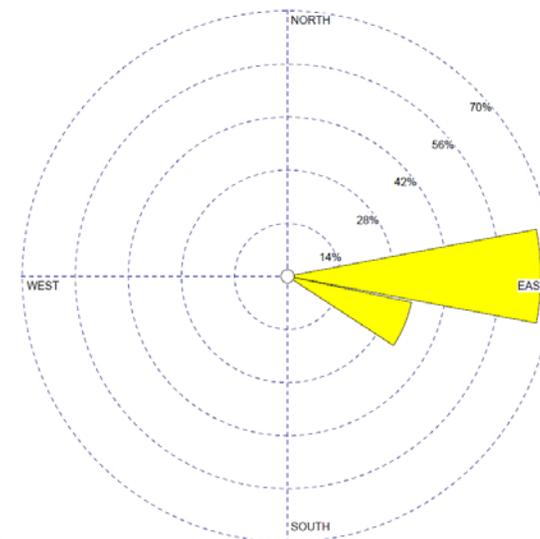
a)



b)



c)



d)

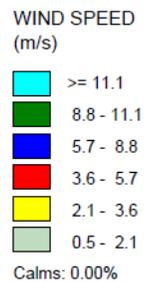


Figure 8. a) Beckford and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on March 7, 2011; b) 24-hour windrose data at KCVG Station on March 7, 2011; c) 4-hour windrose data from 11:00 to 14:00 at KCVG Station on March 7, 2011; d) 3-hour windrose data from 14:00 to 16:00 at KCVG Station on March 7, 2011.

### June 3, 2011

On June 3, 2011, two exceedances were reported at Monitor ID 21-037-3002 between 10:00 and 11:00. The exceedance values reported ranged from 102 to 142 ppb. The exceedances were modeled by one HYSPLIT back trajectory in Figure 9a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 9b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 9c shows the windrose data around the time of the exceedance.

The HYSPLIT back trajectory passes in close proximity to the Beckjord facility. This indicates a high probability of Beckjord contributing to the exceedances reported at the monitor. In addition, the windrose data around the time of the exceedances shows the wind was blowing predominately from the eastern direction, where the Beckjord facility is located. The June 3, 2011 exceedances are therefore predicted to be attributable to the Beckjord facility.

Trajectory ID	Year	Month	Day	Hour	Reading
11	2011	June	3	10:00	102
11	2011	June	3	11:00	142

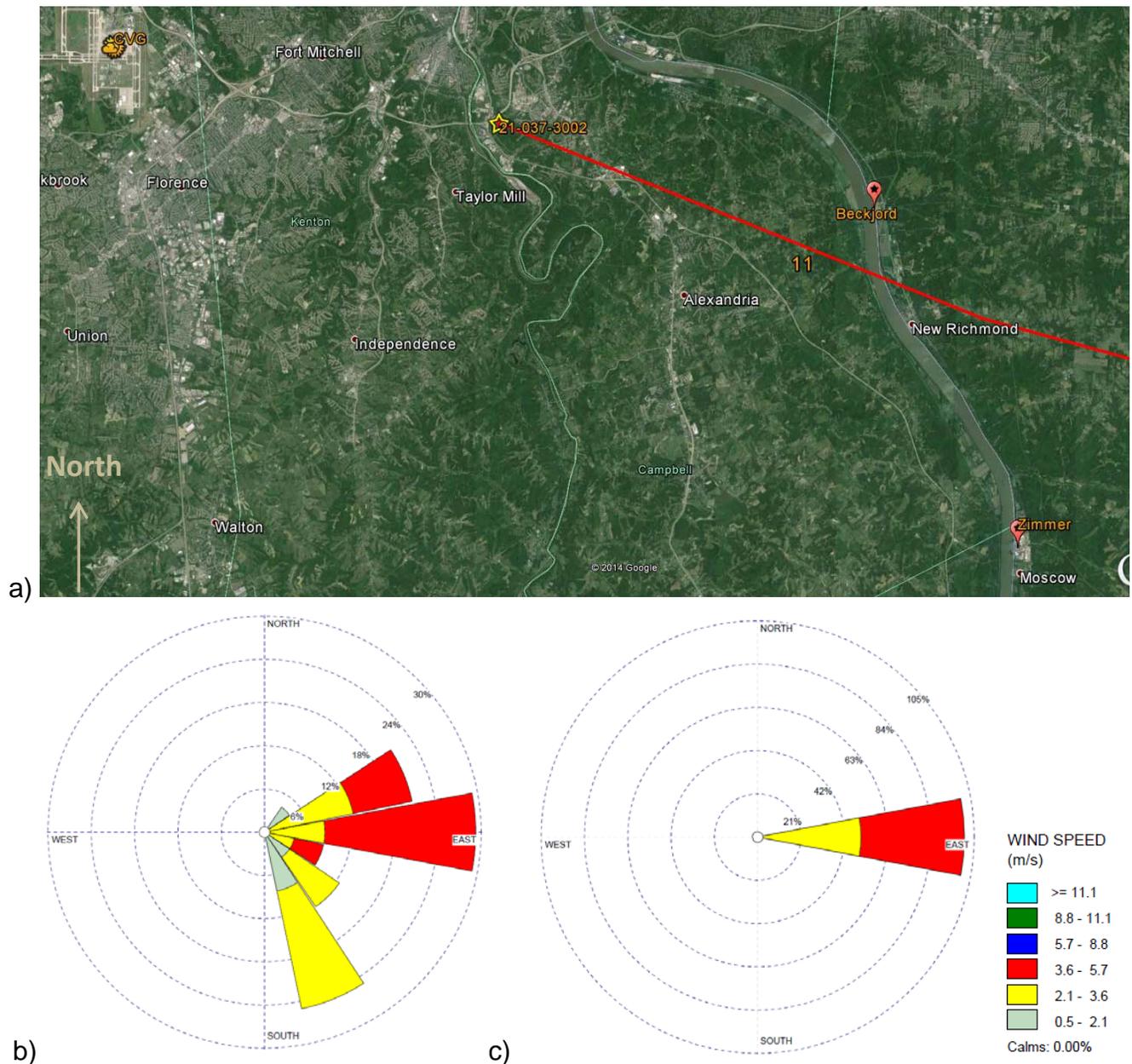


Figure 9. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on June 3, 2011; b) 24-hour windrose data at KCVG Station on June 3, 2011; c) 4-hour windrose data from 9:00 to 12:00 at KCVG Station on June 3, 2011.

July 15, 2011

On July 15, 2011, two exceedances were reported at Monitor ID 21-037-3002 between 17:00 and 18:00. The exceedance values reported ranged from 76 to 92 ppb. The exceedances were modeled by one HYSPLIT back trajectory in Figure 10a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 10b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 10c shows the windrose data around the time of the exceedance.

The HYSPLIT back trajectory passes in close proximity to the Beckjord facility. This indicates a high probability of Beckjord contributing to the exceedances reported at the monitor. The windrose data at the time of the exceedances shows the wind was blowing predominately from the northeast and northwest direction. However, given the lack of other significant sources of SO<sub>2</sub> located north of the monitor and the close proximity of the HYPPLIT back trajectory, it is likely that the emissions from Beckjord contributed to the exceedances.

Trajectory ID	Year	Month	Day	Hour	Reading
13	2011	July	15	17:00	76
13	2011	July	15	18:00	92

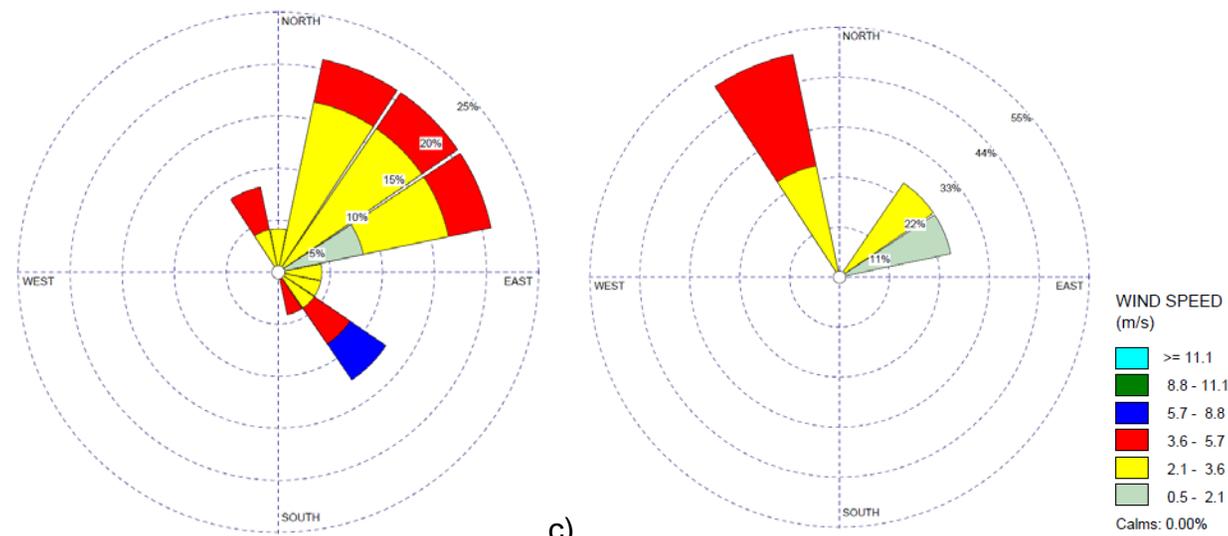
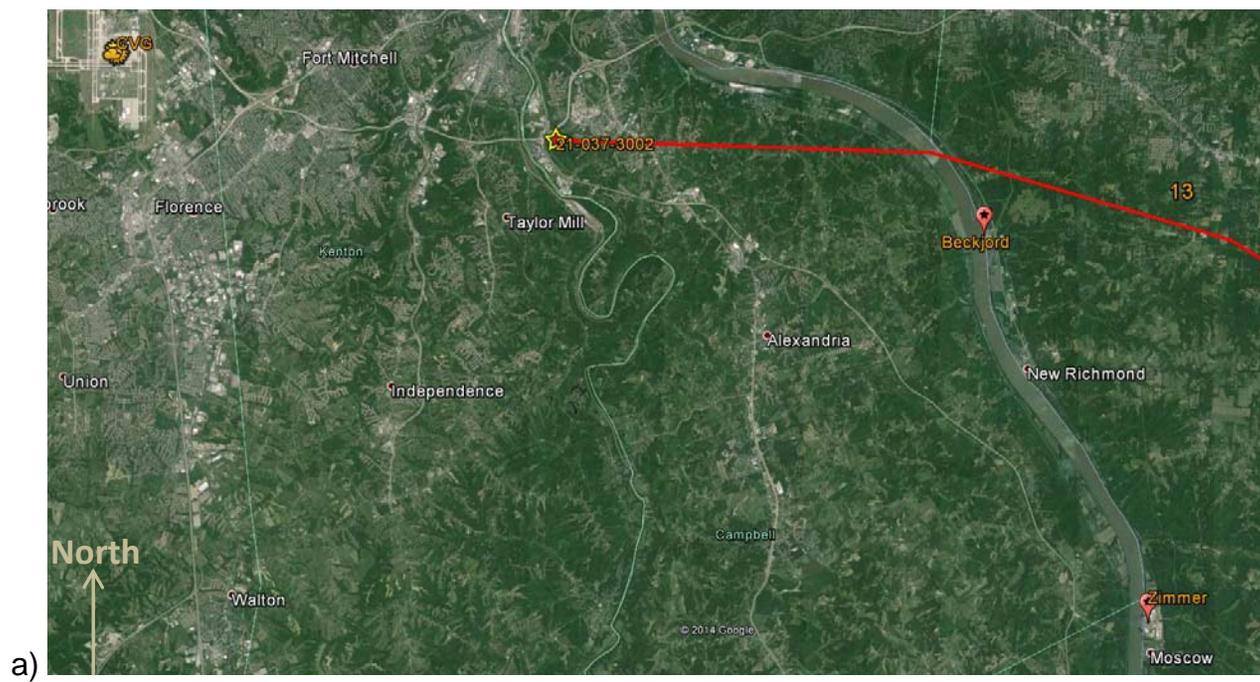


Figure 10. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on June 3, 2011; b) 24-hour windrose data at KCVG Station on June 3, 2011; c) 4-hour windrose data from 16:00 to 19:00 at KCVG Station on June 3, 2011.

## August 30, 2011

On August 30, 2011, five exceedances were reported at Monitor ID 21-037-3002 between 10:00 and 14:00. The exceedance values reported ranged from 76 to 86 ppb. The exceedances were modeled by four HYSPLIT back trajectory in Figure 11a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 11b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 8c shows the windrose data around the time of the exceedance.

The HYSPLIT back trajectories pass in close proximity to the Beckjord facility. This indicates a high probability of Beckjord contributing to the exceedances reported at the monitor. The windrose data on the day of the exceedance and at the time of the exceedances shows the wind was blowing predominately from the east. The August 30, 2011 exceedances are therefore predicted to be attributable to the Beckjord facility.

Trajectory ID	Year	Month	Day	Hour	Reading
14a	2011	August	30	10:00	86
14b	2011	August	30	11:00	76
14b	2011	August	30	12:00	84
14c	2011	August	30	13:00	84
14d	2011	August	30	14:00	80

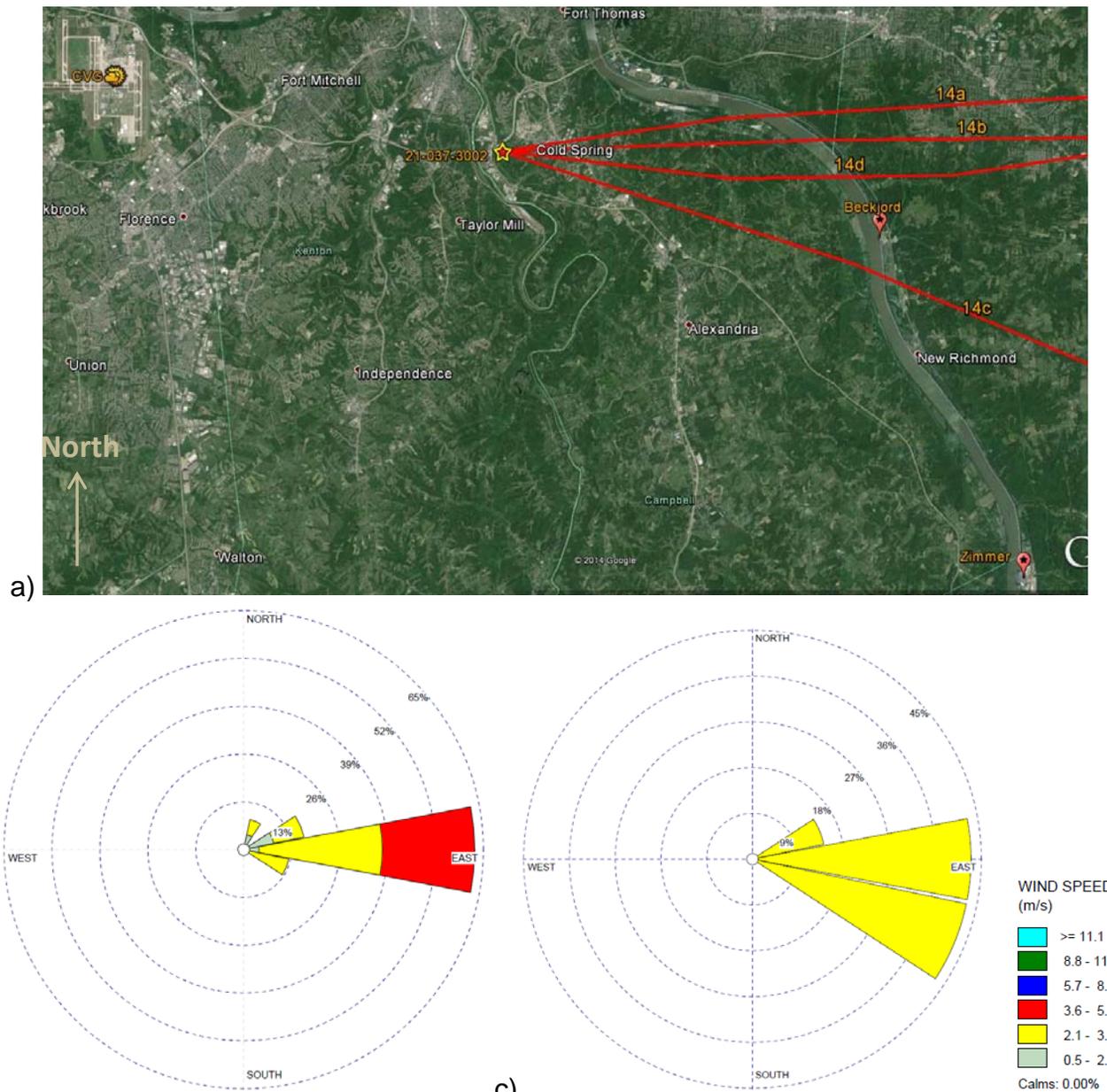


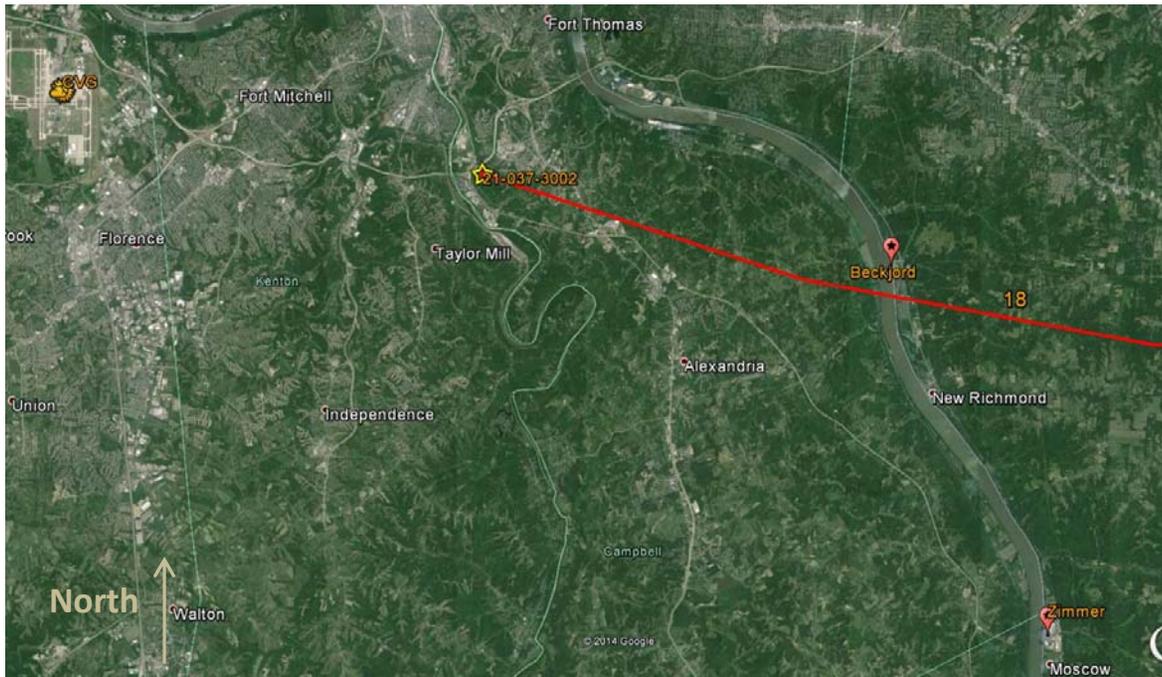
Figure 11. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on August 30, 2011; b) 24-hour windrose data at KCVG Station on August 30, 2011; c) 6-hour windrose data from 9:00 to 15:00 at KCVG Station on August 30, 2011.

## February 20, 2012

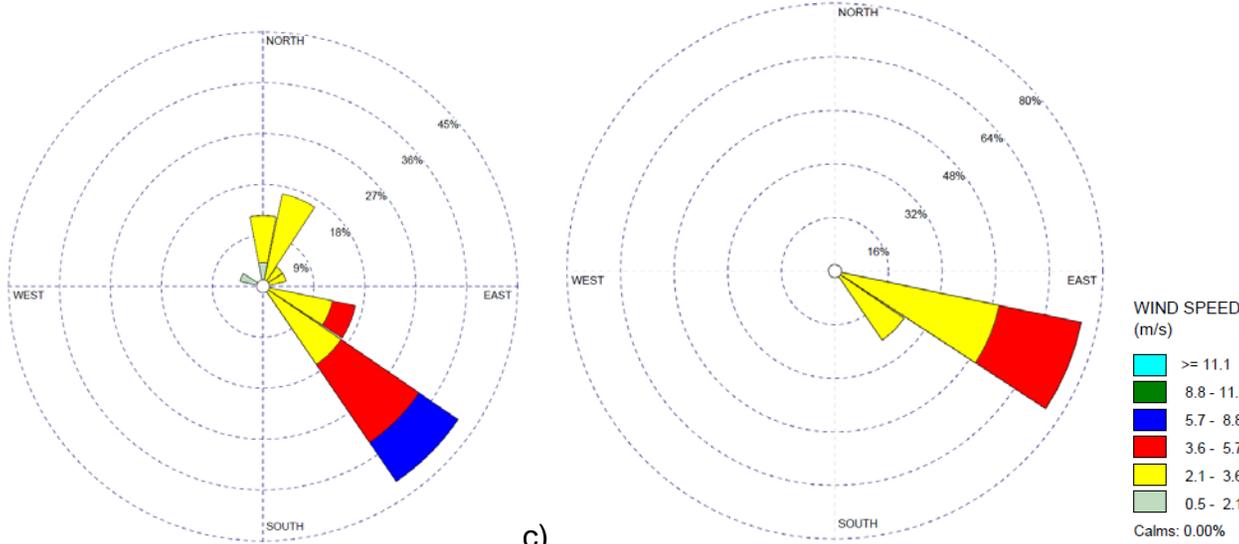
On February 20, 2012, two exceedances were reported at Monitor ID 21-037-3002 between 12:00 and 13:00. The exceedance values reported ranged from 117 to 156 ppb. The exceedances were modeled by one HYSPLIT back trajectory in Figure 12a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 12b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 12c shows the windrose data around the time of the exceedance.

The HYSPLIT back trajectory passes in close proximity to the Beckjord facility. This indicates a high probability of Beckjord contributing to the exceedances reported at the monitor. The windrose data on the day of the exceedance and at the time of the exceedances shows the wind was blowing predominately from the east/southeast. The August 30, 2011 exceedances are therefore predicted to be attributable to the Beckjord facility.

