Missouri
Department of
Natural Resources

Appendix A

Evaluation of the Fire Station #1 $PM_{2.5}$ Monitor Located in Granite City, Illinois (AQS Site ID: 17-119-1007)

Table of Contents

1. Background and Approach 1
   1.1 Fine Particulate Matter Background Information 1
   1.2 2012 Annual PM2.5 NAAQS 3
   1.3 Evaluation Approach 3
   1.4 Episode Days Evaluated 4
2. $PM_{2.5}$ Design Values at St. Louis Area $PM_{2.5}$ Monitors 5
   2.1 2010 – 2012 Annual PM2.5 Design Values in the Illinois/Missouri St. Louis MSA .. 5
   2.2 Annual $PM_{2.5}$ Design Value Trends in the Illinois/Missouri St. Louis Area (2002 – 2012) 6
3. Emissions Data 8
   3.1 Emissions Inventory Data 8
   3.2 Emission Source Location 15
   3.3 Local Emissions Sources in Granite City, Illinois 20
4. Meteorology Data 21
   4.1 Seasonal Variation 21
   4.2 Wind Rose Data 22
   4.3 HYSPLIT Modeling 25
5. Comparison of $PM_{2.5}$ Concentrations at Blair Street and Granite City 28
   5.1 Comparison of 24-hour $PM_{2.5}$ Concentrations 28
   5.2 Speciation Data Analysis at Blair Street and Granite City 33
   5.3 Analysis of $PM_{2.5}$ Concentrations and Speciation Data During and After the U.S. Steel Facility Shutdown and Reopening 37
   5.4 Annual $PM_{2.5}$ Concentrations in Granite City vs. U.S. Steel Emissions 40
6. Consideration of Potential Control Strategies for Missouri Sources in the St. Louis Area ... 42
   6.1 Electric Generating Units on the Missouri-Side of the St. Louis Area 42
   6.2 Maximum Achievable Control Technology for Industrial/Commercial/Institutional Boilers (Boiler MACT) 44
   6.3 Implementation of Reasonably Available Control Technology (RACT) for Missouri Sources Under the 1997 $PM_{2.5}$ NAAQS 46
7. Jurisdictional Boundaries 50
8. Other Considerations 51
9. Conclusion 53

List of Tables

Table 1 Episode Days Evaluated at the Granite City Monitor

Table 2 2010 – 2012 Design Values at Monitors Located in the St. Louis MSA

Table 3 Direct $PM_{2.5}$ Emissions and Percentages by County and Source Category in the Illinois/Missouri St. Louis MSA in 2008 and 2011

Table 4 NO_X Emissions and Percentages by County and Source Category in the Illinois/Missouri St. Louis MSA in 2008 and 2011

Table 5 SO_X Emissions and Percentages by County and Source Category in the Illinois/Missouri St. Louis MSA in 2008 and 2011

Table 6 VOC Emissions and Percentages by County and Source Category in the Illinois/Missouri St. Louis MSA in 2008 and 2011

Table 7 NH_3 Emissions and Percentages by County and Source Category in the Illinois/Missouri St. Louis MSA in 2008 and 2011

Table 8 2011 Facility Level $PM_{2.5}$ and $PM_{2.5}$ Precursor Emissions from Significant Point Sources in the St. Louis Area

Table 9 Distance Between Monitors in Miles (St. Louis Area $PM_{2.5}$ Monitoring Network)

Table 10 Top 5% Days for Granite City vs. Same Day Value for Blair Street (2010)

Table 11 Top 5% Days for Granite City vs. Same Day Value for Blair Street (2011)

Table 12 Top 5% Days for Granite City vs. Same Day Value for Blair Street (2012)

Table 13 Daily SANDWICHED Speciation Data at Granite City and Blair Street During High $PM_{2.5}$ Episode Days at Granite City

Table 14 Quarterly and Annual Average concentrations at the Granite City Monitor (2007 – 2010)

Table 15 Emissions from the U.S. Steel Facility in Granite City, IL

Table 16 2011 Missouri EGU Emissions and Percentages in the St. Louis MSA

Table 17 Missouri Facilities in and Around the St. Louis MSA with Units Subject to the Boiler MACT

Table 18 2011 Missouri Sources Required to Perform a RACT Evaluation Under the 1997 $PM_{2.5}$ NAAQS

List of Figures

Figure 1 Illinois/Missouri St. Louis MSA $PM_{2.5}$ Monitoring Network

Figure 2 IL/MO St. Louis Area $PM_{2.5}$ Monitors Annual $PM_{2.5}$ Concentration Trends (2000 - 2012)

Figure 3 MO – IL 1997 $PM_{2.5}$ Nonattainment Area with Sources Sized by Sum of Total 2011 Direct and Precursor $PM_{2.5}$ Emissions (NH_3, NO_X, $PM_{2.5}$, SO_2, VOC) with Granite City Monitor

Figure 4 MO – IL 1997 $PM_{2.5}$ Nonattainment Area with Sources of Direct and Precursor $PM_{2.5}$ Emissions Breakdown (NH_3, NO_X, $PM_{2.5}$, SO_2, VOC) (2011) with Granite City Monitor

Figure 5 Satellite Image of the Granite City Monitor with Significant Local Emissions Sources' Property Boundaries

Figure 6 Granite City Average $PM_{2.5}$ Concentrations by Season (2010 - 2012)

Figure 7 Wind Directions for All Hours of the Day on High $PM_{2.5}$ Concentration Days at Granite City in 2010 – 2012

Figure 8 Wind Directions for All Hours of the Day on Low $PM_{2.5}$ Concentration Days at Granite City in 2010 – 2012

Figure 9 HYSPLIT Wind Trajectories for High $PM_{2.5}$ Concentration Days at Granite City in 2010 – 2012 (12:00 a.m., 12:00 p.m., and 11:00 p.m.)

Figure 10 HYSPLIT Wind Trajectories for Low $PM_{2.5}$ Concentration Days at Granite City in 2010 – 2012 (12:00 a.m., 12:00 p.m., and 11:00 p.m.)

Figure 11 Wind Directions and Speeds for All Hours of the Day on Outlier $PM_{2.5}$ Concentration Days at Granite City in 2010 – 2012

Figure 12 HYSPLIT Wind Trajectories for Outlier $PM_{2.5}$ Concentration Days at Granite City in 2010 – 2012 (12:00 a.m., 12:00 p.m., and 11:00 p.m.)

Figure 13 2009 - 2011 Average SANDWICHED Speciation Data at Granite City, Blair Street, and Mingo

Figure 14 Average Quarterly $PM_{2.5}$ Concentrations at the Granite City Monitor (2007 - 2010)

Figure 15 2009 Average SANDWICH Speciation Data from CSN Monitors at Granite City and Blair Street (During the Shutdown of U.S. Steel Facility)

Figure 16 2010 Average SANDWICH Speciation Data from CSN Monitors at Granite City and Blair Street

Figure 17 2011 Average SANDWICH Speciation Data from CSN Monitors at Granite City and Blair Street

Figure 18 Granite City Monitor Annual $PM_{2.5}$ Concentrations (2000 - 2012)

Evaluation of the Fire Station #1 $PM_{2.5}$ Monitor Located in Granite City, Illinois (AQS Site ID: 17-119-1007)

1. Background and Approach

1.1 Fine Particulate Matter Background Information

Fine Particulate Matter ($PM_{2.5}$) is one of seven different criteria pollutants for which EPA has established a National Ambient Air Quality Standard (NAAQS). This pollutant includes all particles, both solid and liquid, that have an aerodynamic diameter less than 2.5 micrometers. For this reason, there is no single chemical formula for $PM_{2.5}$. Instead, $PM_{2.5}$ is comprised of dozens of different chemical species. Additionally, $PM_{2.5}$ can be emitted directly (primary $PM_{2.5}$), or it can be formed through chemical reactions of precursor pollutants in the atmosphere (secondary $PM_{2.5}$).