Trajectory ID	Year	Month	Day	Hour	Reading
18	2012	February	20	12:00	117
18	2012	February	20	13:00	156



a)



b)

c)

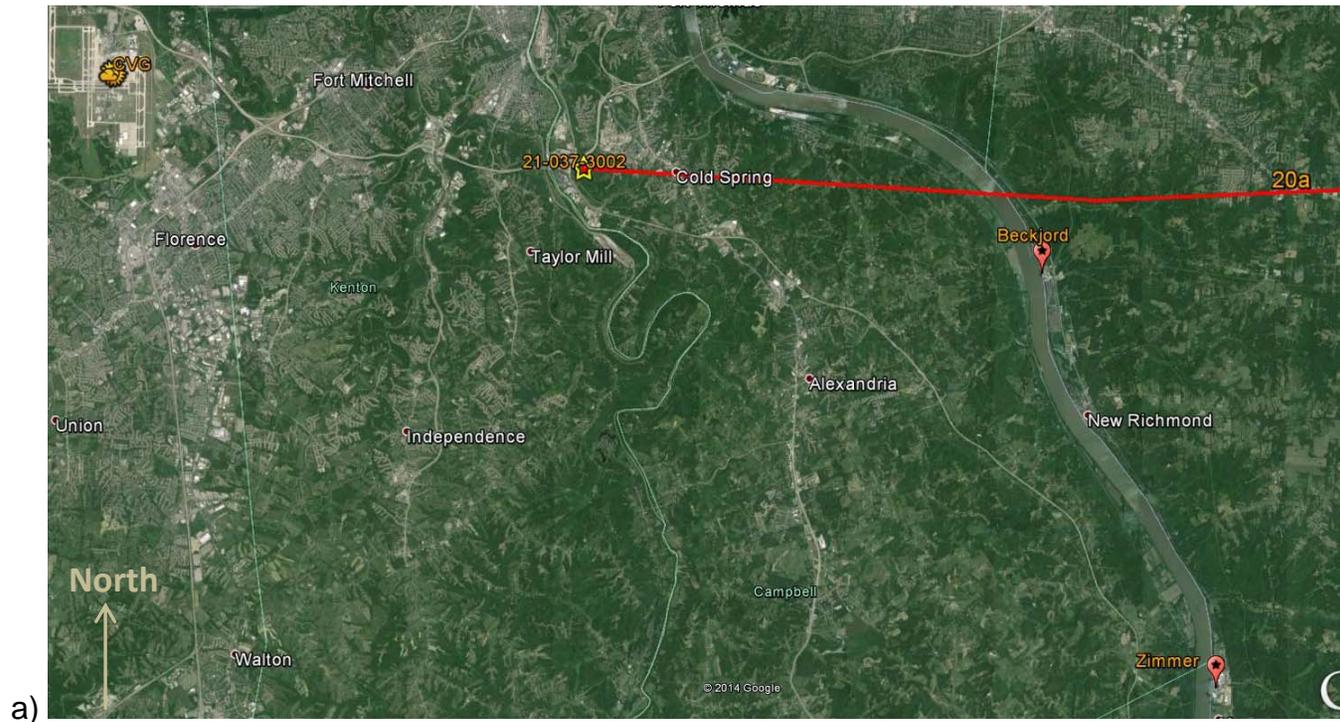
Figure 12. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on February 20, 2012; b) 24-hour windrose data at KCVG Station on February 20, 2012; c) 4-hour windrose data from 11:00 to 14:00 at KCVG Station on February 20, 2012.

April 7, 2012

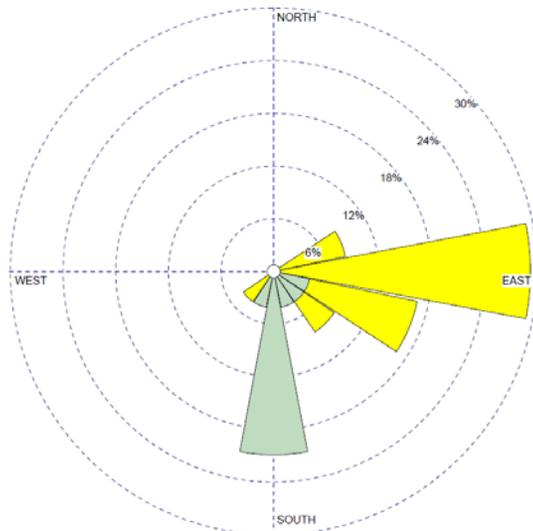
On April 7, 2012, one exceedance was reported at Monitor ID 21-037-3002 at 11:00. The exceedance value reported was 99 ppb. The exceedance was modeled by one HYSPLIT back trajectory in Figure 13a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 13b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 13c shows the windrose data around the time of the exceedance.

The HYSPLIT back trajectory passes in close proximity to the Beckjord facility. This indicates a high probability of Beckjord contributing to the exceedances reported at the monitor. The windrose data on the day of the exceedance and at the time of the exceedances shows the wind was blowing predominately from the east/southeast. Zimmer was not operating on this day; the April 7, 2012 exceedance is therefore predicted to be attributable to the Beckjord facility.

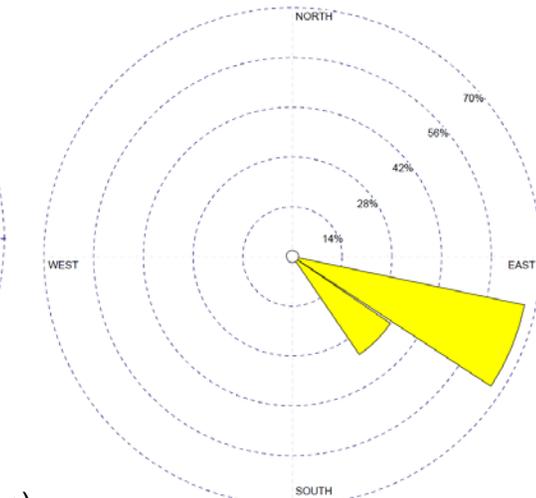
Trajectory ID	Year	Month	Day	Hour	Reading
20a	2012	April	7	11:00	99



a)



b)



c)

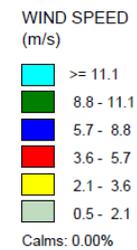


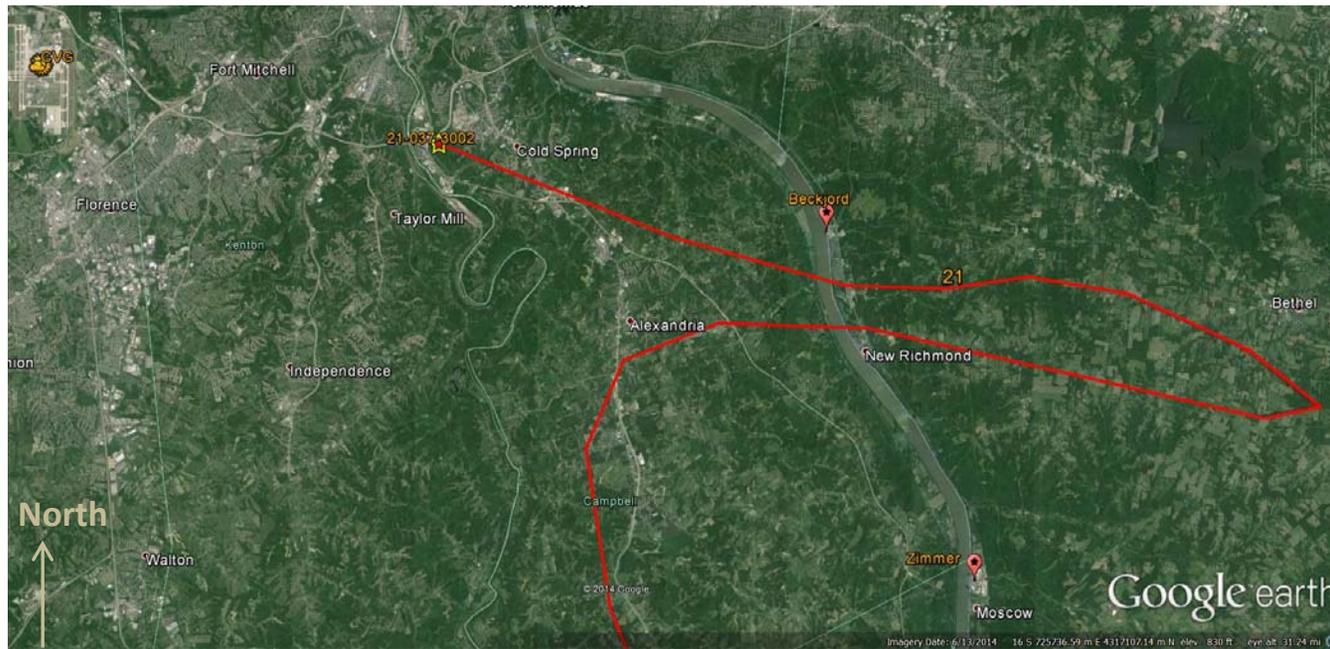
Figure 13. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on April 7, 2012; b) 24-hour windrose data at KCVG Station on April 7, 2012; c) 3-hour windrose data from 10:00 to 12:00 at KCVG Station on April 7, 2012.

## May 6, 2012

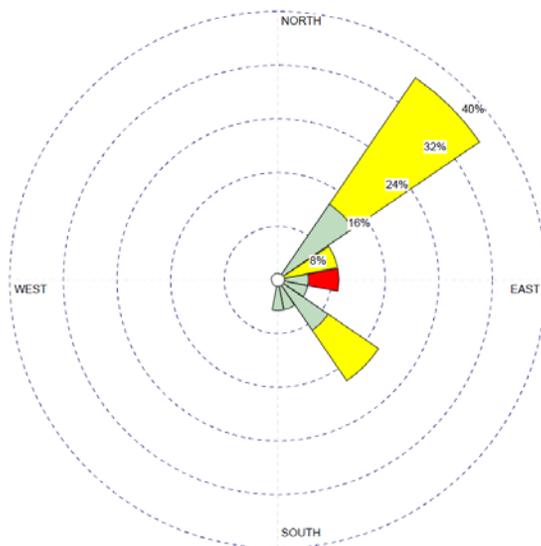
On May 6, 2012, one exceedance was reported at Monitor ID 21-037-3002 at 18:00. The exceedance value reported ranged was 93 ppb. The exceedance was modeled by one back trajectory in Figure 14a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 14b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 14c shows the windrose data around the time of the exceedance.

The HYSPLIT back trajectories pass in close proximity to the Beckjord facility. This indicates a high probability of Beckjord contributing to the exceedances reported at the monitor. The windrose data from around time of the exceedance shows the wind was blowing from the east and southeast. Also, Zimmer did not operate on this day. The May 6, 2012 exceedances are therefore predicted to be attributable to the Beckjord facility.

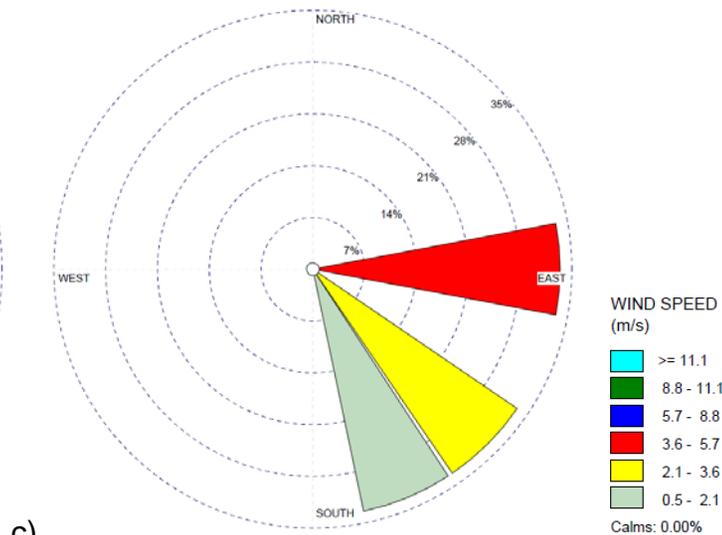
Trajectory ID	Year	Month	Day	Hour	Reading
21	2012	May	6	18:00	93



a)



b)



c)

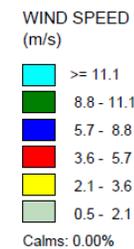


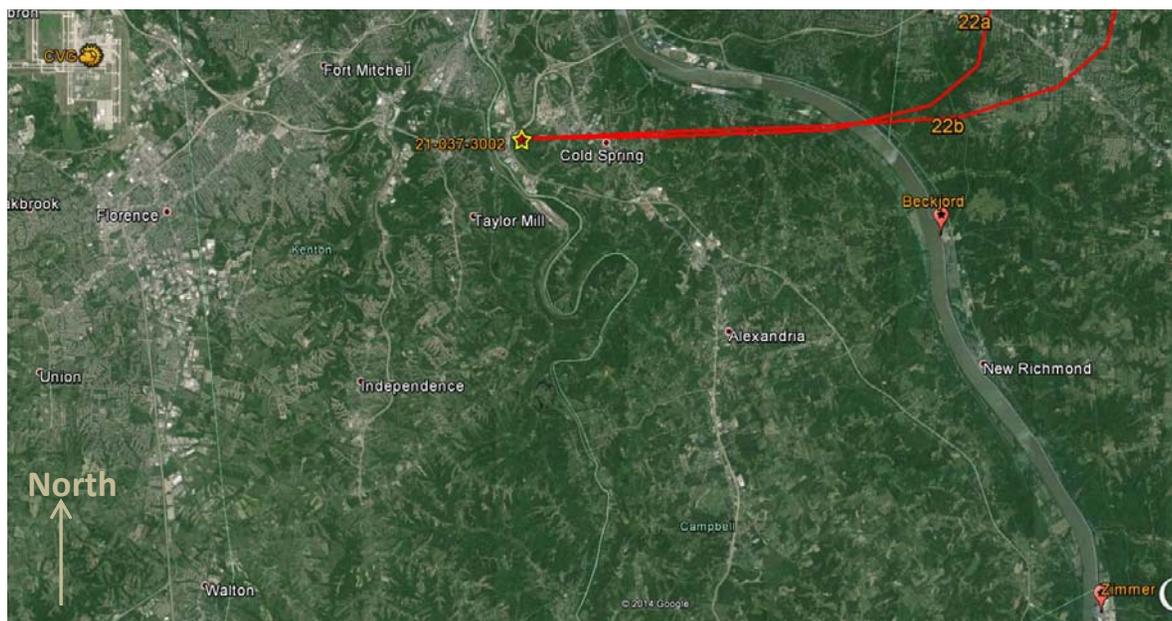
Figure 14. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on May 6, 2012; b) 24-hour windrose data at KCVG Station on May 6, 2012; c) 3-hour windrose data from 17:00 to 19:00 at KCVG Station on May 6, 2012.

### February 9, 2013

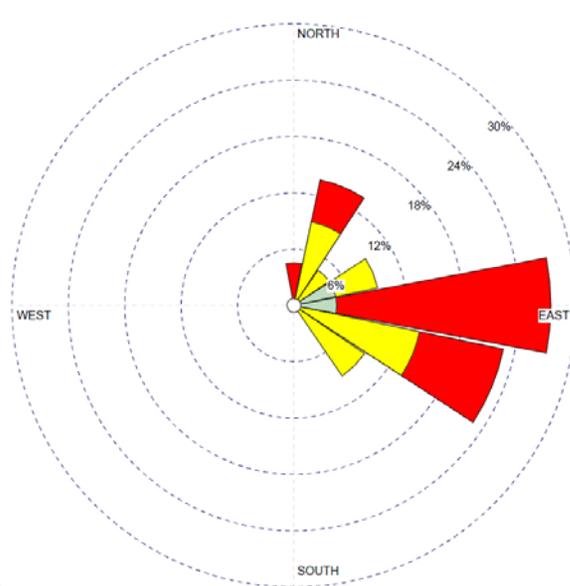
On February 9, 2013, two exceedances were reported at Monitor ID 21-037-3002 between 13:00 and 14:00. The exceedance values reported ranged from 96 to 124 (Table 6). The exceedances were each modeled by an individual trajectory in Figure 15a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 15b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 15c shows the windrose data around the time of the exceedance.

The HYSPLIT back trajectories pass in close proximity to the Beckjord facility. This indicates a high probability of Beckjord contributing to the exceedances reported at the monitor. The surface windrose data from around time of the exceedance shows the wind was blowing from the east and southeast. Zimmer did not operate on this day; the February 9, 2013 exceedances are therefore predicted to be attributable to the Beckjord facility.

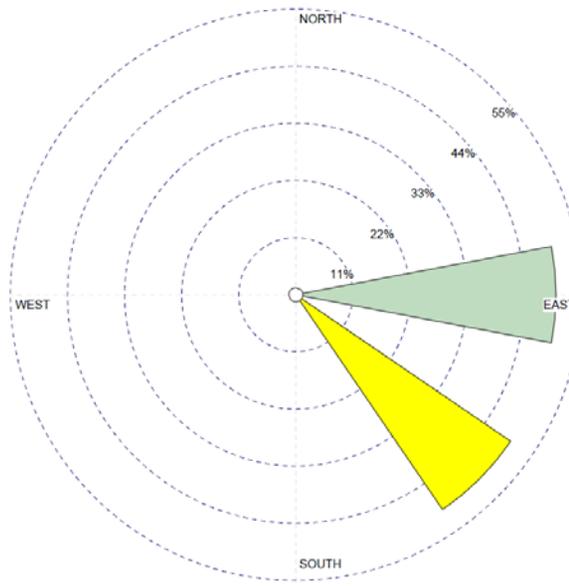
Trajectory ID	Year	Month	Day	Hour	Reading
22a	2013	February	9	13:00	96
22b	2013	February	9	14:00	124



a)



b)



c)

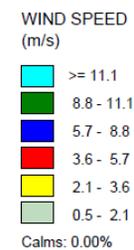


Figure 15. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on February 9, 2013; b) 24-hour windrose data at KCVG Station on February 9, 2013; c) 2-hour windrose data from 13:00 to 14:00 at KCVG Station on February 9, 2013.

## February 25, 2013

On February 25, 2013, two exceedances were reported at Monitor ID 21-037-3002 at 9:00 and 10:00. The exceedance values reported ranged from 100 to 125 ppb. The exceedances were each modeled by an individual trajectory in Figure 16a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 16b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 16c shows the windrose data around the time of the exceedance.

The HYSPLIT back trajectories pass directly over and in close proximity to the Beckjord facility. This indicates a high probability of Beckjord contributing to the exceedances reported at the monitor. The surface windrose data from around time of the exceedance shows the wind was blowing from the east/southeast. Zimmer did not operate on this day, therefore, the February 25, 2013 exceedances are predicted to be attributable to the Beckjord facility.

Trajectory ID	Year	Month	Day	Hour	Reading
23a	2013	February	25	9:00	100
23b	2013	February	25	10:00	125

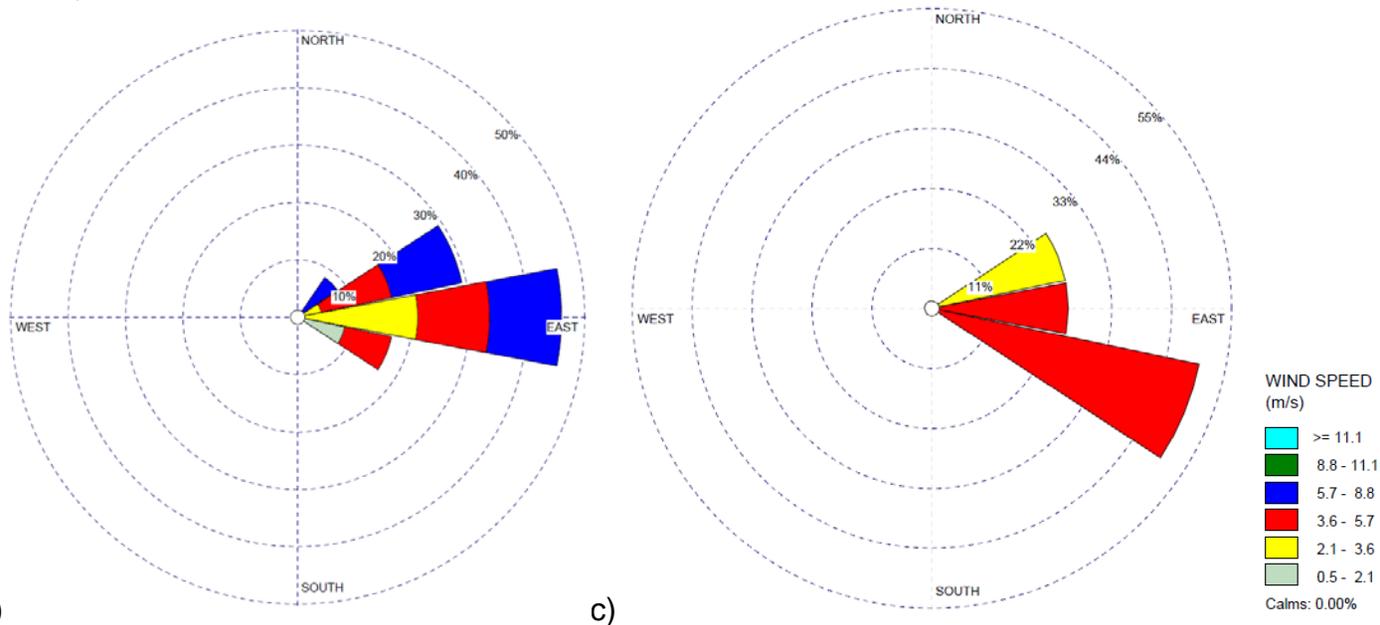
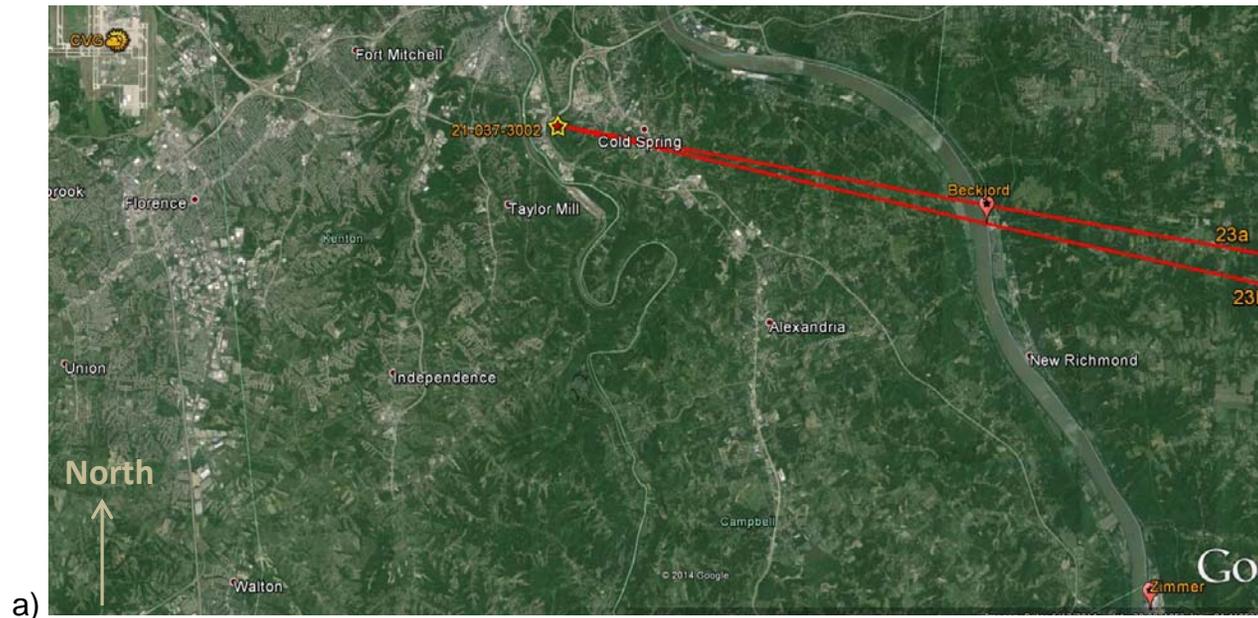


Figure 16. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on February 25, 2013; b) 24-hour windrose data at KCVG Station on February 25, 2013; c) 4-hour windrose data from 8:00 to 11:00 at KCVG Station on February 25, 2013.

### March 5, 2013

On March 5, 2013, one exceedance was reported at Monitor ID 21-037-3002 at 6:00. The exceedance value reported was 125 ppb. The exceedance was modeled by an individual trajectory in Figure 17a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 17b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 17c shows the windrose data around the time of the exceedance.

The HYSPLIT back trajectories pass in close proximity to the Beckjord facility. This indicates a high probability of Beckjord contributing to the exceedances reported at the monitor. The surface windrose data on the exceedance day and around time of the exceedance show the wind was blowing predominately from the east. The March 5, 2013 exceedance is therefore predicted to be attributable to the Beckjord facility.

Trajectory ID	Year	Month	Day	Hour	Reading
24	2013	March	5	6:00	125

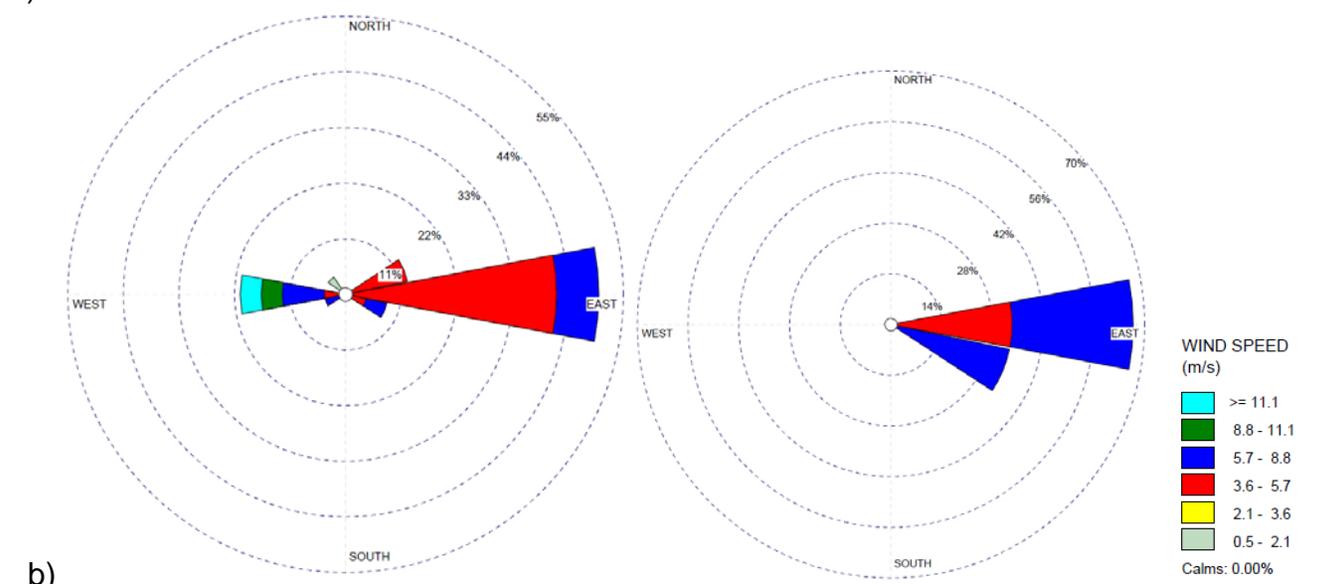
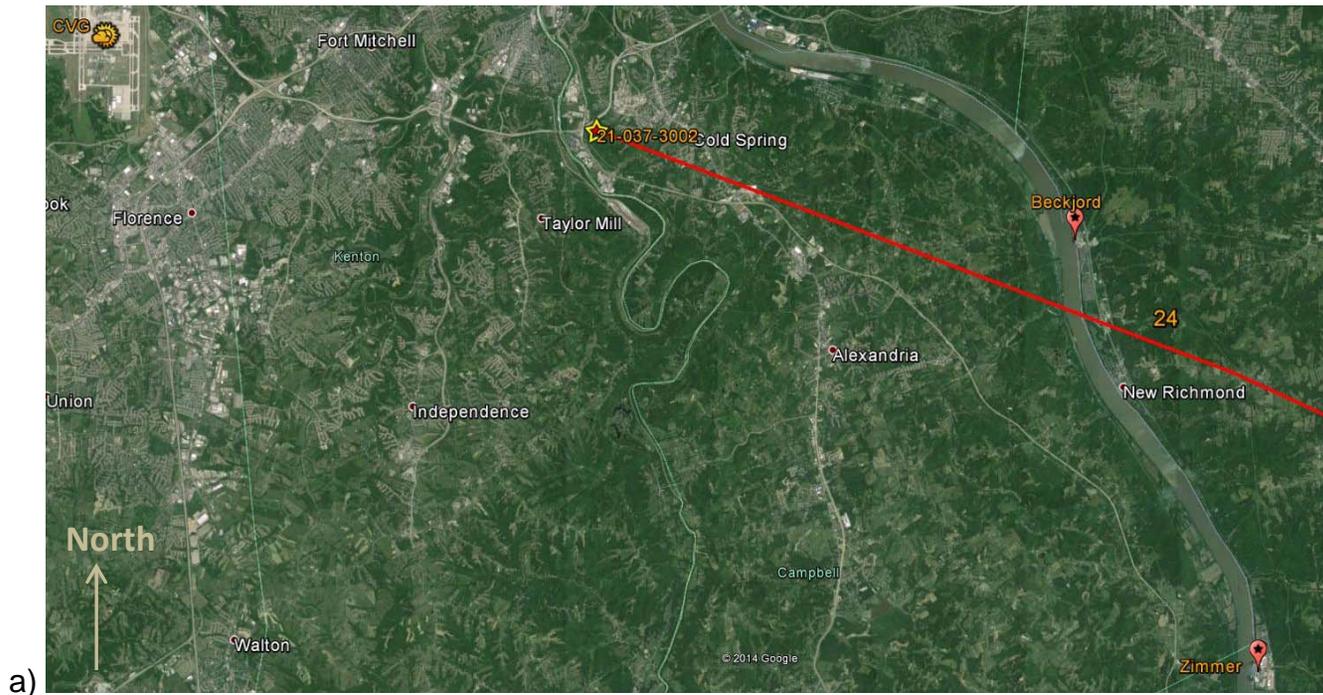


Figure 17. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on March 5, 2014; b) 24-hour windrose data at KCVG Station on March 5, 2014; c) 2-hour windrose data from 5:00 to 7:00 at KCVG Station on March 5, 2014.

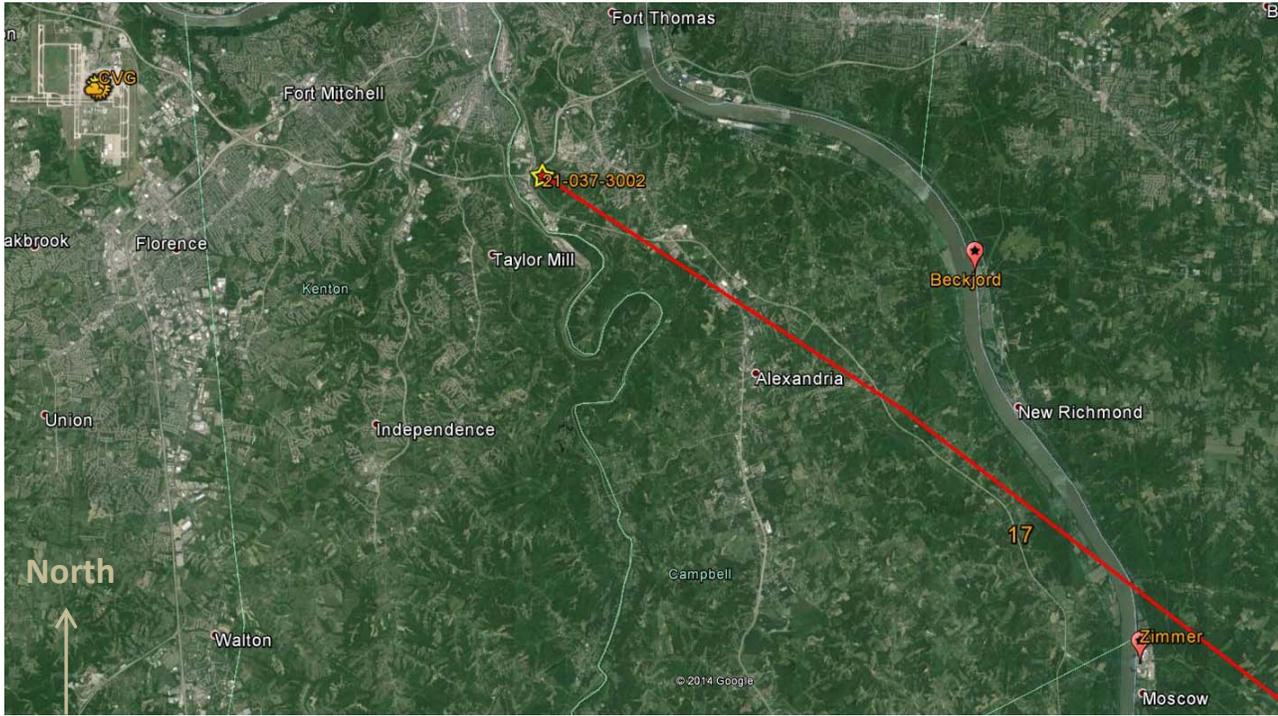
#### IV. Zimmer Trajectories

This Section includes exceedance days in which the HYSPLIT back trajectories pass directly over or in close proximity to the Zimmer facility indicating a high probability of Zimmer contributing to the exceedances reported at the monitor. Also in this Section, data including surface wind data and CEMS data were analyzed to draw conclusions about the likely contribution of Zimmer emissions in relation to the exceedance at the monitor.

##### February 3, 2012

On February 3, 2012, one exceedance was reported at Monitor ID 21-037-3002 at 17:00. The exceedance value reported was 82 ppb. The exceedance was modeled by one HYSPLIT back trajectory in Figure 18a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 18b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 18c shows the windrose data around the time of the exceedance hour. Figure 18d shows the CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day. The HYSPLIT back trajectory passes in close proximity to the Zimmer facility. This indicates a high probability of Zimmer contributing to the exceedances reported at the monitor. The windrose data at the time of the exceedances shows the wind was blowing predominantly from the northeastern direction with a slight contribution from the southeastern direction between 16:00 and 18:00. Examining the windrose data for the entire day shows surface winds blowing predominately from the east/ southeast direction. Based on the results of the HYSPLIT data it would appear Zimmer was the most likely contributor. However, based on the windrose data it would appear Beckjord was more likely the contributor to the exceedance on February 3, 2012. It should be noted emissions from Beckjord were over five times the emissions of Zimmer prior to and during the exceedance period.

Trajectory ID	Year	Month	Day	Hour	Reading
17	2012	February	3	17:00	82



a)

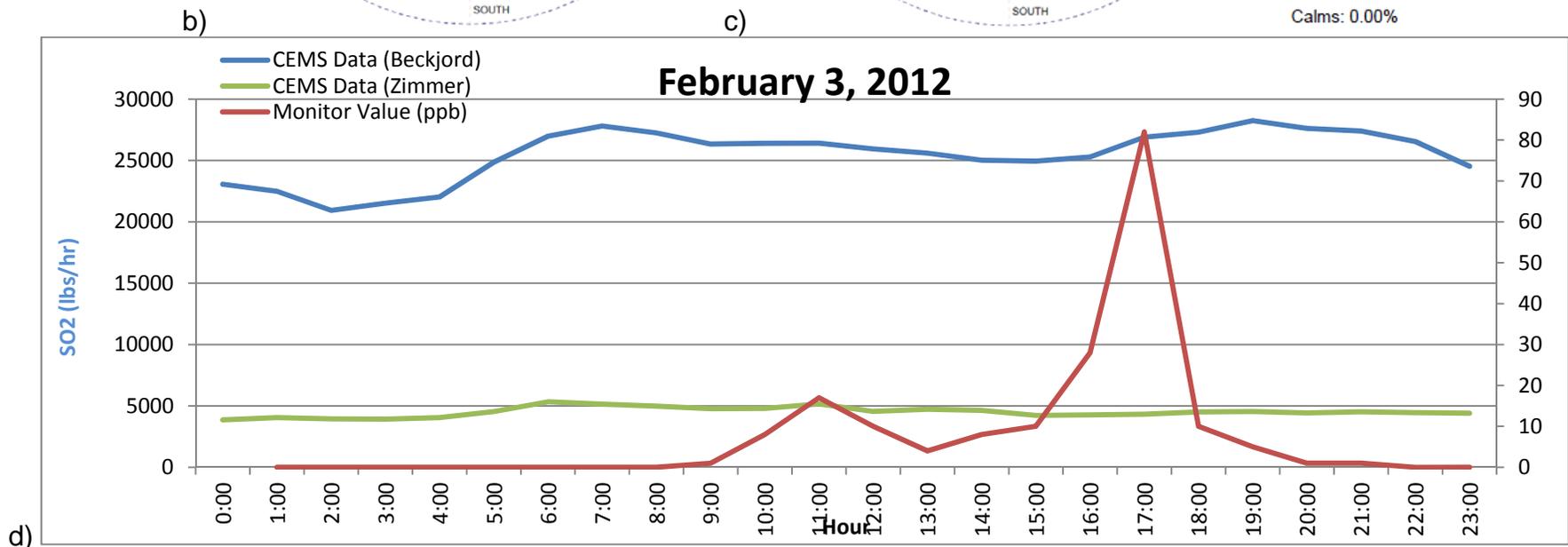
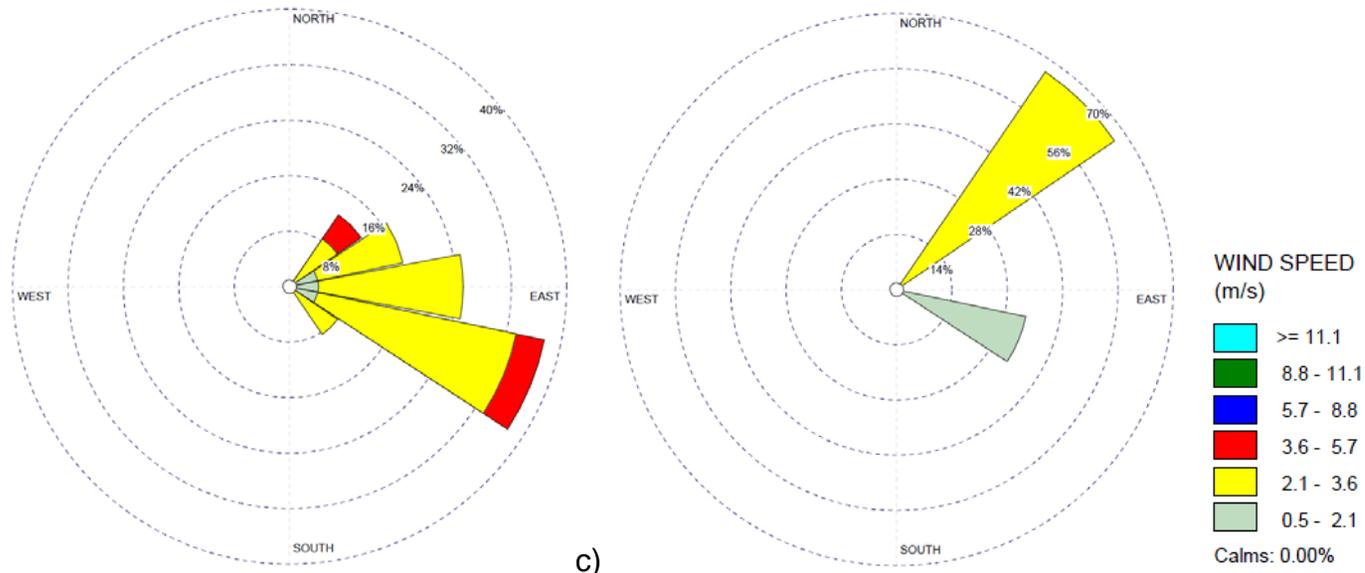


Figure 18. a) Beckjordan and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on February 3, 2012; b) 24-hour windrose data at KCVG Station on February 3, 2012; c) 3-hour windrose data from 16:00 to 18:00 at KCVG Station on February 3, 2012.

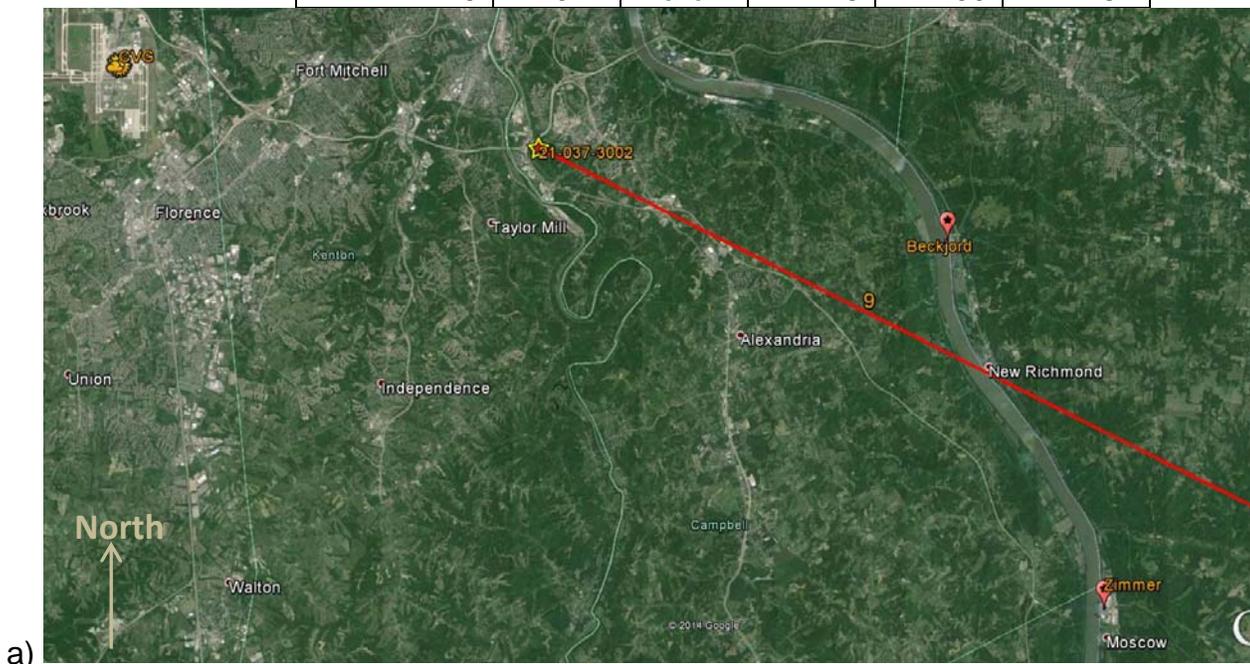
## V. Intermediate Trajectories

This Section includes exceedance days in which the HYSPLIT back trajectories pass between the Beckjord and Zimmer facilities and are not directly attributable to either facility. Additional data including surface wind data and CEMS were analyzed to draw conclusions about the likely contributions of Beckjord and Zimmer emissions in relation to the exceedance at the monitor.

### March 8, 2011 - Beckjord

On March 8, 2011, one exceedance was reported at Monitor ID 21-037-3002 at 17:00. The exceedance value reported was 84 ppb. The exceedance was modeled by one HYSPLIT back trajectory in Figure 19a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 19b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 19c shows the windrose data around the time of the exceedance hour. Figure 19d shows the CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day. The HYSPLIT back trajectory passes in between the Beckjord facility and the Zimmer facility. Examination of the wind rose around the time of the exceedance demonstrates that the prevailing surface winds were from the East. The surface wind direction data would suggest that emissions from Beckjord were most likely impacting the monitor and contributing to the exceedance. In addition, emissions data shown in Figure 6e, demonstrate that on this date emissions from the Beckjord facility were approximately four times greater than those of Zimmer. Based on the analysis of the data for March 8, 2011 Beckjord has a high probability of contributing to the exceedance at the monitor.