Primary $PM_{2.5}$ includes all nongaseous particles with aerodynamic diameters less than 2.5 micrometers in size that are emitted directly from an emissions source. Examples of primary $PM_{2.5}$ include microscopic dust particles; oxides of metals from milling and smelting operations; organic carbon particles from the combustion of fossil fuels and biomass; and other microscopic particles that aren't fully combusted during combustion processes. The three speciation categories most heavily impacted by primary $PM_{2.5}$ emissions include organic carbon particulates, elemental carbon particulates, and crustal particulates. Primary $PM_{2.5}$ emissions have an immediate impact on ambient $PM_{2.5}$ concentrations in the local area surrounding the emissions source; however, as distance from the emissions source increases, the $PM_{2.5}$ concentrations resulting from the primary $PM_{2.5}$ emissions quickly disperse bringing $PM_{2.5}$ concentrations back down to regional/local background levels only a few miles away from the primary $PM_{2.5}$ emissions source. Under low and calm wind conditions, primary $PM_{2.5}$ emissions cannot disperse and buildups of $PM_{2.5}$ concentrations can occur around sources of primary $PM_{2.5}$ emissions.

Secondary $PM_{2.5}$ includes several different chemical species, each of which forms under different conditions. The three speciation categories most heavily impacted by secondary $PM_{2.5}$ include sulfates, nitrates and organic carbon particulates. Sulfates are formed from sulfur dioxide (SO_2) emissions from power plants and industrial facilities. Nitrates are formed from emissions of nitrogen oxides (NO_X) from power plants, automobiles, and other combustion sources. Secondary organic particulates result from gaseous organic emissions from mobile and stationary fossil fuel combustion sources, industrial chemicals, gasoline evaporation, and biogenic emissions. Secondary $PM_{2.5}$ formation is a process that can take hours or days and is primarily responsible for long range transportation contribution to $PM_{2.5}$ levels in other areas.

Sources of primary $PM_{2.5}$ include the following:

- Stationary sources that burn fossil fuels:
  - Organic carbon particles and elemental carbon particles from power plants, industrial/commercial/residential heating/combustion equipment
  - Oxides of trace metals from coal or oil combustion
- Mobile sources that burn fossil fuels:
  - Organic carbon particles and elemental carbon particles from the exhaust of cars, trucks, buses, locomotives, marine engines, and off-road equipment
  - Fugitive dust from on-road and off-road vehicles/equipment
- Industrial processes:
  - Organic carbon particles, elemental carbon particles, and oxides of metals from smelting, milling, and asphalt production
- Construction activities:
  - Fugitive dust from construction/earth moving activities
  - Organic carbon particles and elemental carbon particles from the exhaust of off-road equipment
- Agricultural operations:
  - Fugitive dust from earth moving/agricultural tilling
  - Organic carbon particles and elemental carbon particles from the exhaust of off-road farming equipment
- Non-anthropogenic sources:
  - Organic carbon particles and elemental carbon particles from wild fires

Sources of secondary $PM_{2.5}$ precursors that react in the air to form secondary $PM_{2.5}$ include:

- Stationary sources that burn fossil fuels
  - SO_2, NO_X, and gaseous organic emissions from power plants, industrial/commercial/residential heating/combustion equipment
- Mobile sources that burn fossil fuels
  - SO_2, NO_X, and gaseous organic emissions from exhaust of cars, trucks, buses, locomotives, marine engines, and off-road equipment
  - Gaseous organic emissions from gasoline/diesel fuel evaporation
- Gasoline fueling and refining
  - SO_2, NO_X, and gaseous organic emissions from refining operations
  - Gaseous organic emissions from gasoline/diesel fuel evaporation
- Surface coating operations
  - Gaseous organic emissions from solvent evaporation
- Industrial processes
  - SO_2, NO_X, and gaseous organic emissions from fossil fuel combustion
  - Gaseous organic emissions from solvent/chemical/liquid fuel evaporation
- Agricultural operations
  - Ammonia (NH_3) and gaseous organic emissions from fertilizers/animal feeding operations
  - SO_2, NO_X, and gaseous organic emissions from exhaust of off-road farming equipment
- Mining
  - Gaseous organic emissions from vented mine shafts
- Biogenic Sources
  - NH_3, NO_X, and gaseous organic emissions from vegetative and biological processes

1.2 2012 Annual PM2.5 NAAQS

On January 15, 2013, EPA promulgated $PM_{2.5}$ air quality standards (78 FR 3036). These standards were based on a number of health studies showing that increased exposure to $PM_{2.5}$ is correlated with increased mortality and a range of serious health effects, including aggravation of lung disease, asthma attacks, and heart problems. EPA established a new primary standard for $PM_{2.5}$. The standard is based on an annual average and was set at a level of 12 micrograms per cubic meter ($\mu g/m^3$). Under the same action, EPA retained the existing secondary annual standard for $PM_{2.5}$, the existing primary and secondary 24-hour standards for $PM_{2.5}$, as well the existing primary and secondary standards for particulate matter with aerodynamic diameters of 10 microns or less (PM_{10}).

In the St. Louis area, there are two (2) $PM_{2.5}$ air quality monitors that are suitable for comparison with the annual $PM_{2.5}$ NAAQS and are currently violating the newly established $PM_{2.5}$ standard. Both of these monitors are located in Illinois. Per the Clean Air Act Amendments of 1990, any area with a monitor that has a design value in violation of a NAAQS is to be designated nonattainment. Additionally, nearby areas with sources that are contributing to the violation shall be included in the nonattainment area that results from the violating monitor. This Appendix evaluates one of these violating monitors located in Granite City, Illinois in an effort to determine the sources that are causing/contributing to the violation.

1.3 Evaluation Approach

In an effort to determine the contributing sources to the ambient $PM_{2.5}$ concentrations recorded by the "Fire Station #1" $PM_{2.5}$ monitor located in Granite City, Illinois (hereafter referred to as the Granite City monitor) with a 2010 – 2012 annual $PM_{2.5}$ design value in violation of the 2012 Annual $PM_{2.5}$ NAAQS, the Missouri Department of Natural Resources has performed an evaluation of the following: monitoring data from the Granite City Monitor and other ambient $PM_{2.5}$ monitors located in the MO/IL St. Louis Metropolitan Statistical Area (MSA), the emissions sources located in the St. Louis MSA, the wind directions on days with the top 5% and bottom 5% recorded 24-hour $PM_{2.5}$ concentrations at the Granite City monitor from 2010 – 2012, modeled wind trajectories for these same days, and seasonal variations in monitored concentrations at the site.

Additionally, the $PM_{2.5}$ average concentrations at the Granite City monitor were calculated and reviewed for each calendar quarter during the period from 2007 – 2010. A significant $PM_{2.5}$ emission source located less than a mile to the south of the monitor was shutdown in 2009. Therefore by reviewing the concentrations during these years, the goal is to determine the impact that this emission source has on $PM_{2.5}$ concentrations at this monitor. Finally, a review of Missouri's major emissions sources in the area along with current and planned future control measures was performed to determine the level of potentially controllable emissions in Missouri that might be impacting the $PM_{2.5}$ concentrations at this site.

1.4 Episode Days Evaluated

Much of the evaluation performed to determine the contributing sources to the current violation at the Granite City monitor focused on a set of days during 2010 – 2012 when monitored $PM_{2.5}$ concentrations were at their highest and lowest. The high days were selected for evaluation as they drive the annual average higher, contributing significantly to the violation of the 2012 annual $PM_{2.5}$ standard. The low days were selected to determine if certain meteorological conditions tend to result in lower ambient $PM_{2.5}$ concentrations at this particular monitor. For both the high and low days, the highest and lowest 5 percent 24-hour value concentrations recorded at this monitor in each year from 2010 – 2012 were evaluated. The value of 5 percent equates to 17 or 18 days in the year as this monitor recorded $PM_{2.5}$ concentrations an average of 340 days per year during the 2010 – 2012 time frame. This was determined to be a sufficient number of episode days to evaluate, to ensure that enough data is analyzed to obtain representative trends, while keeping the amount of resources necessary for the evaluation at a manageable level.

Table 1 lists the dates used as episode days throughout much of this evaluation.