Trajectory ID	Year	Month	Day	Hour	Reading
9	2011	March	8	17:00	84



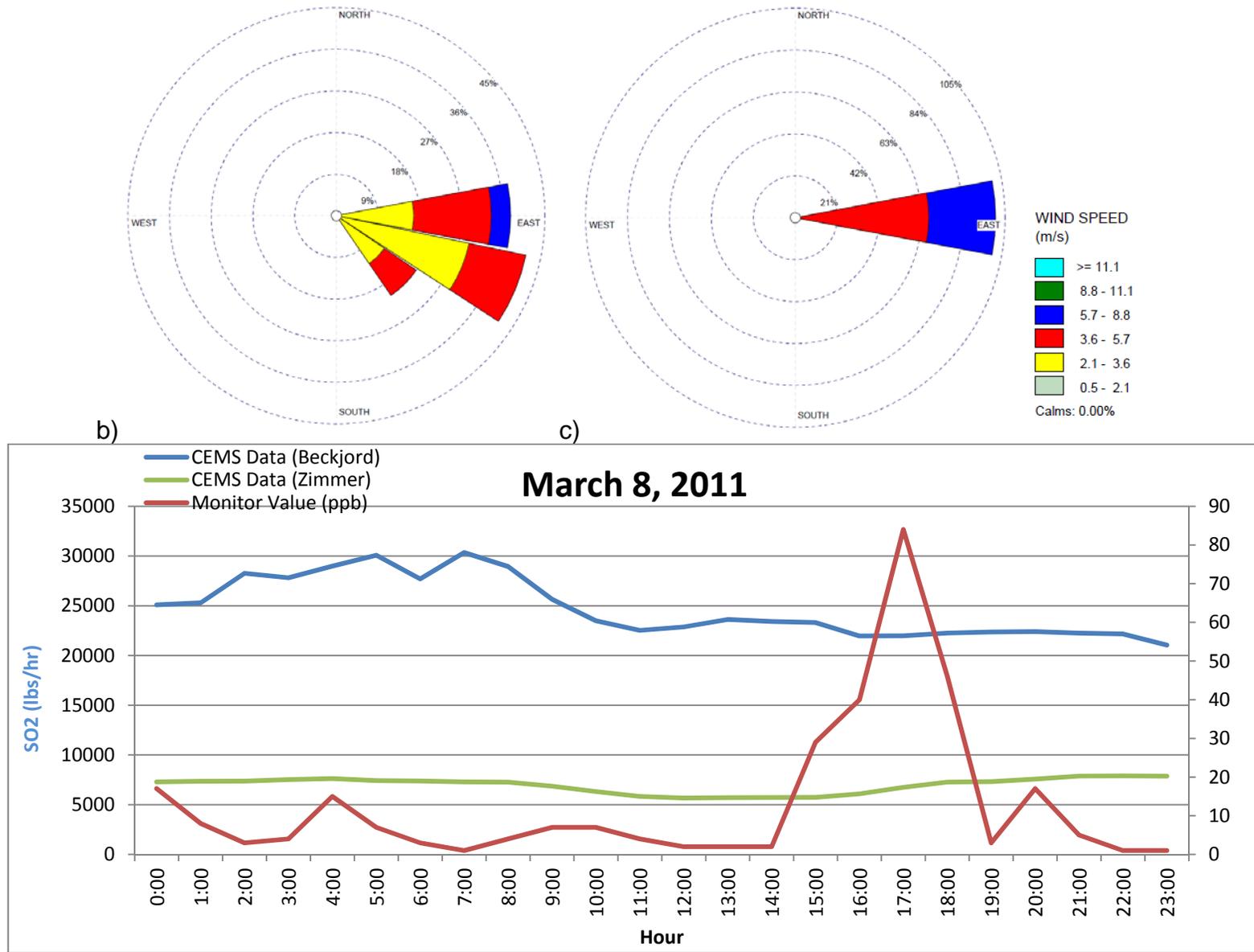
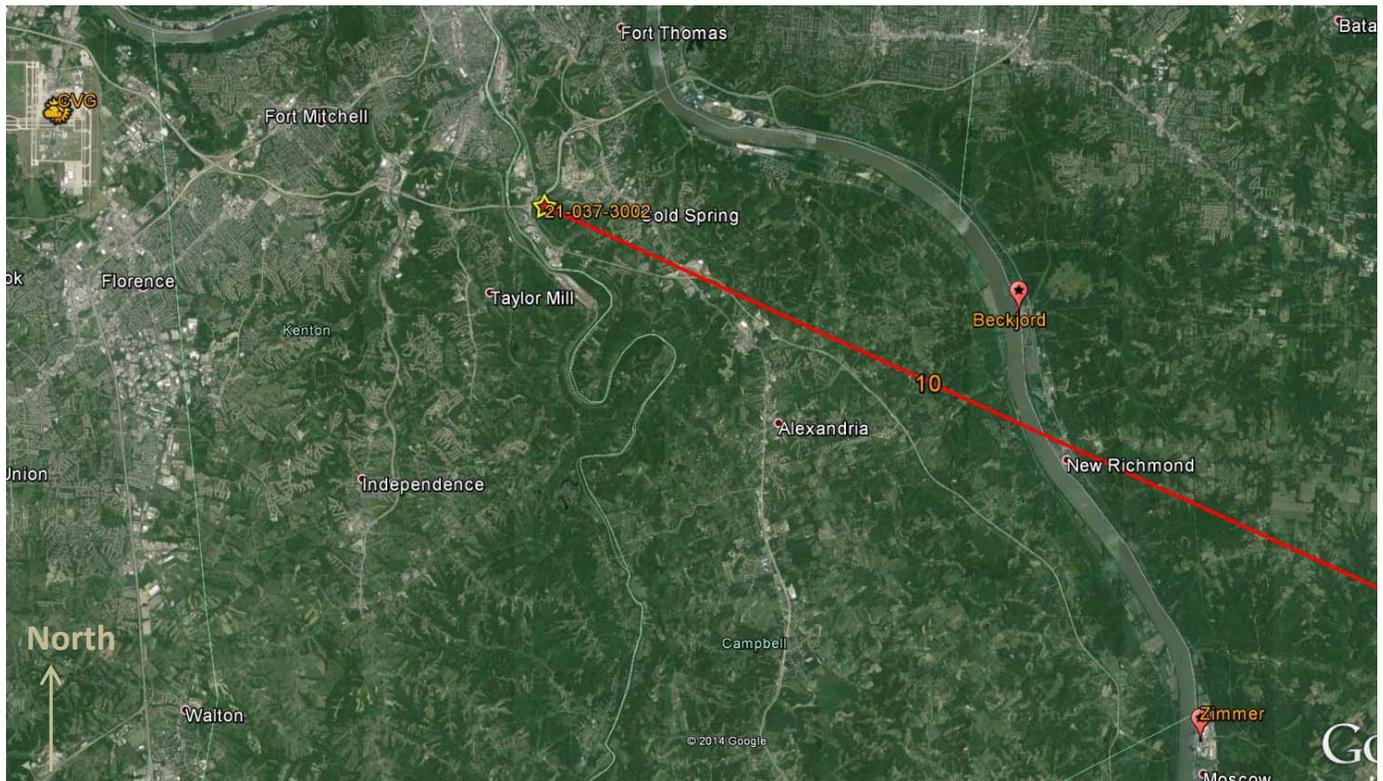


Figure 19. a) Beckjordan and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on March 8, 2011; b) 24-hour windrose data at KCVG Station on March 8, 2011; c) 3-hour windrose data from 16:00 to 18:00 at KCVG Station on March 8, 2011; d) CEMS data for both the Beckjordan and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

## March 20, 2011 - Beckjord

On March 20, 2011, one exceedance was reported at Monitor ID 21-037-3002 at 7:00. The exceedance value reported was 89 ppb. The exceedance was modeled by one HYSPLIT back trajectory in Figure 20. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 20b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 20c shows the windrose data around the time of the exceedance hour. Figure 20d shows the CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day. The HYSPLIT back trajectory passes in between the Beckjord facility and the Zimmer facility. Examination of the wind rose around the time of the exceedance demonstrates that the prevailing surface winds were from the East. The surface wind direction data would suggest that emissions from Beckjord were most likely impacting the monitor and contributing to the exceedance. It should be noted that the winds did not begin blowing from the south and southeast until approximately 13:00, well after the exceedance was recorded. Additionally, prior to the exceedance emissions from Beckjord increased markedly in a relatively short period of time, while emissions from Zimmer remained relatively constant. Taking these further data into account, it is highly probable that emissions from Beckjord are the likely contributor to the exceedance recorded on March 20, 2011.

Trajectory ID	Year	Month	Day	Hour	Reading
10	2011	March	20	7:00	89



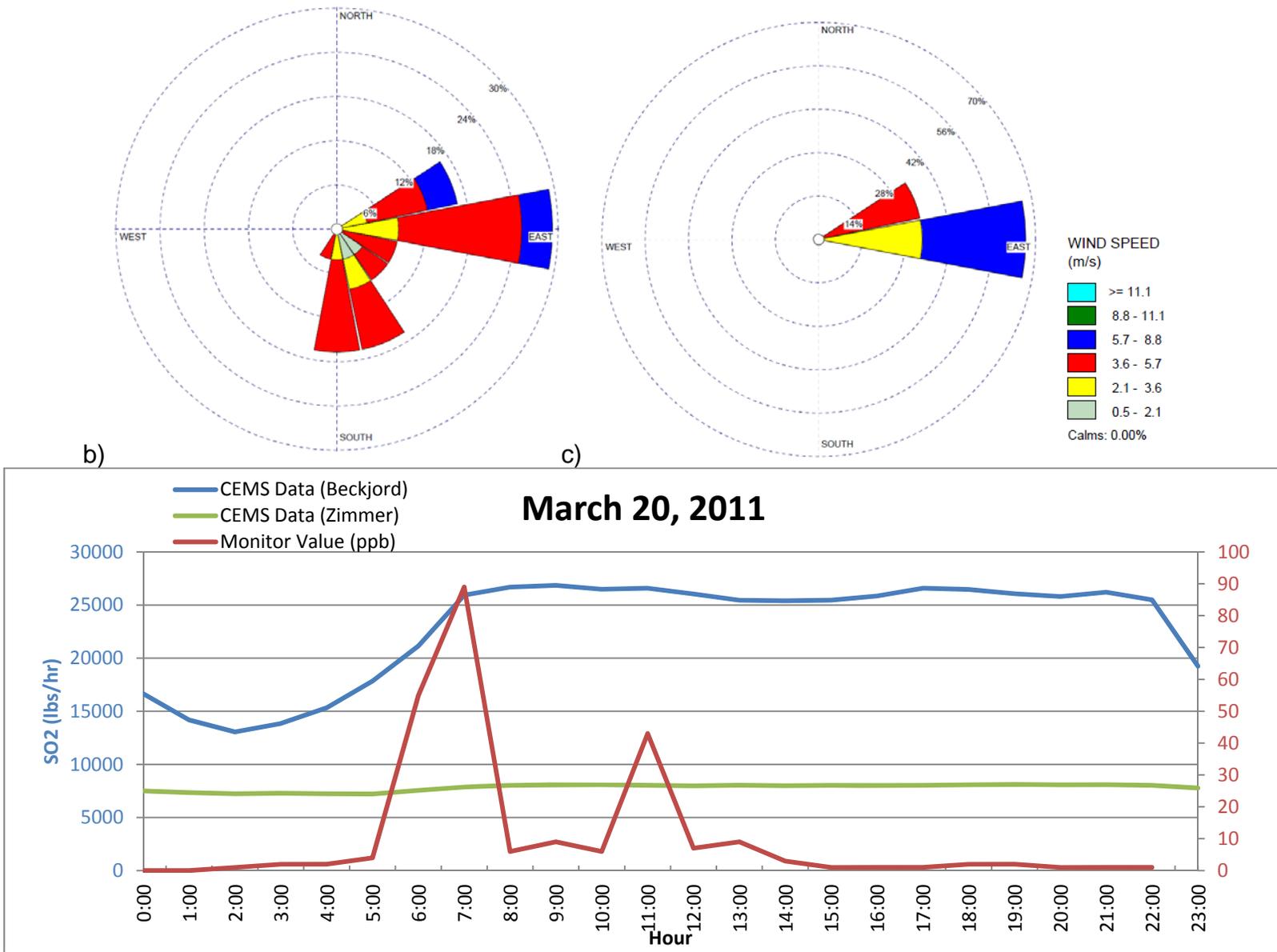
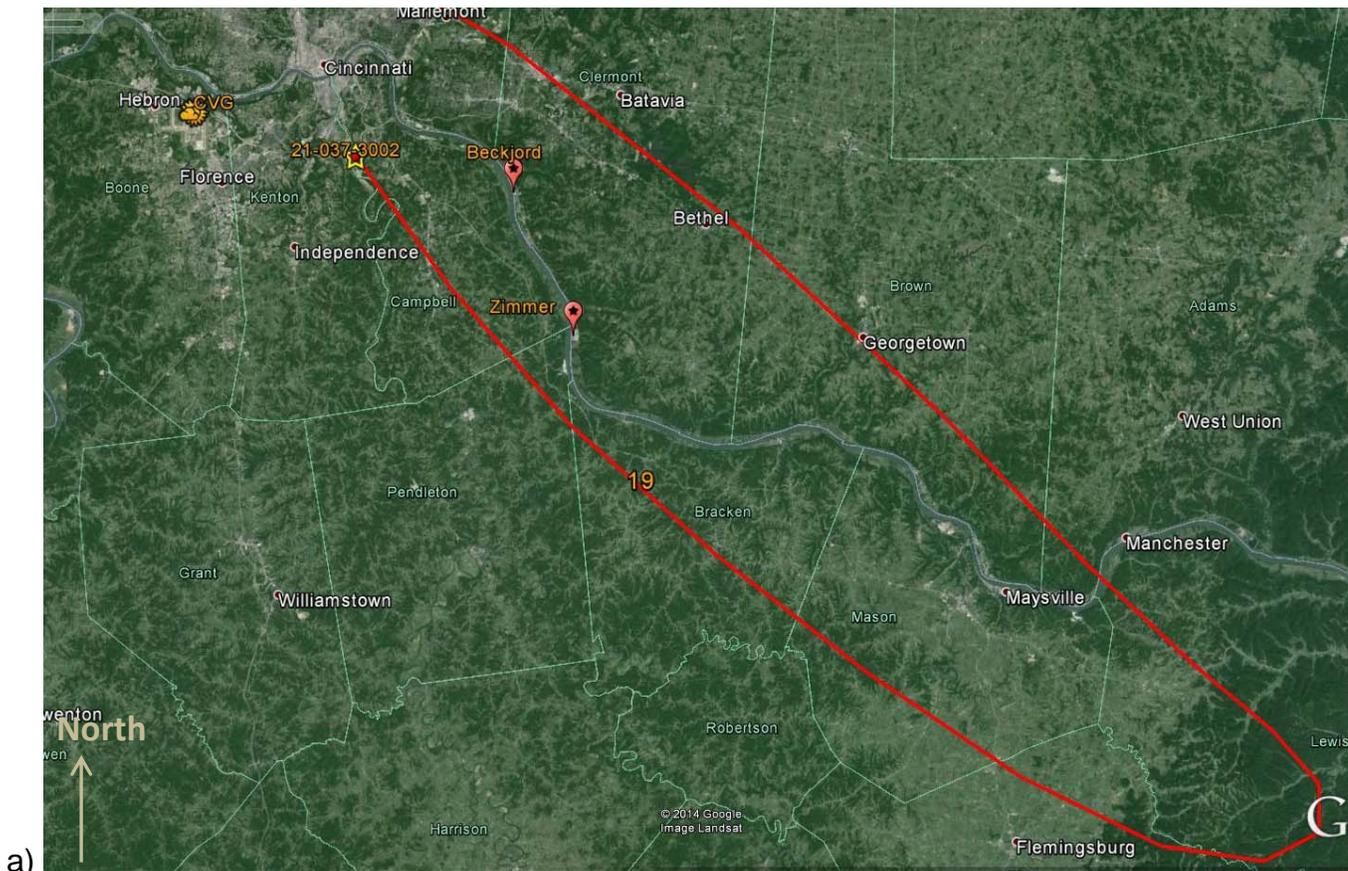


Figure 20. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on March 20, 2011; b) 24-hour windrose data at KCVG Station on March 20, 2011; c) 3-hour windrose data from 6:00 to 8:00 at KCVG Station on March 20, 2011; d) CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

## February 28, 2012 - Beckjord

On February 28, 2012, one exceedance was reported at Monitor ID 21-037-3002 at 12:00. The exceedance value reported was 77 ppb. The exceedance was modeled by one HYSPLIT back trajectory in Figure 21a. The trajectory analysis on this date is atypical, as the upper level winds take a circuitous route around both Beckjord and Zimmer prior to reaching the monitor location. This impedes a straightforward determination of the cause of the exceedance based on the HYSPLIT data. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 21b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 21c shows the windrose data around the time of the exceedance hour. Figure 21d shows the CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day. The surface wind data around the time of the violation shows predominant winds from the eastern direction. Further examination of the emissions data shows only that emissions data from Beckjord were approximately five times greater than that of Zimmer. Taking these further data into account, it is highly probable that emissions from Beckjord are the likely contributor to the exceedance on February 28, 2012.

Trajectory ID	Year	Month	Day	Hour	Reading
19	2012	February	28	12:00	77



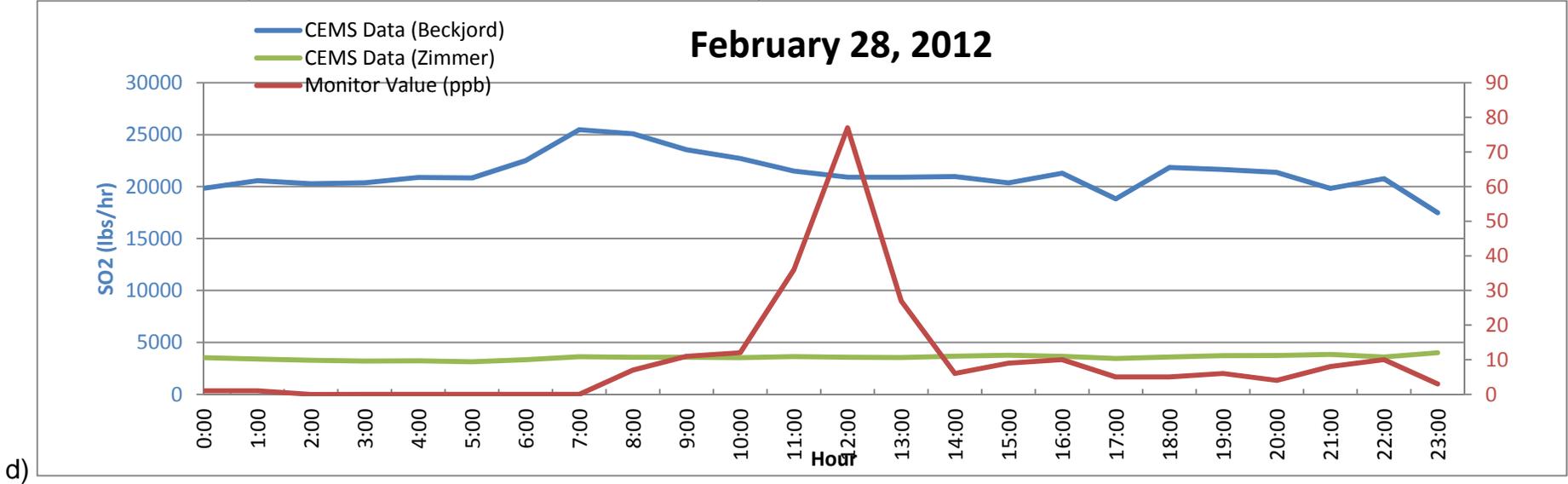
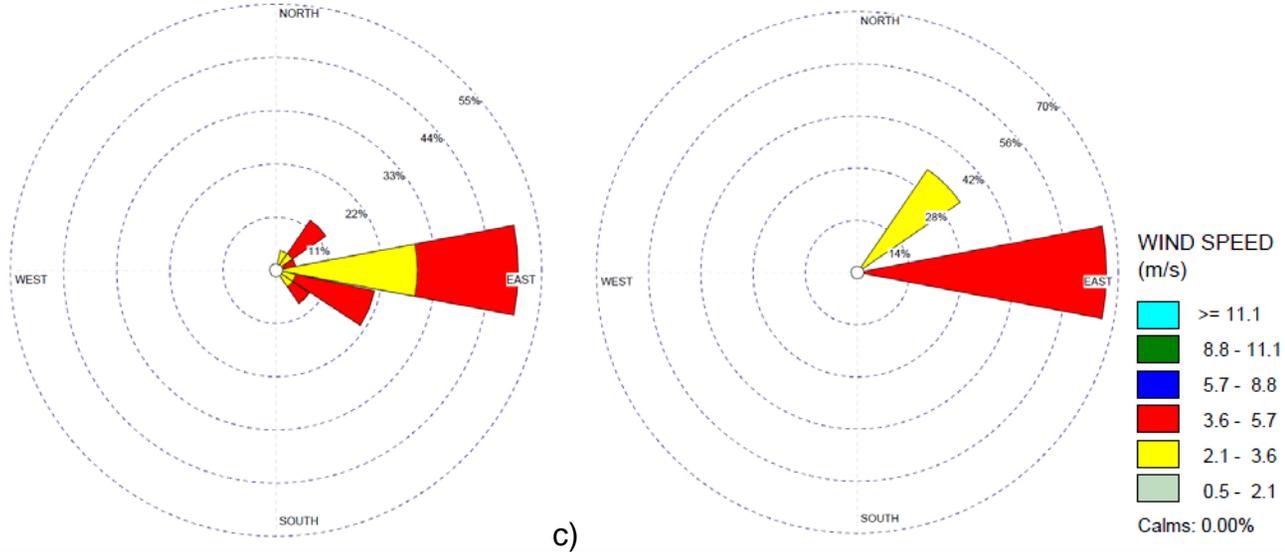


Figure 21. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on February 28, 2012; b) 24-hour windrose data at KCVG Station on February 28, 2012; c) 3-hour windrose data from 11:00 to 13:00 at KCVG Station on February 28, 2012; d) CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