Table 1. Episode Days Evaluated at the Granite City Monitor

Granite City High Days			Granite City Low Days		
2010	2011	2012	2010	2011	2012
3/9/2010	1/28/2011	11/17/2012	4/25/2010	10/14/2011	4/21/2012
2/4/2010	1/17/2011	11/21/2012	3/13/2010	10/20/2011	10/19/2012
2/3/2010	7/16/2011	11/18/2012	9/3/2010	11/17/2011	4/11/2012
8/8/2010	6/8/2011	7/4/2012	5/8/2010	9/5/2011	9/18/2012
12/19/2010	2/4/2011	12/24/2012	2/2/2010	10/19/2011	3/12/2012
1/15/2010	1/24/2011	6/29/2012	7/6/2010	4/12/2011	1/7/2012
12/20/2010	1/27/2011	7/2/2012	11/5/2010	4/16/2011	2/24/2012
8/7/2010	6/9/2011	11/28/2012	9/7/2010	11/27/2011	11/23/2012
1/16/2010	1/25/2011	2/17/2012	10/18/2010	5/2/2011	9/8/2012
12/28/2010	6/3/2011	11/20/2012	3/14/2010	9/15/2011	10/6/2012
2/21/2010	1/18/2011	9/6/2012	5/4/2010	9/7/2011	2/11/2012
4/13/2010	3/31/2011	11/16/2012	5/17/2010	4/20/2011	1/1/2012
1/23/2010	9/2/2011	6/30/2012	9/27/2010	3/23/2011	1/3/2012
8/9/2010	8/2/2011	7/7/2012	1/28/2010	5/16/2011	6/21/2012
12/10/2010	6/7/2011	1/10/2012	1/19/2010	11/29/2011	1/17/2012
12/9/2010	6/4/2011	4/2/2012	10/14/2010	5/15/2011	10/5/2012
3/8/2010	8/1/2011	11/15/2012	3/1/2010	5/14/2011	1/2/2012
	5/10/2011			9/6/2011	

2. $PM_{2.5}$ Design Values at St. Louis Area $PM_{2.5}$ Monitors

2.1 2010 – 2012 Annual PM2.5 Design Values in the Illinois/Missouri St. Louis MSA

To begin the evaluation, the 2010 – 2012 annual $PM_{2.5}$ design values at all monitors located in Missouri and Illinois were reviewed. All monitoring data used throughout this Appendix were pulled from EPA's Air Quality System (AQS). Figure 1 displays a map of the $PM_{2.5}$ monitoring network in the MO/IL St. Louis MSA. The $PM_{2.5}$ annual design values from 2010 – 2012 are listed below in Table 2. A quick review of the design values shows that all monitors located on the Missouri side of the St. Louis MSA that are suitable for comparison to the annual $PM_{2.5}$ NAAQS are in compliance with the 2012 annual $PM_{2.5}$ standard, while two monitors located in Illinois have 2010 – 2012 design values above the level of the standard. This evaluation focuses on the violating monitor located in Granite City, Illinois. A separate evaluation was performed for the violating monitor located in East St. Louis, Illinois, which can be found in Appendix B.

Table 2 2010 – 2012 Design Values at Monitors Located in the St. Louis MSA *

Annual $PM_{2.5}$ Monitoring Data (all values in micrograms/cubic meter ($\mu g/m^3$)) **

Missouri Monitors			
Site Location	**AQS Site ID**	**County**	**2010 - 2012 Annual Design Value**
Arnold West	29-099-0019	Jefferson	10.1
South Broadway	29-510-0007	St. Louis City	11.0
Blair Street	29-510-0085	St. Louis City	11.7
Ladue	29-189-3001	St. Louis County	10.9
Illinois Monitors			
Site Location	**AQS Site ID**	**County**	**2010 - 2012 Design Value**
Alton	17-119-2009	Madison	11.8
Wood River	17-119-3007	Madison	11.6
East St. Louis	17-163-0010	St. Clair	12.2
Granite City	17-119-1007	Madison	13.5

* Note: Monitoring data was pulled from Federal Equivalent Method (FEM) and Federal Reference Method (FRM) $PM_{2.5}$ air quality monitors in the St. Louis area that are acceptable for comparison to the Annual $PM_{2.5}$ NAAQS, per EPA's July 2013 Air Quality Design Value Review: http://www.epa.gov/ttn/analysis/dvreview.htm