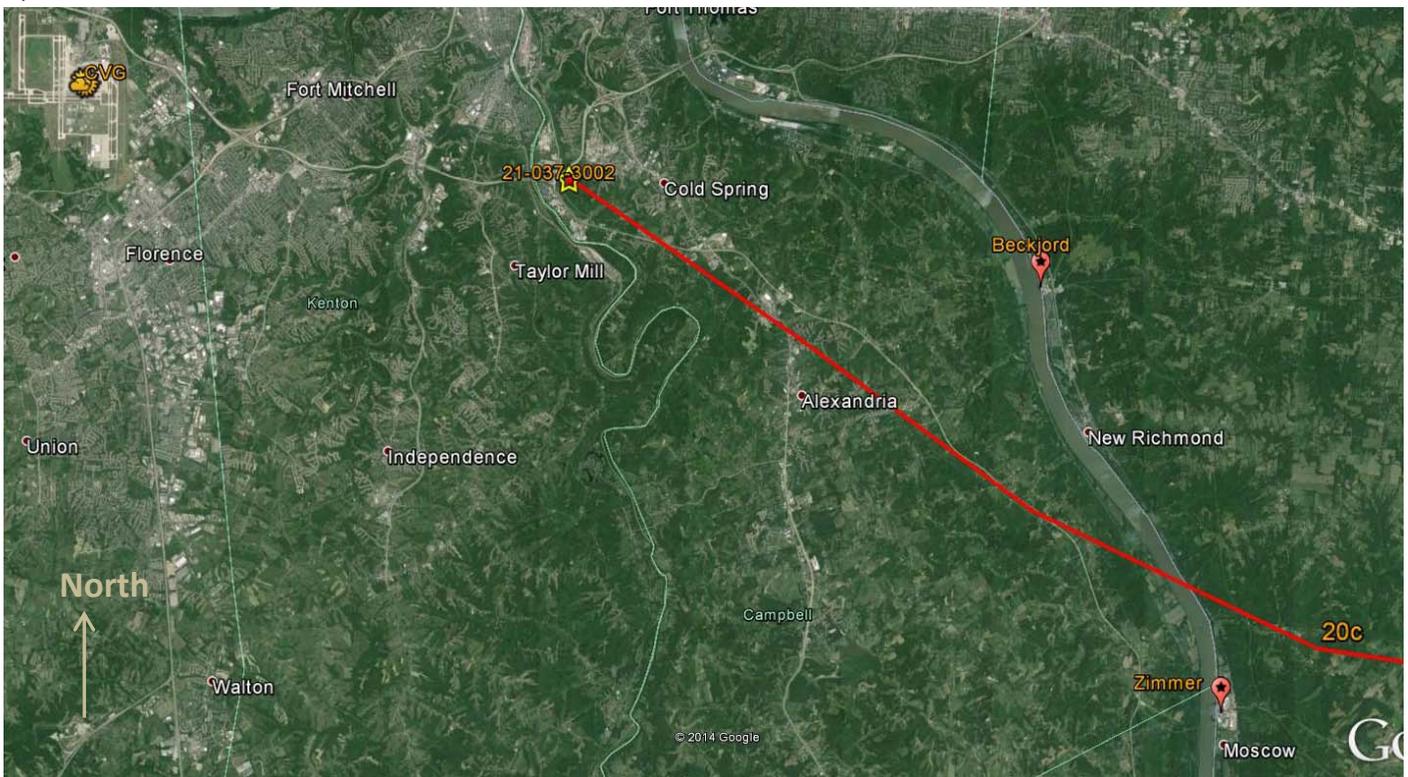
## April 7, 2012 – Beckjord

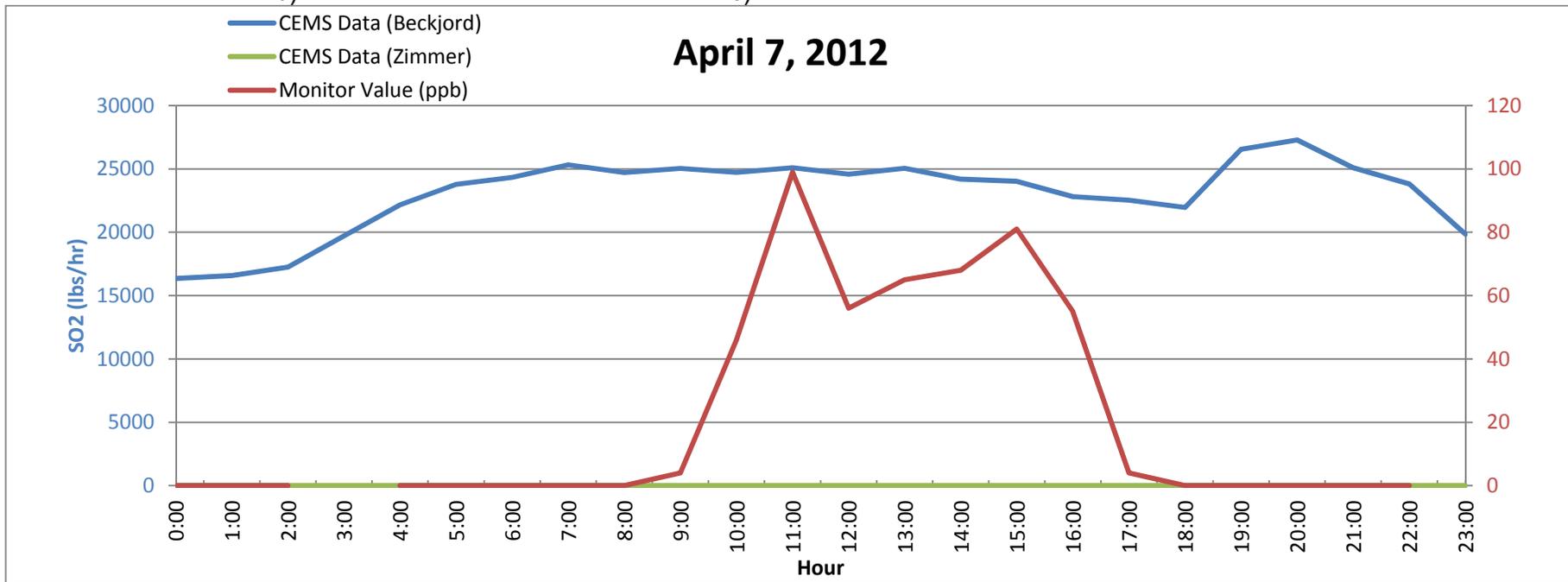
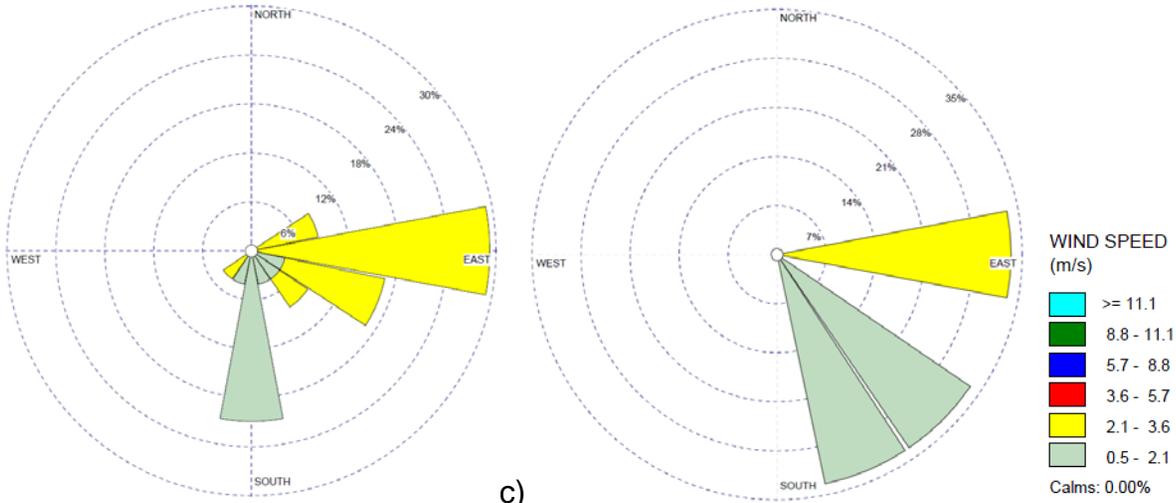
On April 7, 2012, two exceedances were reported at Monitor ID 21-037-3002. Beckjord was determined to be the most probably contributor the exceedance at the 11:00 hour as discussed in Section I of this report. The exceedance of 81 ppb at 15:00 is discussed below. The exceedance was modeled by one HYSPLIT back trajectory in Figure 22a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 22b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 22c shows the windrose data around the time of the exceedance hour. Figure 22d shows the CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

The HYSPLIT back trajectory passes in close proximity to the Zimmer facility. This indicates a high probability of Zimmer contributing to the exceedance reported at the monitor. The windrose data at the time of the exceedances winds were blowing from the east/southeast direction between 14:00 and 16:00. This would indicate Beckjord and Zimmer may have contributed to the exceedance; however, as shown in Figure 22d Zimmer did not have SO<sub>2</sub> emissions on this day. Therefore, it is most likely that the exceedance was caused by the Beckjord facility.

Trajectory ID	Year	Month	Day	Hour	Reading
20c	2012	April	7	15:00	81

a)





d) Figure 22. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on April 7, 2012; b) 24-hour windrose data at KCVG Station on April 7, 2012; c) 3-hour windrose data from 14:00 to 16:00 at KCVG Station on April 7, 2012; d) CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

## VI. Other Trajectories

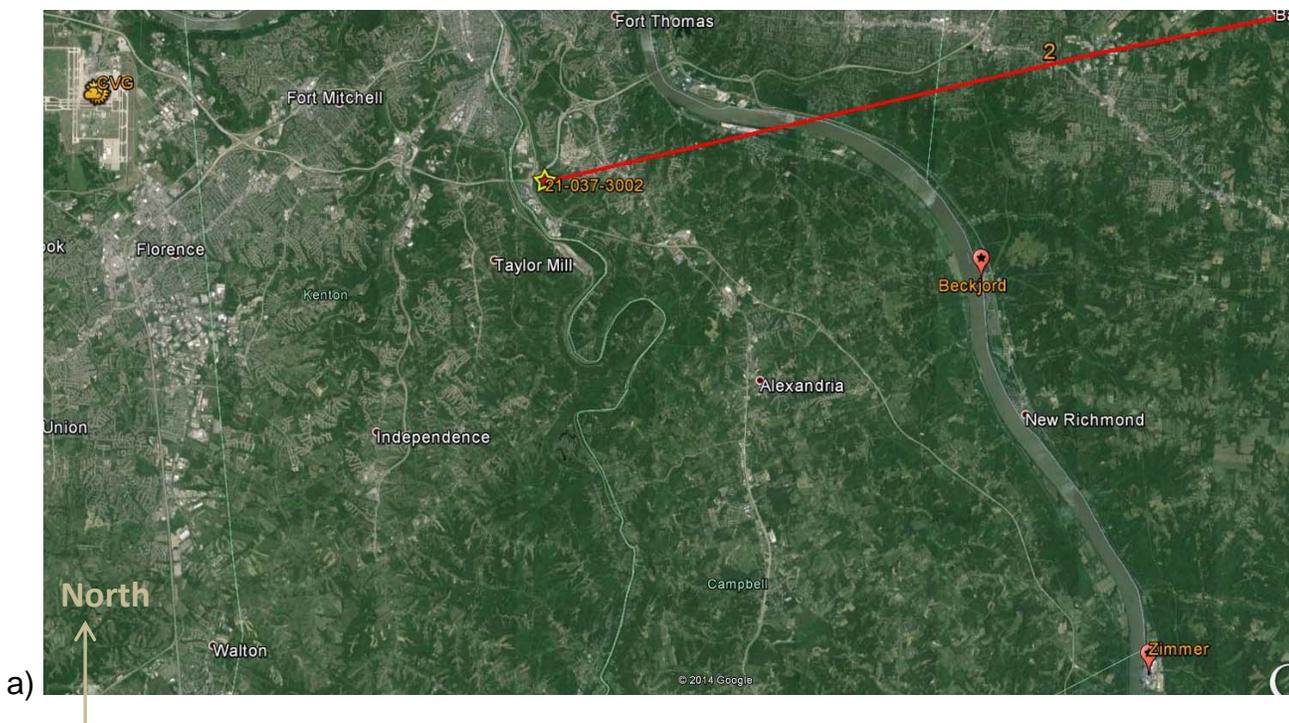
This Section includes exceedance days in which the HYSPLIT back trajectories do not pass near proximity to Beckjord or Zimmer. For these exceedance days, the analysis relied heavily upon the surface wind data and CEMS data to determine the likely contribution of Beckjord and Zimmer emissions in relation to the exceedance at the monitor.

### July 31, 2010 - Beckjord

On July 31, 2010, one exceedance was reported at Monitor ID 21-037-3002 at 14:00. The reported exceedance value was 82 ppb. One HYSPLIT back trajectory was modeled as shown in Figure 23a to represent the exceedance in the table below. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 23b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 23c shows the windrose data around the time of the 14:00 hour exceedance.

The HYSPLIT back trajectories pass north the Beckjord facility. The windrose data at the time of the exceedances shows the wind was blowing exclusively from the direction where the Beckjord facility is located. The SO<sub>2</sub> emissions at the Beckjord facility markedly increased in the hours prior to the exceedance. Based on the combined interpretation of the data presented for this exceedance day, Beckjord is the most likely contributor to the exceedances reported at the monitor.

Trajectory ID	Year	Month	Day	Hour	Reading
2	2010	7	31	14:00	82



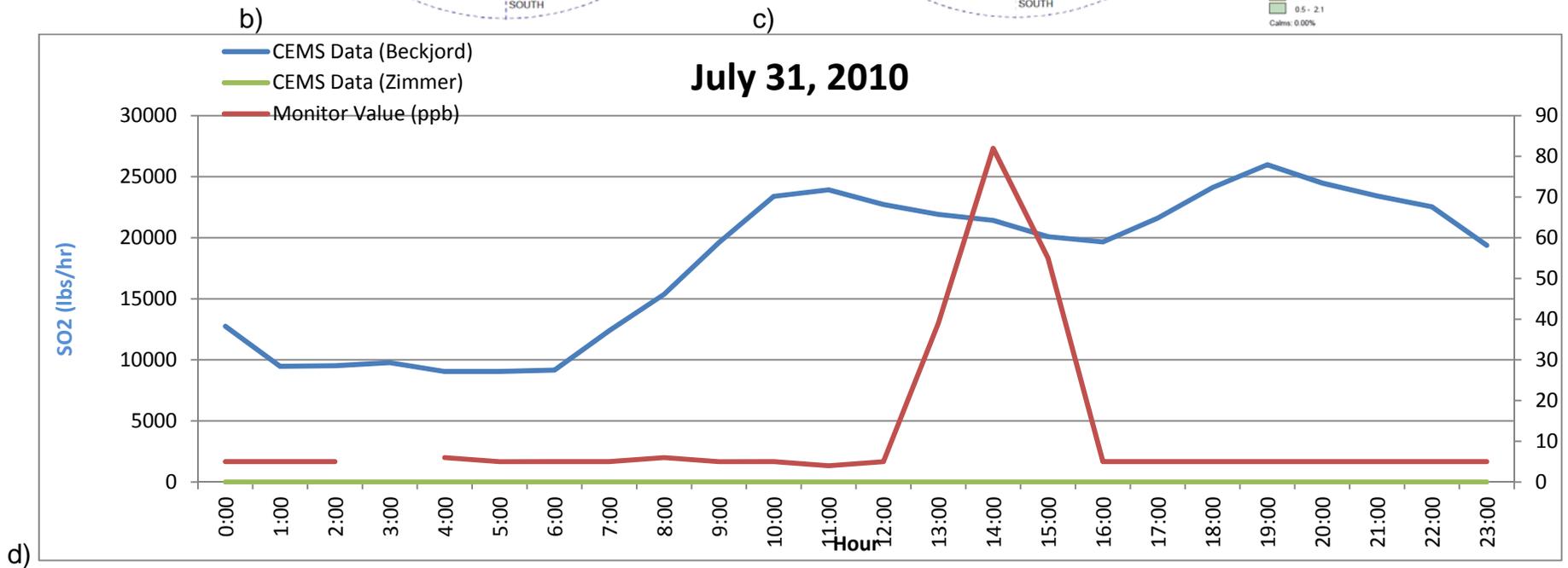
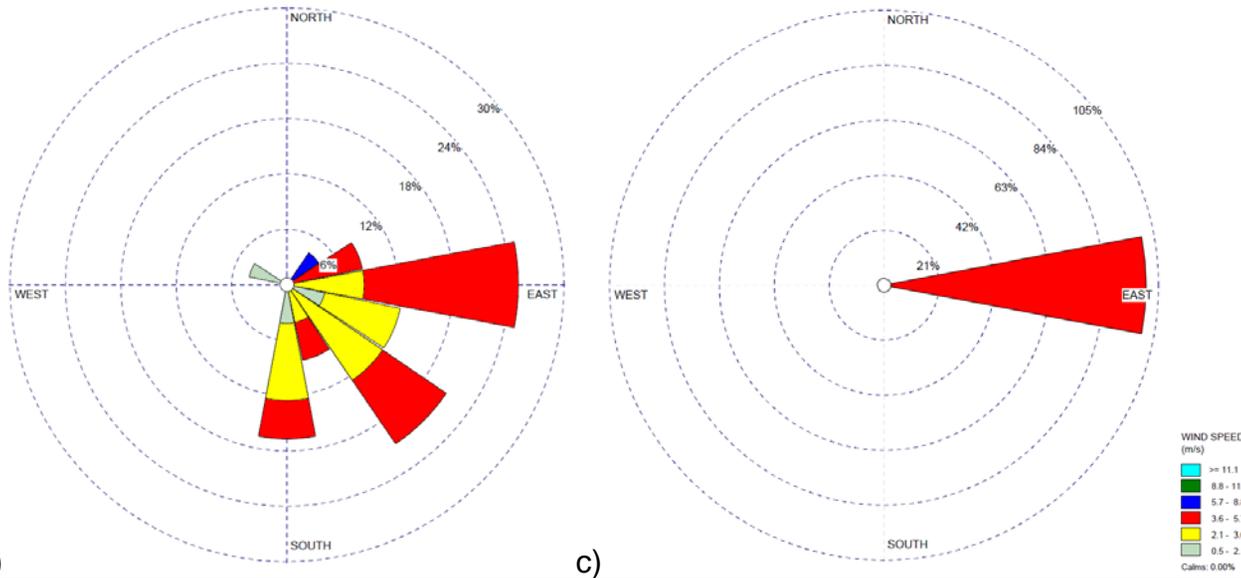


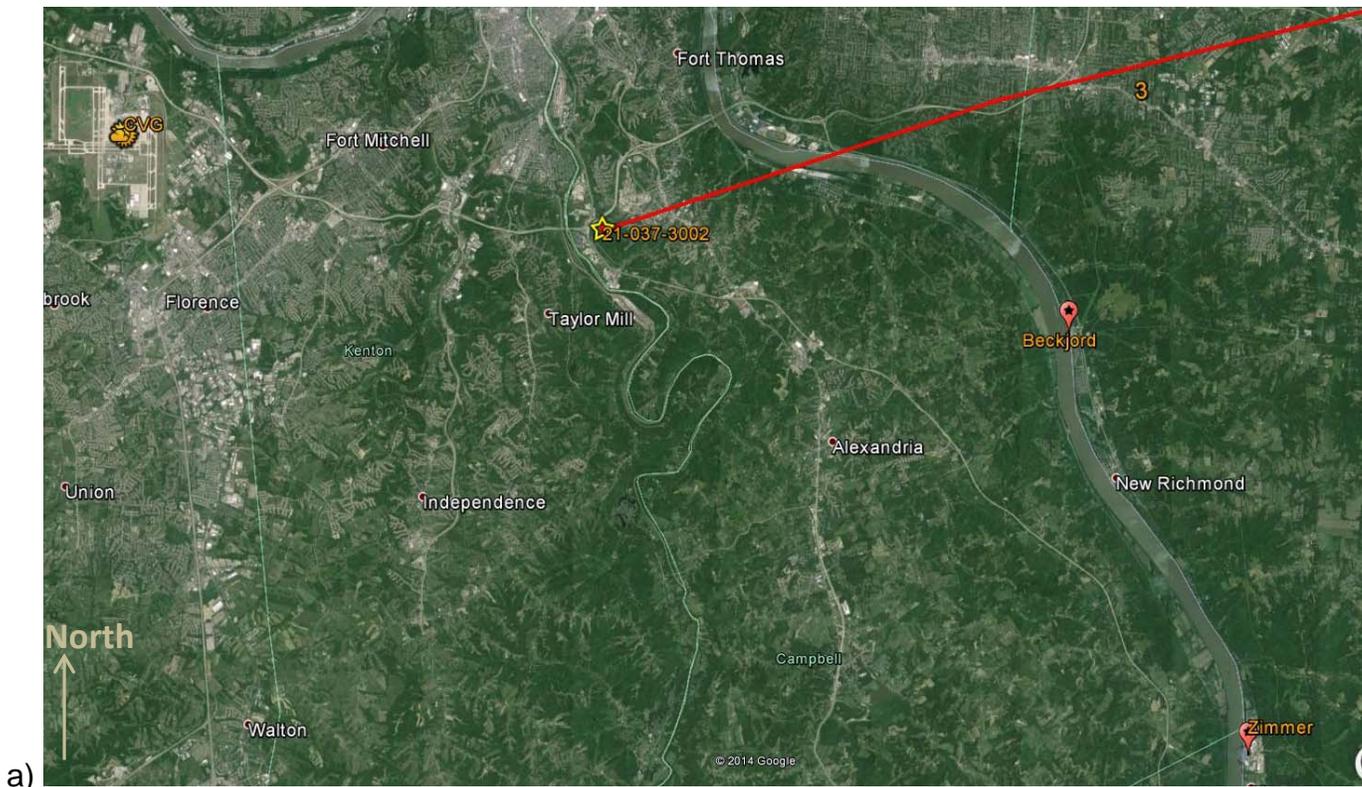
Figure 23. a) Beckjordan and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on July 31, 2010; b) 24-hour windrose data at KCVG Station on July 31, 2010; c) 3-hour windrose data from 13:00 to 15:00 at KCVG Station on July 31, 2010; d) CEMS data for both the Beckjordan and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

## August 27, 2010 - Beckjord

On August 27, 2010, one exceedance was reported at Monitor ID 21-037-3002 at 9:00. The exceedance value reported was 118 ppb. The exceedance was modeled by one HYSPLIT back trajectory in Figure 24a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 24b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 24c shows the windrose data around the time of the exceedance hour. Figure 24d shows the CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

The HYSPLIT back trajectory is shown north of the Beckjord facility. The windrose data at the time of the exceedances shows the wind was blowing from the east/northeast. The SO<sub>2</sub> emissions at the Beckjord facility markedly increased in the hours prior to the exceedance. Based on the data presented for this exceedance day, Beckjord is the most likely contributor to the exceedances reported at the monitor.

Trajectory ID	Year	Month	Day	Hour	Reading
3	2010	August	27	9:00	118



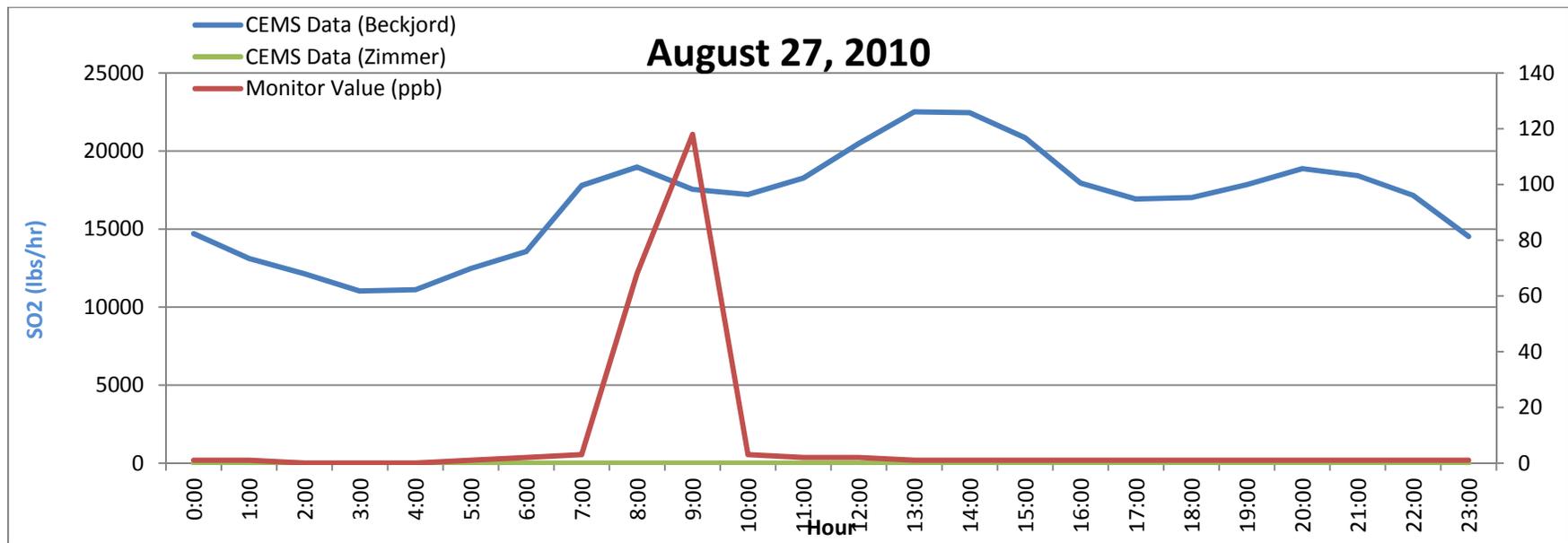
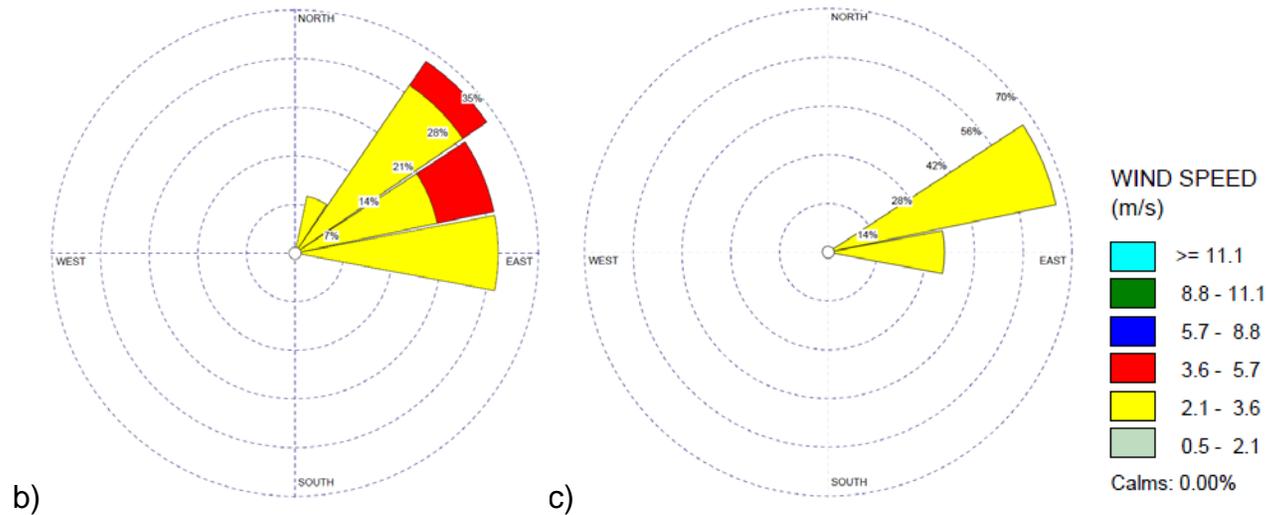


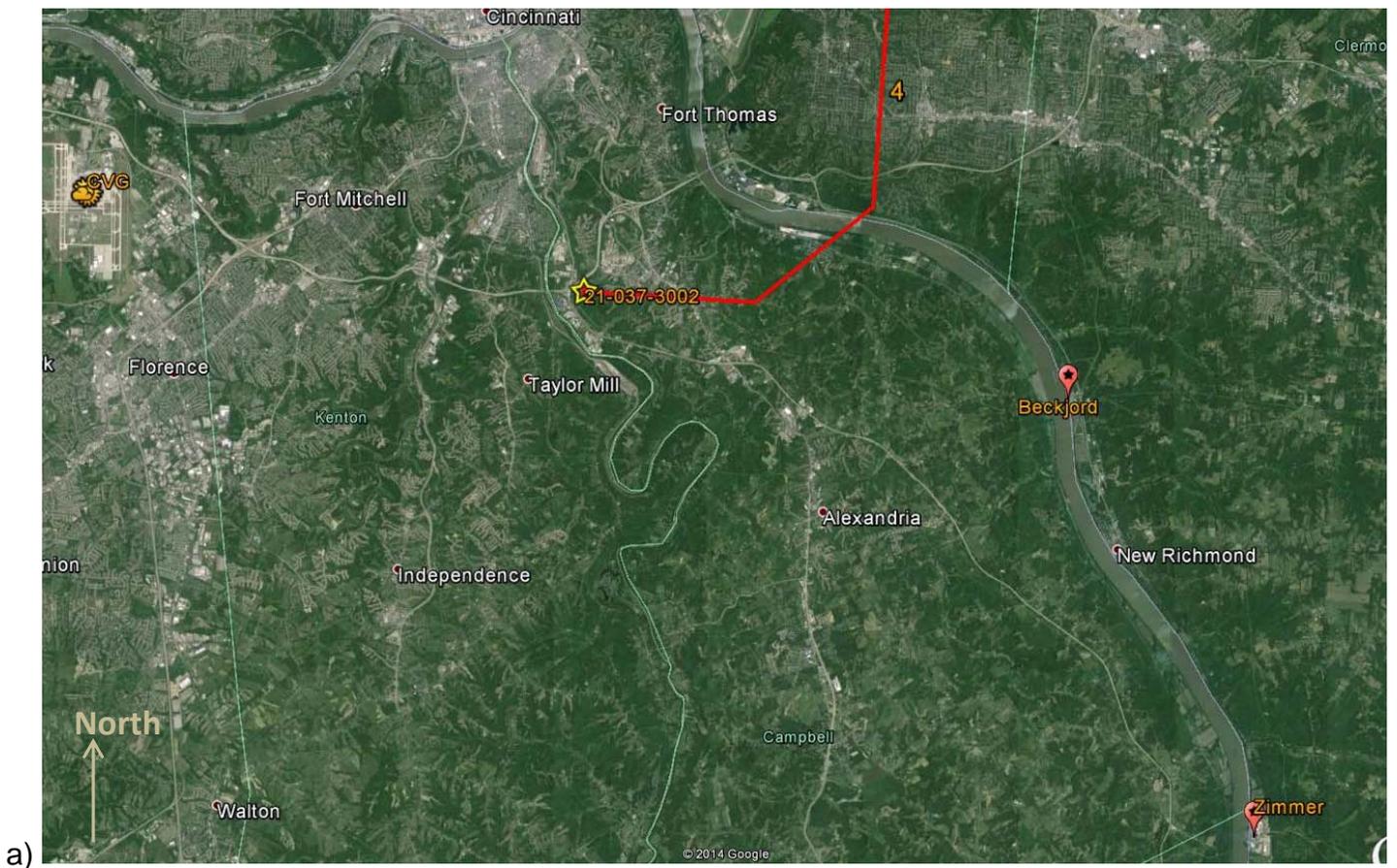
Figure 24. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on August 27, 2010; b) 24-hour windrose data at KCVG Station on August 27, 2010; c) 3-hour windrose data from 8:00 to 10:00 at KCVG Station on August 27, 2010; d) CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

## September 14, 2010 – Beckjord

On September 14, 2010, one exceedance was reported at Monitor ID 21-037-3002 at 11:00. The exceedance value reported was 118 ppb. The exceedance was modeled by one HYSPLIT back trajectory in Figure 25a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 25b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 25c shows the windrose data around the time of the exceedance hour. Figure 25d shows the CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

The HYSPLIT trajectory does not pass over or in close proximity to Beckjord or Zimmer. Examination of the wind direction data reveals that surface level winds on this date were primarily from the east which suggests that emissions from Beckjord are the likely cause of the exceedance on this date. Furthermore, examination of the emissions data shown in Figure 25d shows that emissions from Beckjord markedly increased in the hours leading up to the exceedance. Based on the data, and the lack of other significant sources of SO<sub>2</sub> along the trajectory shown, Beckjord was determined to be the most likely contributor to the exceedance.

Trajectory ID	Year	Month	Day	Hour	Reading
4	2010	September	14	11:00	99



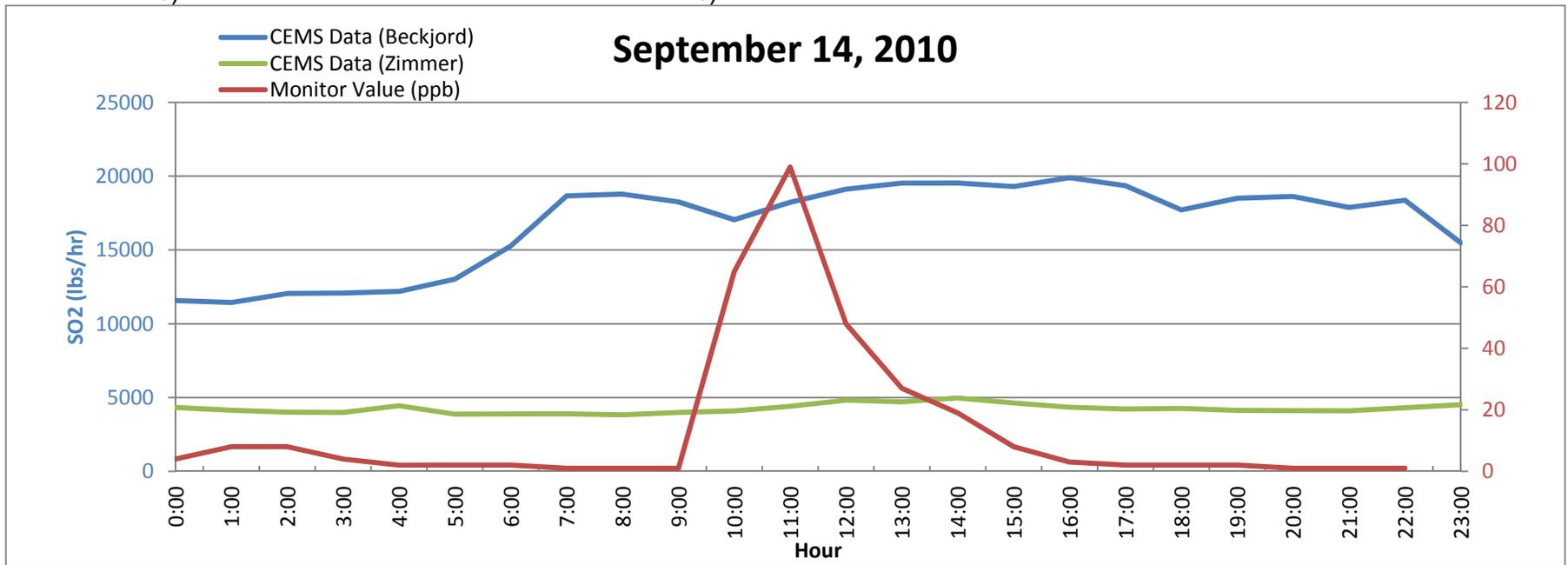
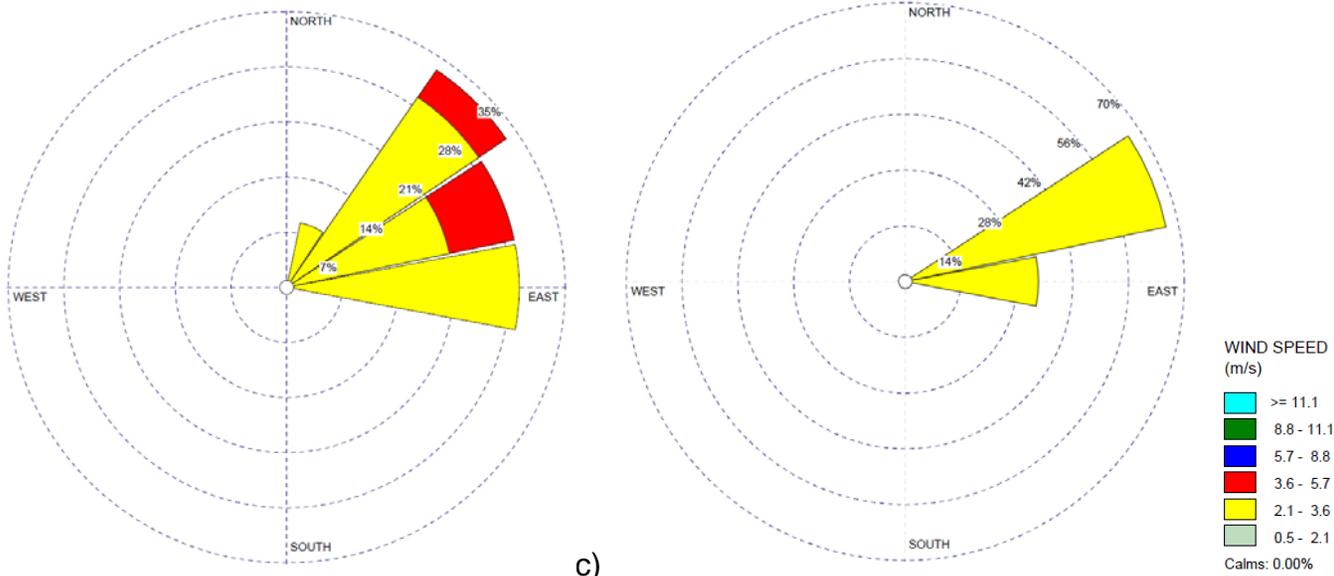


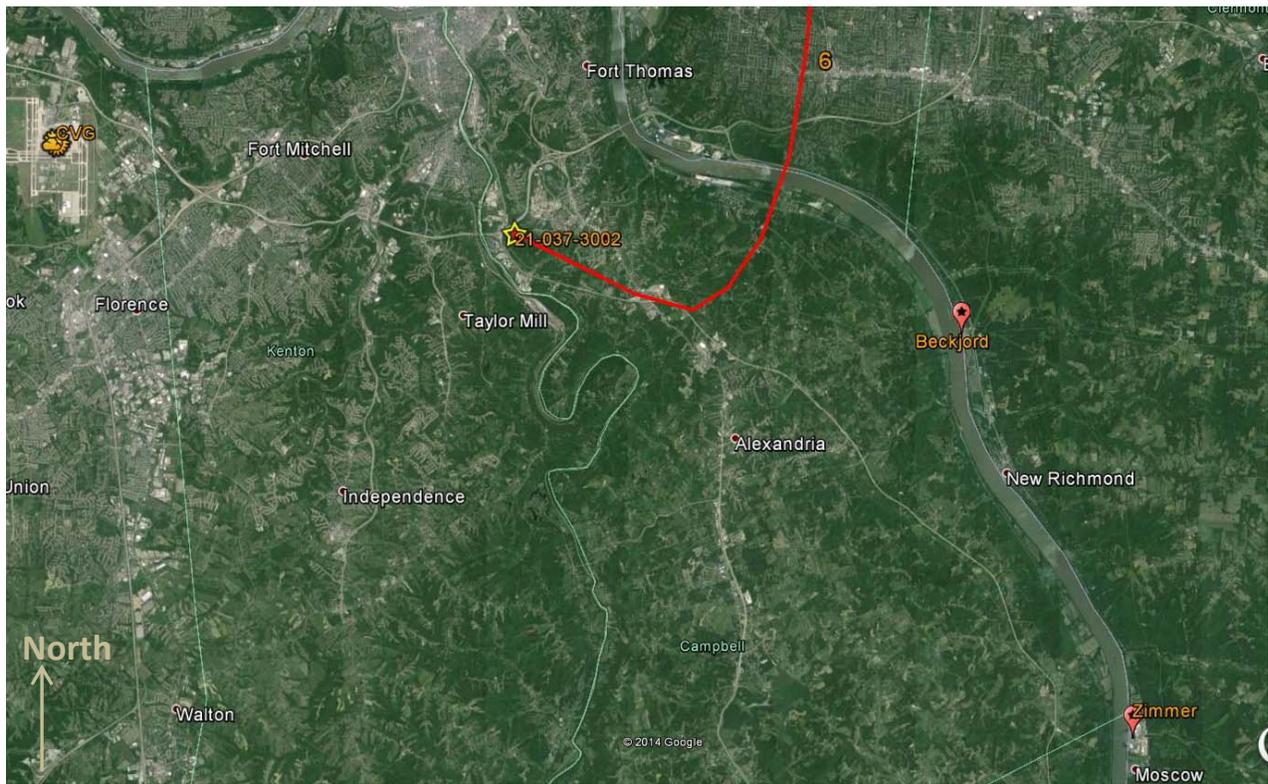
Figure 25. a) HYSPLIT back trajectory from Monitor ID 21-037-3002 on September 14, 2010 at 11:00 ; c) 24-hour windrose data at KCVG Station on September 14, 2010; d) 3-hour windrose data from 8:00 to 11:00 at KCVG Station on September 14, 2010; d) CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

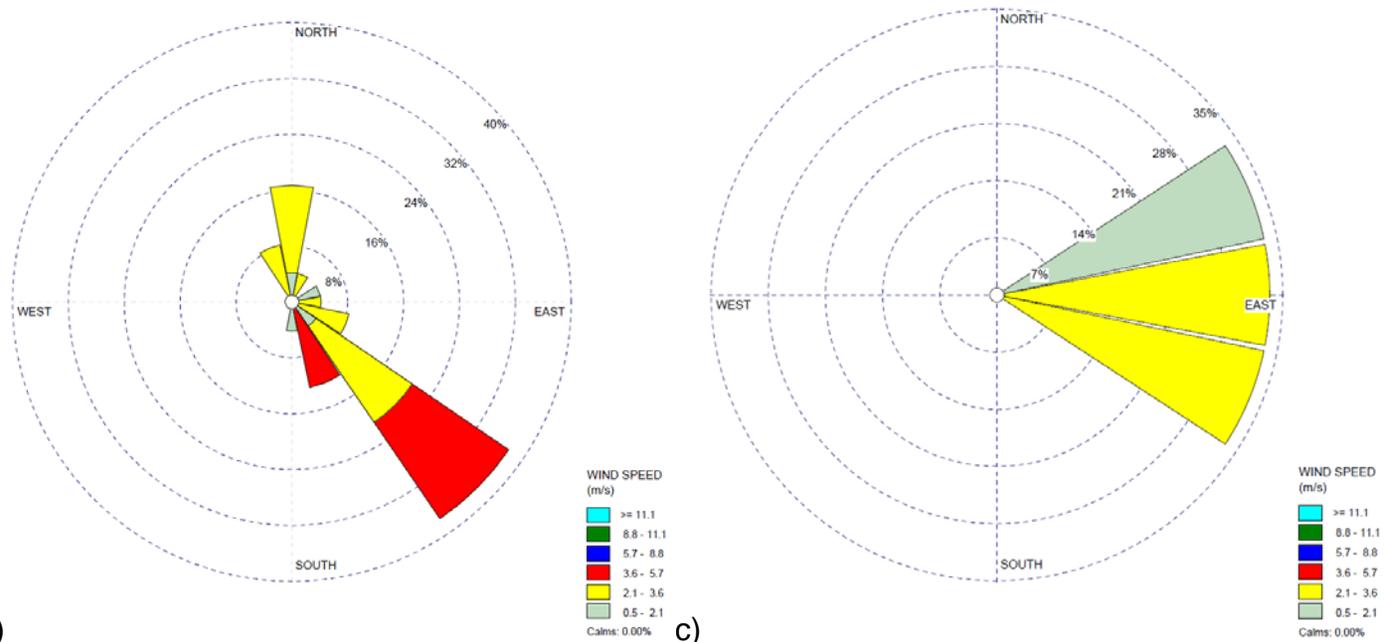
## February 23, 2011 - Beckjord

On February 23, 2011, one exceedance was reported at Monitor ID 21-037-3002 at 9:00. The exceedance value reported was 137 ppb. The exceedance was modeled by one HYSPLIT back trajectory in Figure 26a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 26b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 26c shows the windrose data around the time of the exceedance hour. Figure 26d shows the CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

The HYSPLIT trajectory does not pass over or in close proximity to Beckjord or Zimmer. Emissions from both facilities were relatively stable throughout the day and recorded values remained low at the monitor with the exception of the sharp spike observed at the exceedance hour. Examination of the wind direction data reveals that surface level winds on this date were predominantly from the southeast direction where Zimmer is located. Winds data around the time of the exceedance reveals that surface level winds during this period were predominantly from the eastern direction where Beckjord is located. Based on the data, Beckjord was determined to be the most likely contributor to the exceedance.

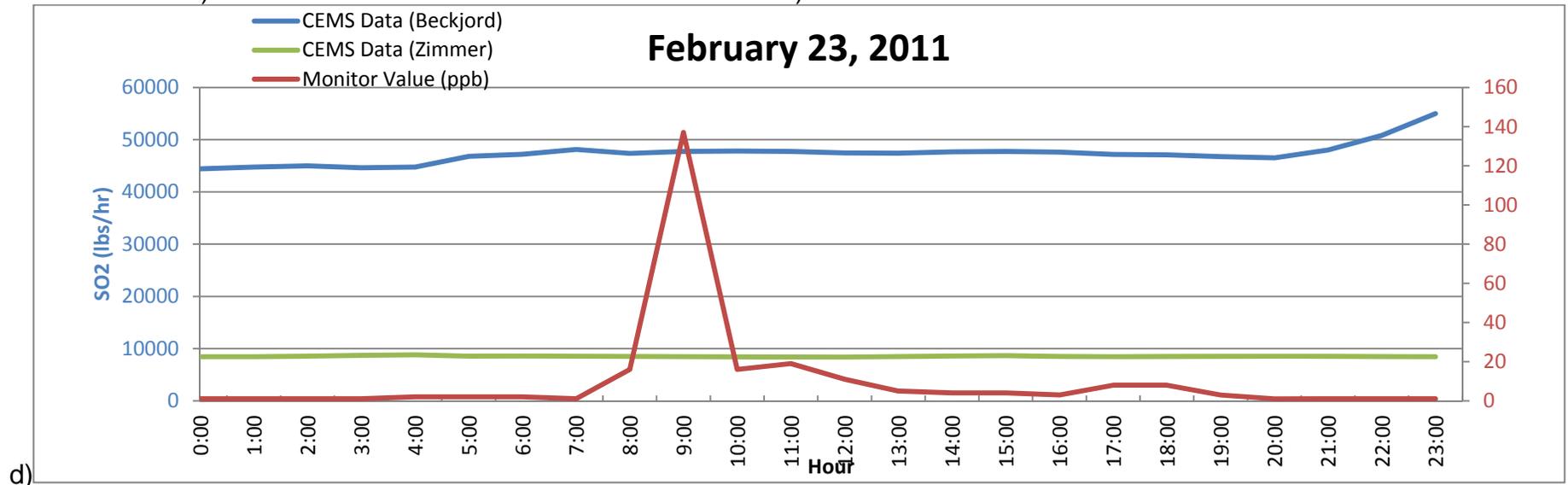
Trajectory ID	Year	Month	Day	Hour	Reading
6	2011	February	23	9:00	137





b)

c)



d)

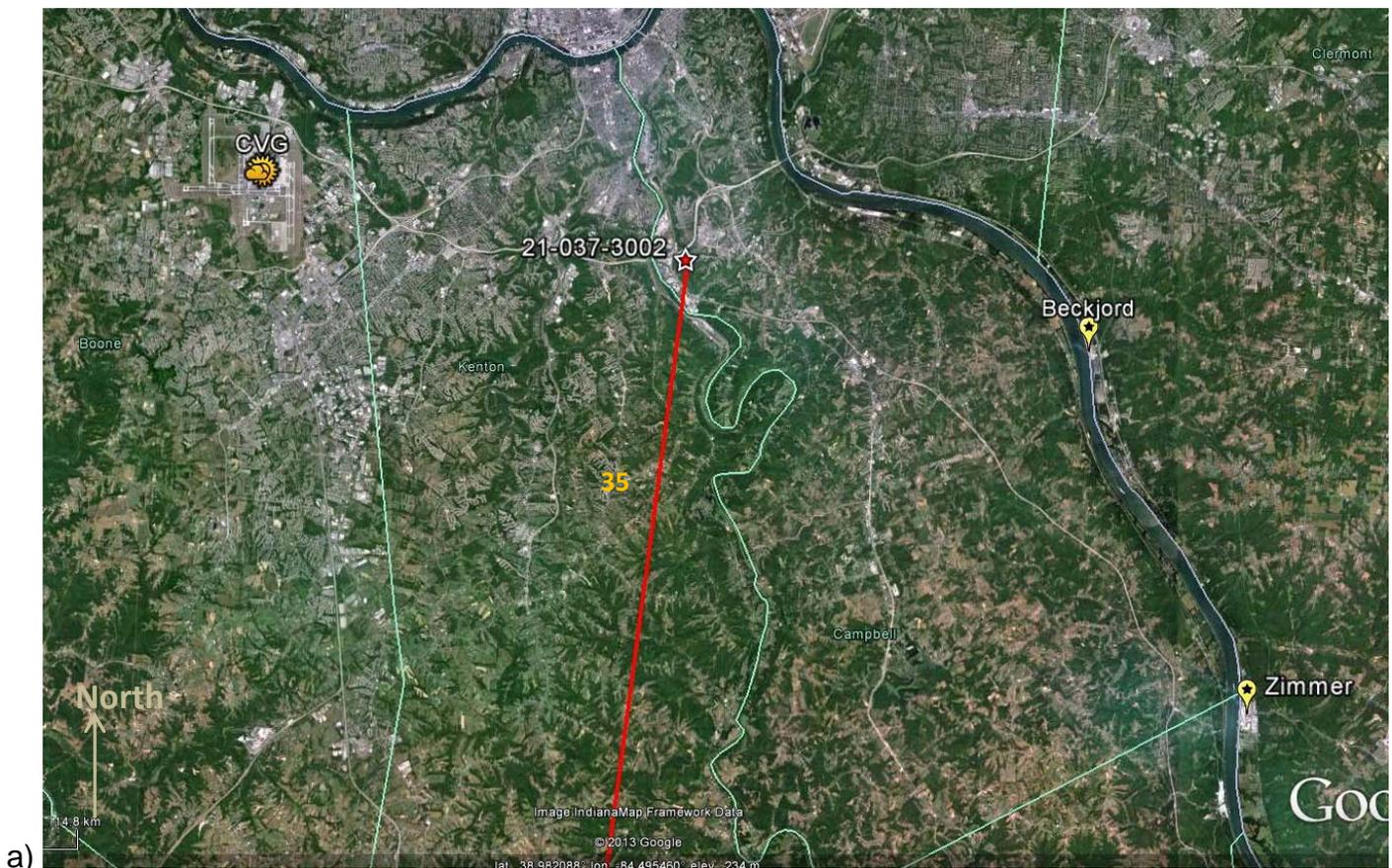
Figure 26. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on February 23, 2011; b) 24-hour windrose data at KCVG Station on February 23, 2011; c) 3-hour windrose data from 8:00 to 11:00 at KCVG Station on February 23, 2011; d) CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

## April 22, 2011 – Beckjord

On April 22, 2011, one exceedance was reported at Monitor ID 21-037-3002 at 3:00. The exceedance value reported was 109 ppb. The exceedance was modeled by one HYSPLIT back trajectory in Figure 27a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 27b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 27c shows the windrose data around the time of the exceedance hour. Figure 27d shows the CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

The HYSPLIT trajectory does not pass over or in close proximity to Beckjord or Zimmer. Examination of the surface wind direction data reveals that surface level winds on this date were predominantly from the east. Winds data around the time of the exceedance shows that surface level winds during this period were also predominantly from the east where Beckjord is located. Based on the data, Beckjord was determined to be the most likely contributor to the exceedance.