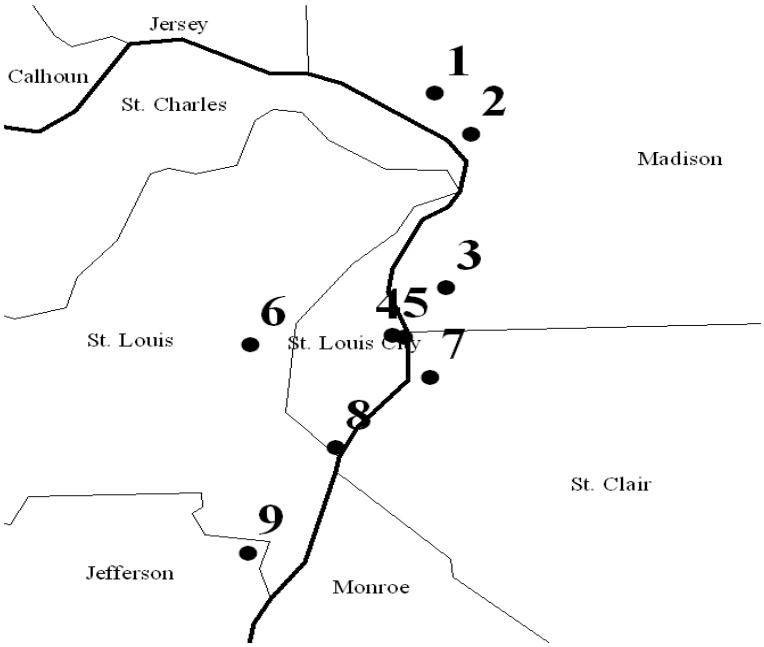
** Note: All values have been rounded to the nearest 0.1 microgram/cubic meter

Figure 1 Illinois/Missouri St. Louis MSA $PM_{2.5}$ Monitoring Network

Missouri	
Site #	**Site Location**
4	Blair Street
5	Branch Street *
6	Ladue
8	South Broadway
9	Arnold West

* Note: unique middle-scale monitor not comparable to Annual $PM_{2.5}$ NAAQS

Illinois	
Site #	**Site Location**
1	Alton
2	Wood River
3	Granite City
7	East St. Louis