Trajectory ID	Year	Month	Day	Hour	Reading
35	2011	April	22	3:00	109



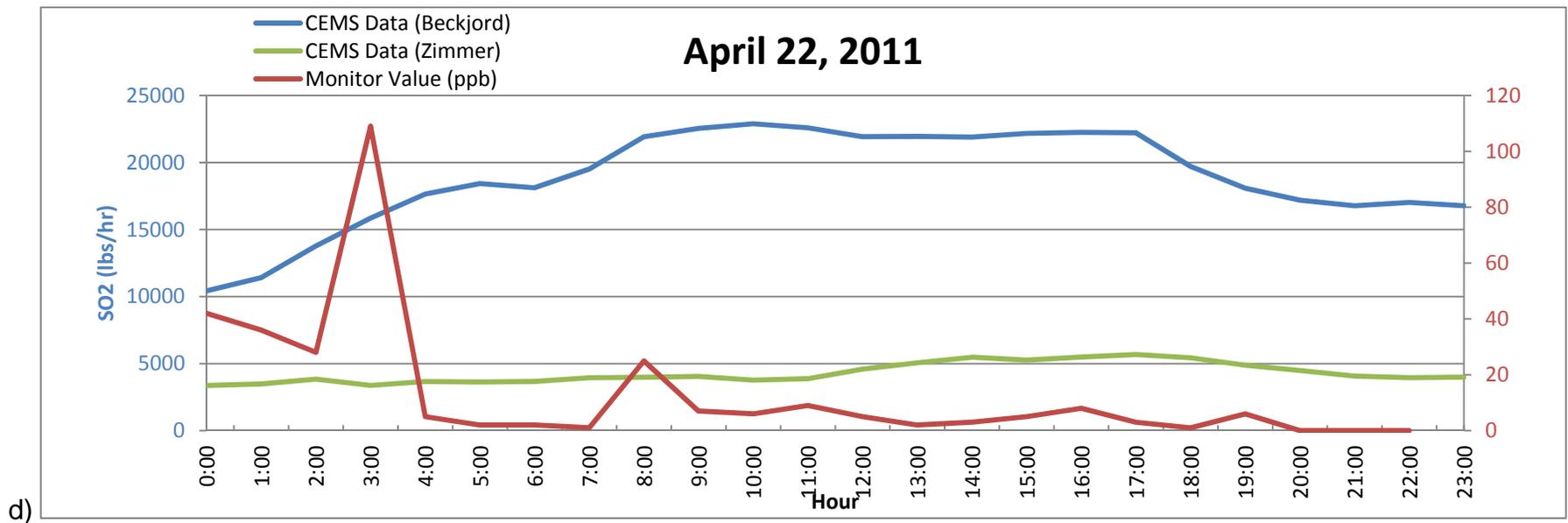
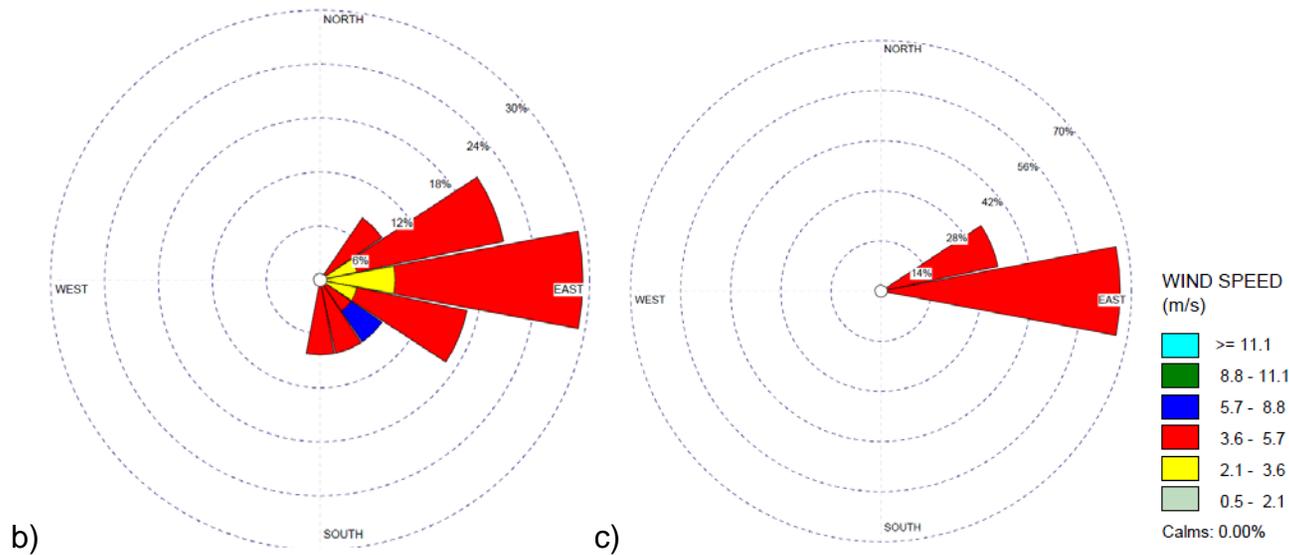


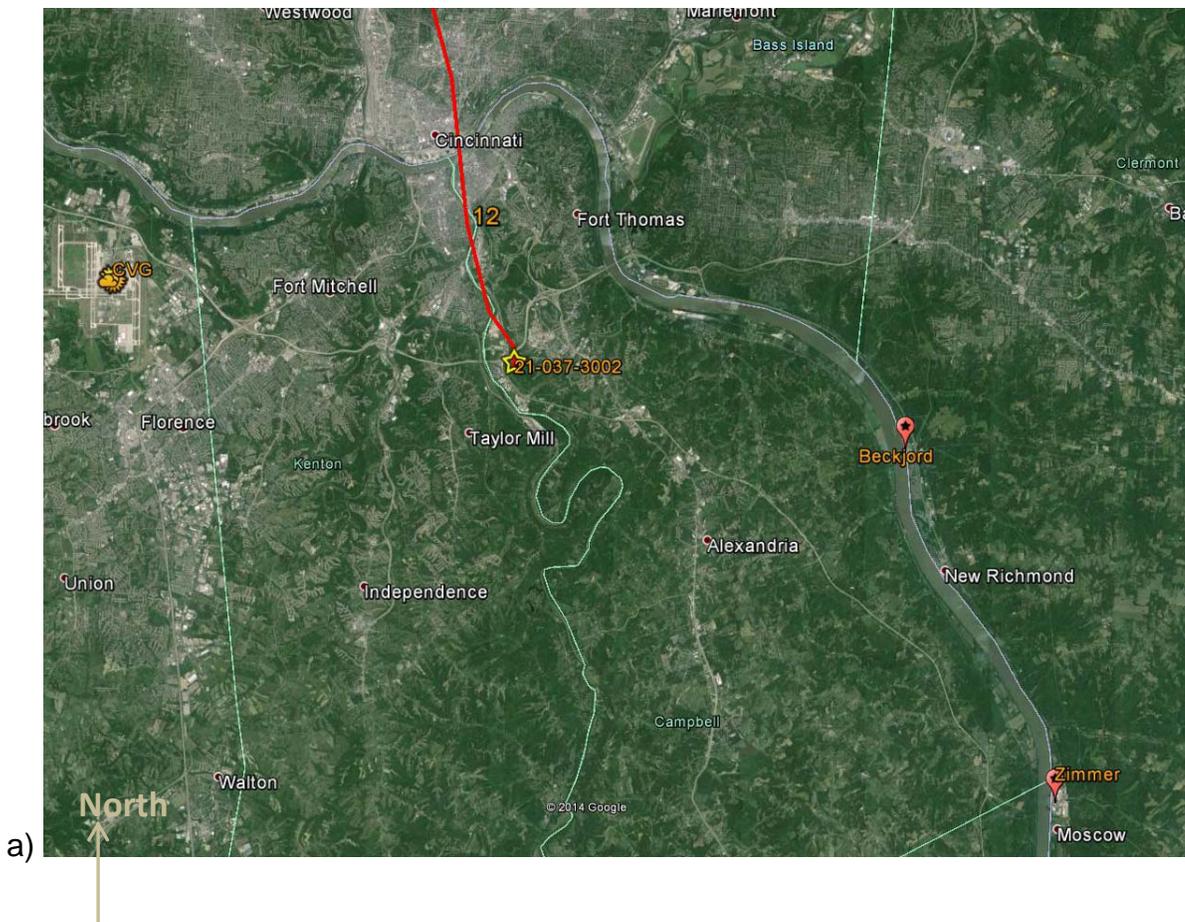
Figure 27. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on April 22, 2011; b) 24-hour windrose data at KCVG Station on April 22, 2011; c) 3-hour windrose data from 2:00 to 4:00 at KCVG Station on April 22, 2011; d) CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

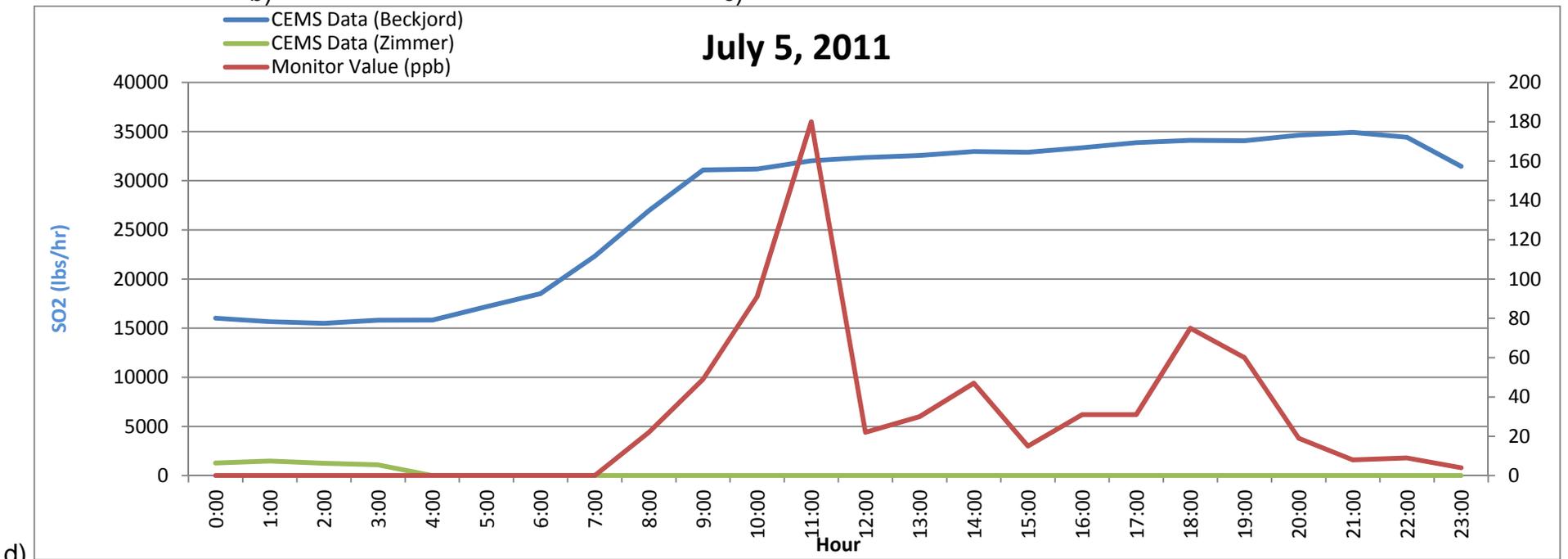
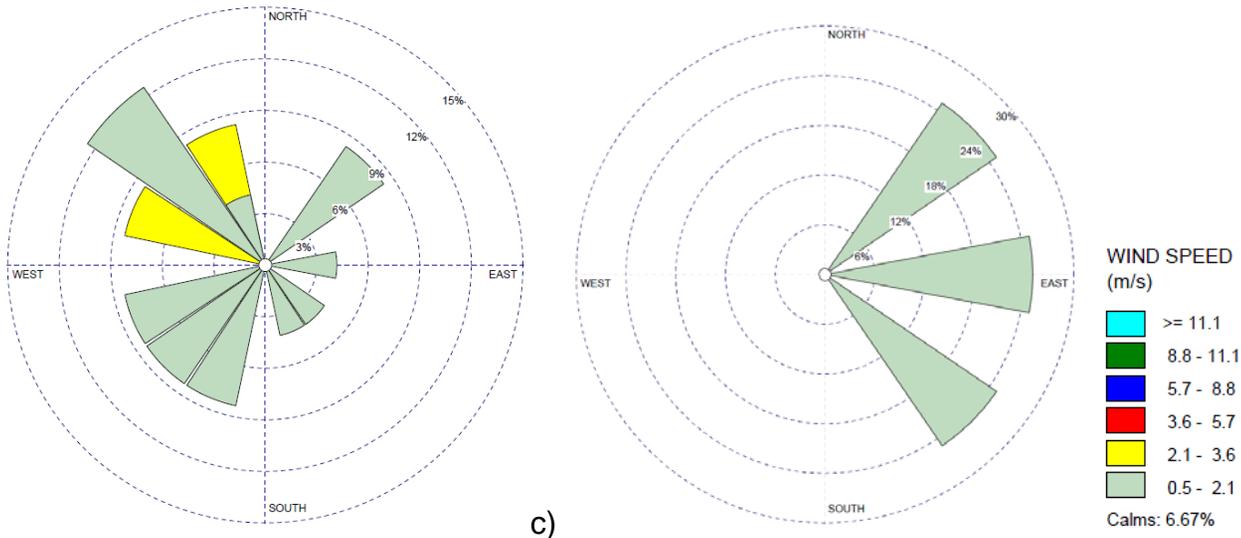
## July 5, 2011 - Beckjord

On July 5, 2011, two exceedances were reported at Monitor ID 21-037-3002 between 10:00 and 11:00. The exceedance values reported were 91 and 180, respectively. The exceedances were modeled by one HYSPLIT back trajectory in Figure 28a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 28b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 28c shows the windrose data around the time of the exceedance hours. Figure 28d shows the CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

The HYSPLIT trajectory does not pass over or in close proximity to Beckjord or Zimmer. Examination of the surface wind direction data reveals that surface level winds on this date were predominantly northwest. Wind data around the time of the exceedance shows that surface level winds during this period were from the northeast/east/southeast indicating that Beckjord or Zimmer may have contributed to the exceedance. The CEMS data shows the Beckjord emissions markedly increased in the hours prior to the exceedance and the emissions at Zimmer were zero at the time of the exceedance and for several hours prior. Based on this information, Beckjord was determined to be the most likely contributor to the exceedance.

Trajectory ID	Year	Month	Day	Hour	Reading
12	2011	July	5	10:00	91
12	2011	July	5	11:00	180





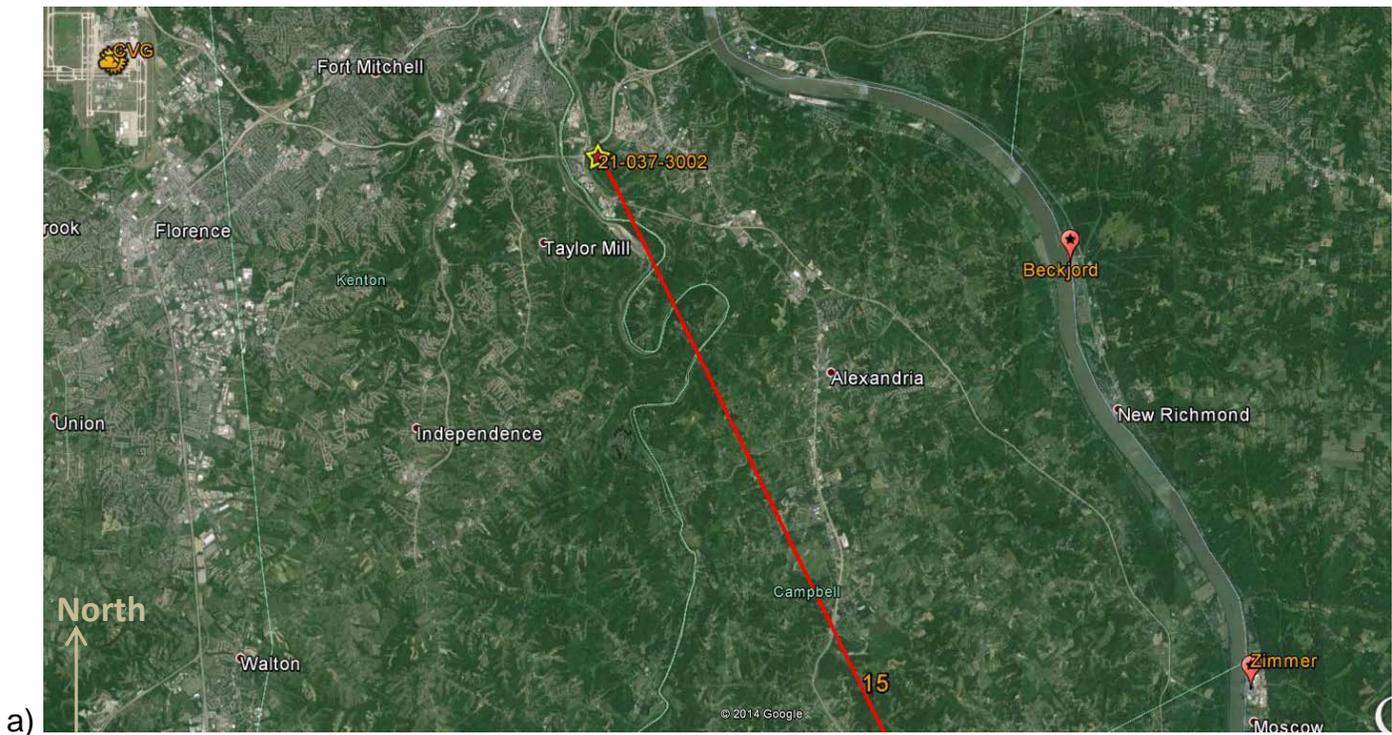
d) Figure 28. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on July 5, 2011; b) 24-hour windrose data at KCVG Station on July 5, 2011; c) 3-hour windrose data from 9:00 to 12:00 at KCVG Station on July 5, 2011; d) CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

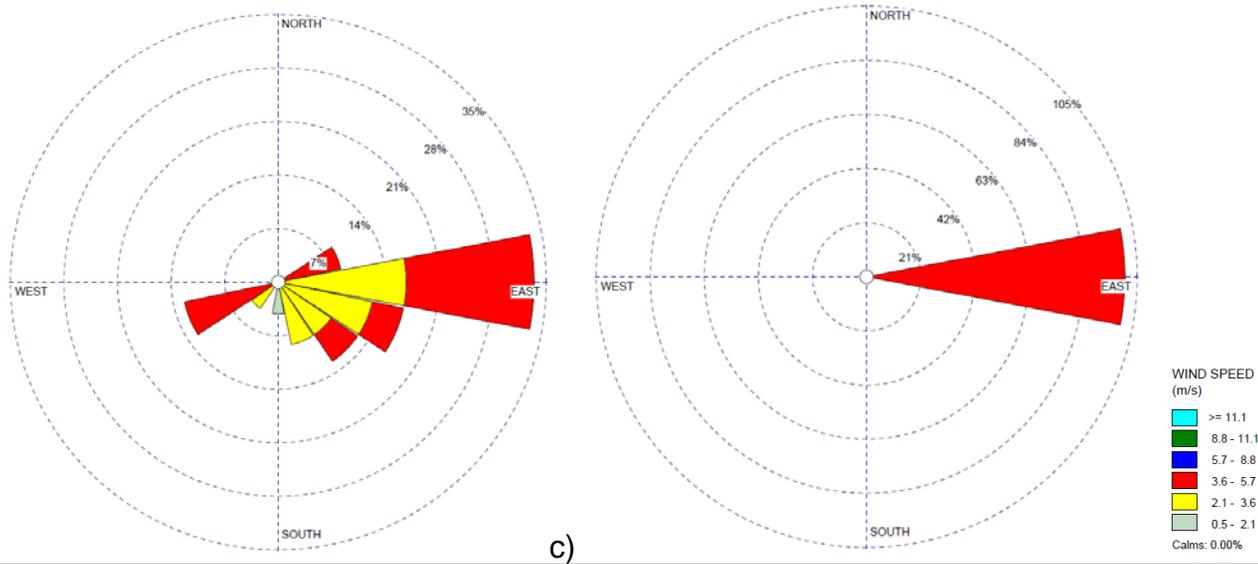
## January 11, 2012 - Beckjord

On January 11, 2012, one exceedance was reported at Monitor ID 21-037-3002 between at 12:00. The exceedance value reported was 76 ppb. The exceedance was modeled by one HYSPLIT back trajectory in Figure 29a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 29b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 29c shows the windrose data around the time of the exceedance hour. Figure 29d shows the CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

The HYSPLIT trajectory does not pass over or in close proximity to Beckjord or Zimmer. The CEMS data shows a slight increase in SO<sub>2</sub> emissions in the hours prior to the exceedance; the Zimmer SO<sub>2</sub> emissions remained steadily elevated throughout the day until dropping off at 15:00. Examination of the surface wind direction data reveals that surface level winds on this date were predominantly from the east. Surface level wind data around the time of the exceedance shows that surface level winds during this period were exclusively from the east indicating a high probability that Beckjord contributed to the exceedance. Based on this information, Beckjord was determined to be the most likely contributor to the exceedance.