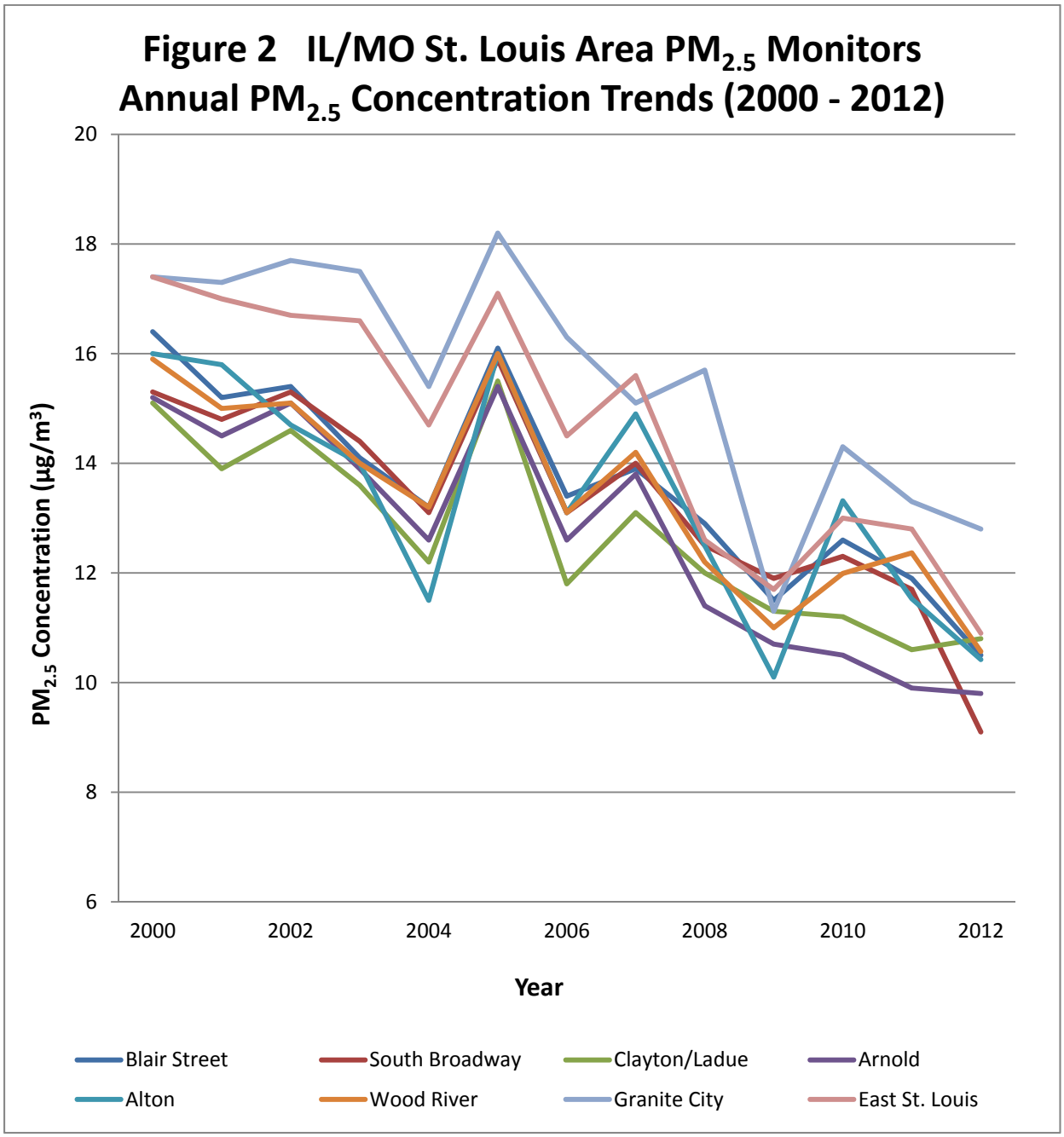


Note: The Branch Street monitor is defined as a unique middle scale monitor and has been given a legacy exemption meaning it is not comparable to the 2012 Annual $PM_{2.5}$ NAAQS, per EPA's July 2013 Air Quality Design Value Review: http://www.epa.gov/ttn/analysis/dvreview.htm. This monitor is not representative of area-wide $PM_{2.5}$ concentrations as many of the episodes and trends recorded at the Branch Street monitor are unique to this location and not experienced across the St. Louis Region even by the neighborhood scale Blair Street monitor, which is less than 800 m from the Branch Street monitor location. Therefore, while trends and episodes at this monitor are useful and relevant for comparison and analysis of the 24-hour $PM_{2.5}$ NAAQS, the episodes and design values at this monitor are not suitable for comparison and analysis of the Annual $PM_{2.5}$ NAAQS. For additional details regarding the Branch Street monitor's status as a unique middle scale monitor, please see Appendix C.

2.2 Annual $PM_{2.5}$ Design Value Trends in the Illinois/Missouri St. Louis Area (2002 – 2012)

It is important to understand that significant improvements in $PM_{2.5}$ concentrations have been achieved across the entire MO/IL St. Louis MSA over the past decade as a result of both regional and local emission control strategies that have been implemented during this timeframe. Figure 2 displays the annual average $PM_{2.5}$ concentrations from 2002 – 2012 for each of the St. Louis area monitors listed in Table 2. As can be seen, the declining trend in $PM_{2.5}$ concentrations is persistent across the entire region. Average $PM_{2.5}$ concentrations across the region have reduced from approximately 16 $\mu g/m^3$ in 2000 down to approximately 11 $\mu g/m^3$ in 2012. This declining trend in $PM_{2.5}$ concentrations across the Region show that control strategies currently in place have been effective and are resulting in the continued improvement in $PM_{2.5}$ concentrations. As federal control measures such as motor vehicle and non-road engine standards, the Clean Air Interstate Rule phase II (or its expected replacement), the Boiler Maximum Achievable Control Technology Standards, and the Utility Mercury and Air Toxics Standards become phased in, regional emissions reductions in St. Louis and across the country are only expected to continue, which will continue the downward trend in $PM_{2.5}$ concentrations measured across the St. Louis area.