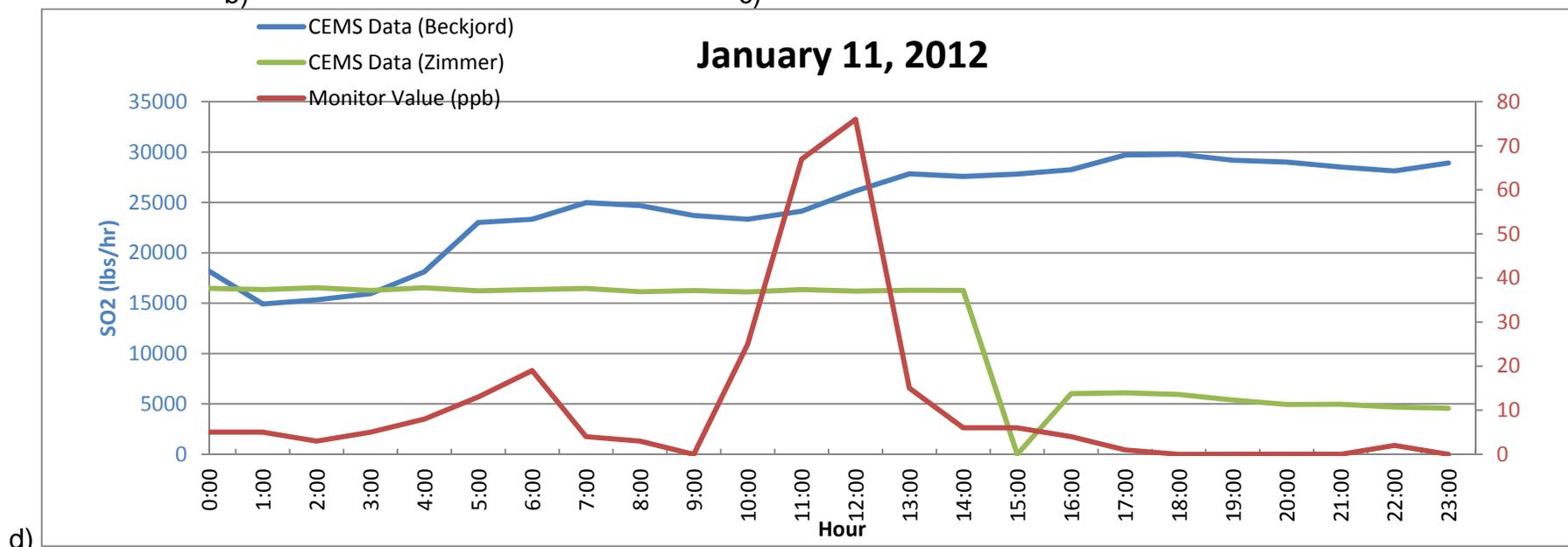
Trajectory ID	Year	Month	Day	Hour	Reading
15	2012	January	11	12:00	76





b)

c)



d)

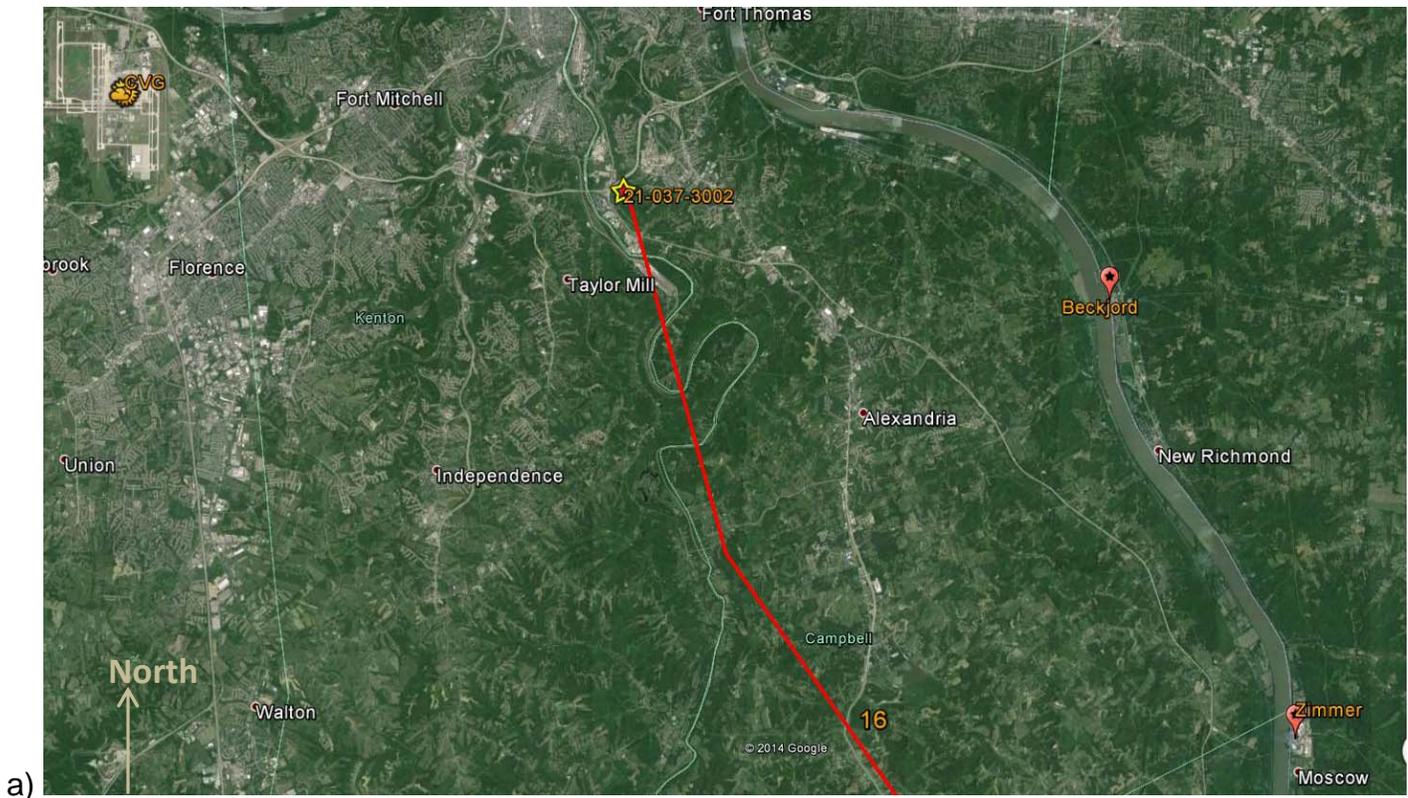
Figure 29. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on January 11, 2012; b) 24-hour windrose data at KCVG Station on January 11, 2012; c) 3-hour windrose data from 11:00 to 13:00 at KCVG Station on January 11, 2012; d) CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

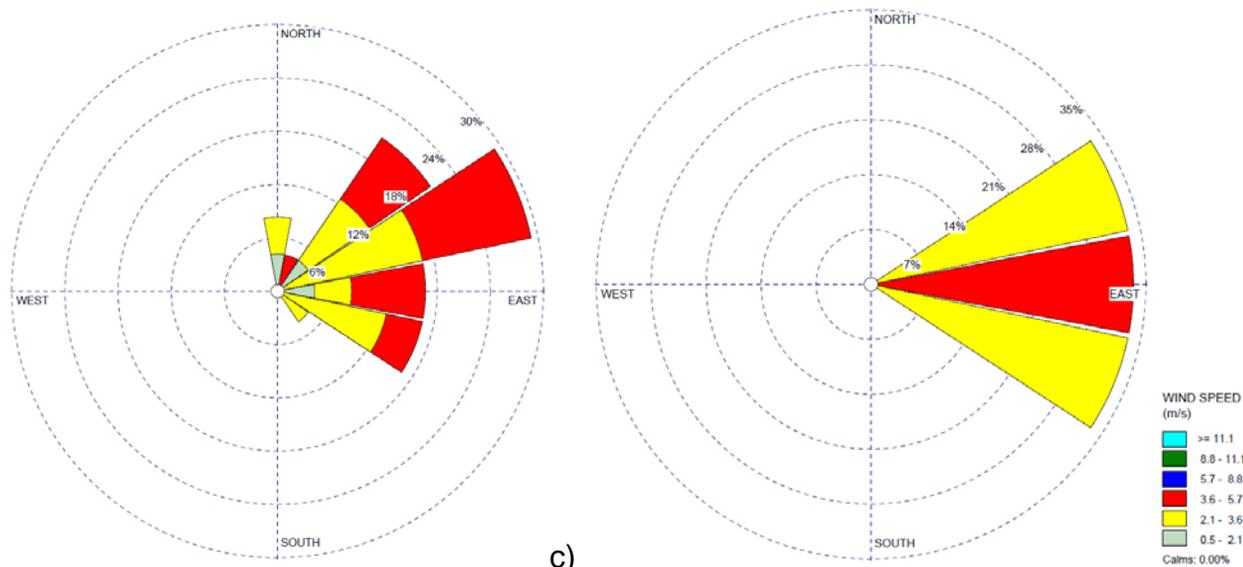
## January 25, 2012 – Beckjord/Combined

On January 25, 2012, one exceedance was reported at Monitor ID 21-037-3002 at 12:00. The exceedance value reported was 85 ppb. The exceedance was modeled by one HYSPLIT back trajectory in Figure 30a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 30b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 30c shows the windrose data around the time of the exceedance hour. Figure 30d shows the CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

The HYSPLIT trajectory does not pass over or in close proximity to Beckjord or Zimmer. The CEMS data shows both facilities emissions remained relatively constant throughout the day. Examination of the surface wind direction data around the time of the exceedance shows winds were blowing from the northeast/east/southeast direction. It should be noted that Beckjord's emissions were over four times that of Zimmer during the day. This would indicate that Beckjord was the main contributor to the exceedance although wind data may indicate Zimmer had a contribution.

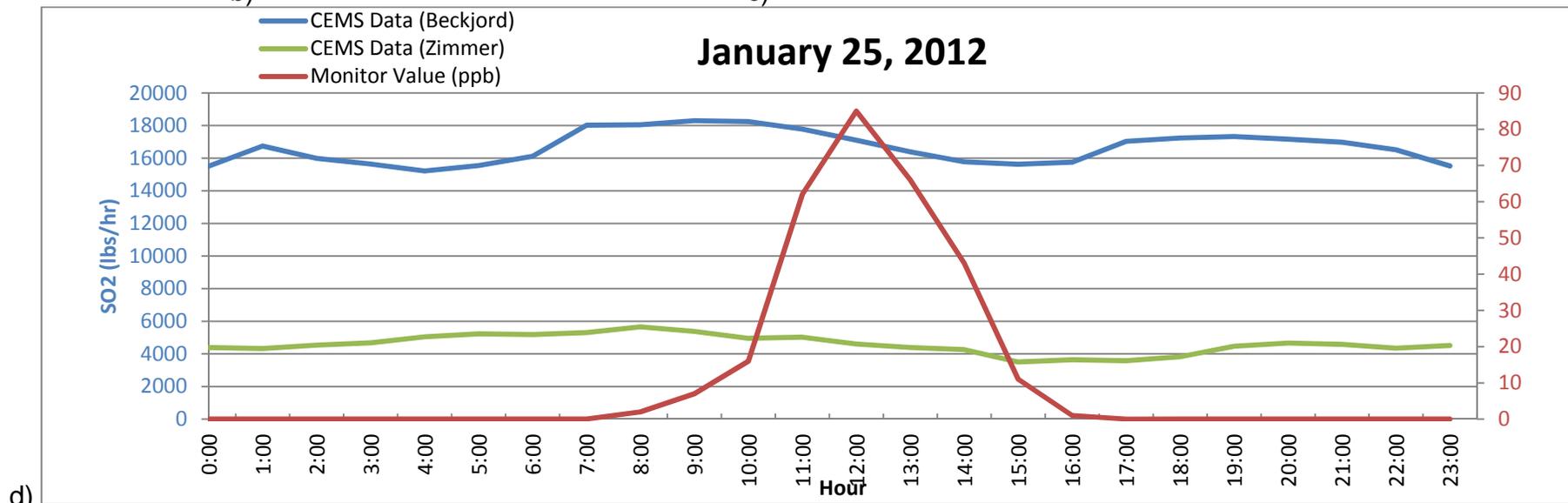
Trajectory ID	Year	Month	Day	Hour	Reading
16	2012	January	25	12:00	85





b)

c)



d)

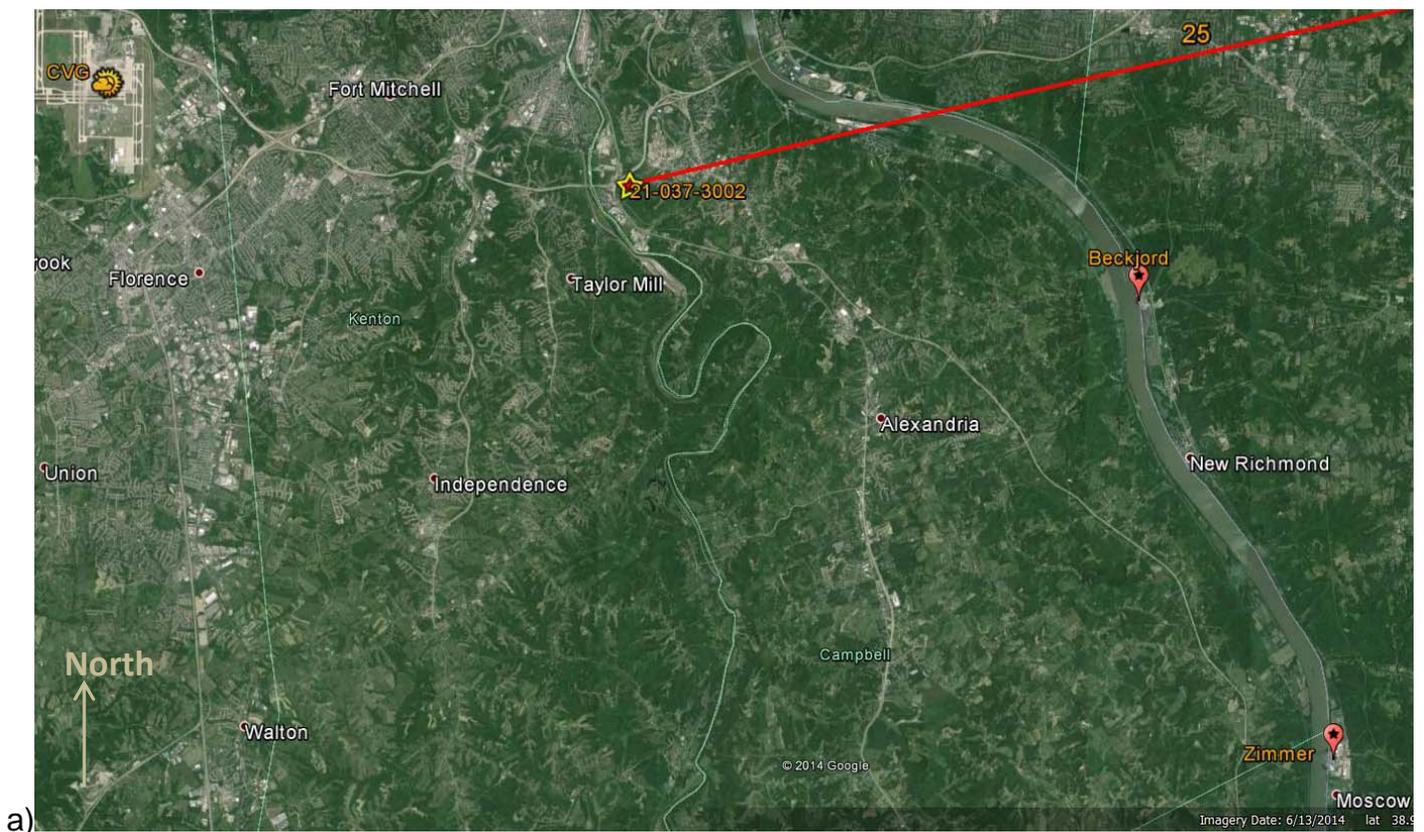
Figure 30. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on January 25, 2012; b) 24-hour windrose data at KCVG Station on January 25, 2012; c) 3-hour windrose data from 11:00 to 13:00 at KCVG Station on January 25, 2012; d) CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

## March 6, 2014 – neither

On March 6, 2013, one exceedance was reported at Monitor ID 21-037-3002 at 12:00. The exceedance value reported was 93 ppb. The exceedance was modeled by an individual trajectory in Figure 31a. The meteorological windrose data was also plotted to determine where the wind was blowing from on the exceedance date. Figure 31b shows the windrose data for a 24 hour period on the exceedance day (0:00 to 23:00), Figure 31c shows the windrose data around the time of the exceedance.

The HYSPLIT back trajectories pass north of the Beckjord facility. The surface windrose data on the exceedance day and around time of the exceedance show the wind was blowing predominately from the northeast. The March 6, 2014 exceedance is therefore not attributable to Beckjord or Zimmer. Ohio EPA is not aware of other major sources of SO<sub>2</sub> emissions in the area encompassed by the trajectory.

Trajectory ID	Year	Month	Day	Hour	Reading
25	2014	March	6	12:00	93



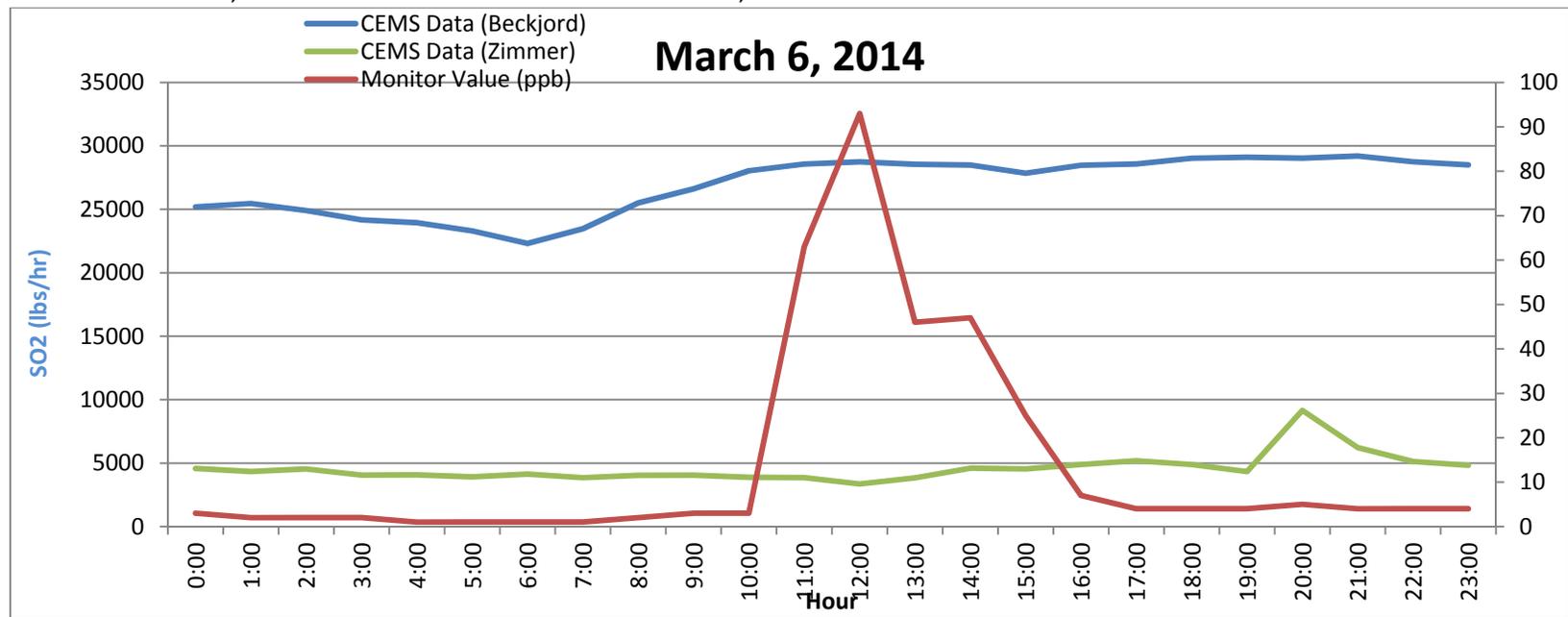
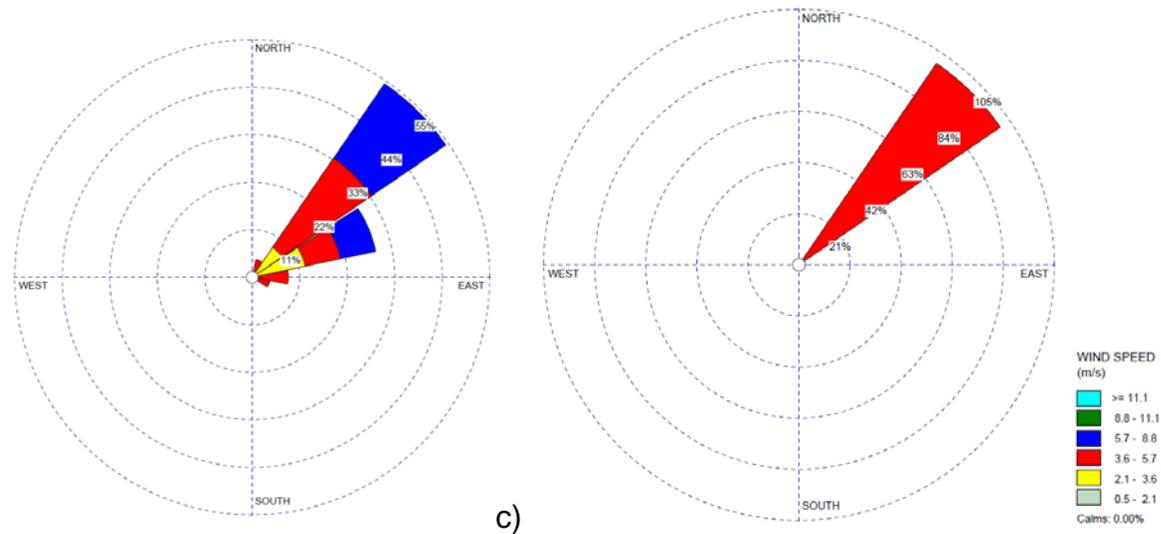


Figure 31. a) Beckjord and Zimmer CEMS data and monitored values at Kentucky Monitor ID 21-037-3002 on March 6, 2014; b) 24-hour windrose data at KCVG Station on March 6, 2014; c) 2-hour windrose data from 11:00 to 13:00 at KCVG Station on March 6, 2014; d) CEMS data for both the Beckjord and Zimmer facilities in relation to the recorded monitored values on an hourly basis for the exceedance day.

## **VII. Summary**

Between January 1, 2010 and August 31, 2014, 44 exceedances of the 2010 1-hour SO<sub>2</sub> NAAQS were reported at Monitor ID 21-037-3002. Review of the data presented in this report indicates 42 of the exceedances were most likely attributable to SO<sub>2</sub> emissions at the W.C. Beckjord Facility; and 1 exceedance was likely attributable to the W.C. Beckjord Facility but may have been influenced by SO<sub>2</sub> emissions from both facilities; and 1 exceedance was not attributable to either facility.

As presented in Table 2 of this report, the W.C. Beckjord Facility consistently emitted substantially higher SO<sub>2</sub> emission for the period analyzed. Although emissions themselves are not directly indicative of a particular source causing or contributing to an exceedance or exceedances, together with the majority of exceedances being attributable to Beckjord demonstrates the Beckjord facility is the primary SO<sub>2</sub> source causing exceedances of the 1-hour SO<sub>2</sub> NAAQS at monitor 21-037-3002.