As seen in Figure 2, the Granite City monitor consistently records average annual $PM_{2.5}$ concentrations approximately 2 µg/m^3 – 3 µg/m^3 above the average levels recorded by all other monitors in the St. Louis area. The evaluation in this Appendix focuses on this trend and analyzes the sources suspected of causing the consistently elevated $PM_{2.5}$ concentrations at this monitor.



3. Emissions Data

3.1 Emissions Inventory Data

Tables 3 – 7 list the emissions of direct $PM_{2.5}$ and the $PM_{2.5}$ precursors, oxides of nitrogen (NO_X), oxides of sulfur (SO_X), volatile organic compounds (VOC), and ammonia (NH_3), respectively, for each county in the Illinois/Missouri St. Louis MSA in tons/year by source category for both 2008 and 2011. The point and area source emissions inventories listed in these tables for Missouri and Illinois were generated for submission to EPA for the National Emissions Inventory in these two years. Mobile source emissions in Missouri and Illinois were calculated by the Missouri Department of Natural Resources and the Illinois EPA. NONROAD 2008 was used to develop the non-road mobile source emissions with county specific data, and EPA's Motor Vehicle Emissions Simulator (MOVES) version 2010b was used to develop the on-road mobile source emissions with county specific data.

Area sources comprise a large percentage of direct $PM_{2.5}$ emissions from all counties in the MO/IL St. Louis MSA. However, a vast majority of the direct $PM_{2.5}$ emissions from area sources are calculated values for paved and unpaved roads and agricultural tilling. These emissions categories account for dust that is disturbed on roads by vehicles and in fields during agricultural tilling. These types of emissions are very local in nature, and quickly settle out of the air usually within 100 – 500 yards from their origin. Therefore, these types of emissions in Missouri, while significant to the overall percentage of direct $PM_{2.5}$ emissions in the MSA, would not have an impact on $PM_{2.5}$ concentrations recorded at the Granite City monitor. Although it is noted that a marginal percentage direct $PM_{2.5}$ emissions from paved and unpaved roads nearby the Granite City monitor in Madison County could have an impact on the $PM_{2.5}$ concentrations recorded by the Granite City monitor, the vast majority of direct $PM_{2.5}$ emissions from these three emissions source categories in the IL/MO St. Louis MSA are not impacting the $PM_{2.5}$ concentrations in Granite City. For this reason, direct $PM_{2.5}$ emissions from these three categories have been excluded from the area source category for all counties evaluated in Table 3 to allow for a more focused evaluation on emissions that may be impacting the violating monitor in Granite City.

As seen in the following tables, all the Missouri counties included in the MSA except for Lincoln and Warren have a significant amount of emissions from point, on-road, and non-road categories for all pollutants reviewed. There are also significant emissions on the Illinois side, particularly in Madison County (the location of the Granite City Monitor), but generally speaking, the emissions from the Missouri side of the MSA comprise a majority from the entire MSA.

Looking at mobile source emissions from 2008 to 2011 shows a general decline in all emission categories evaluated from 2008 – 2011. This is the result of federal motor vehicle and non-road engine standards that have been phased in and the retirement of older higher polluting mobile source engines. In addition to federal motor vehicle emissions standards, Missouri implements reformulated gasoline requirements in the St. Louis area along with an inspection and maintenance (I/M) program for all vehicles registered in the City of St. Louis and the Counties of St. Louis, St. Charles, Franklin, and Jefferson. This I/M program ensures that vehicles in the area fix the emission controls on their vehicles when they break and eliminates any attempts for

residents to tamper with the emission control devices on their vehicles, thus ensuring the emissions reductions expected from the federal motor vehicle standards remain in place. Therefore, the trend of declining mobile source emissions is expected to continue in the St. Louis area.

When analyzing point source emissions, particularly for the pollutant categories of SO_X and NO_X a vast majority of the emissions result from electric generating units, and are emitted from stacks hundreds of feet in the air. This results in dispersion and prevents high concentrations of these pollutants from forming at ground-level. While these types of emissions do contribute to $PM_{2.5}$ concentrations as they undergo chemical reactions in the atmosphere, the $PM_{2.5}$ contribution can result hundreds of miles away from the actual emission source, meaning they contribute more to regional background levels than they do to the local MSA. Therefore, these types of emissions sources have typically been controlled in the past through regional emission control programs aimed at reducing the impact of emissions on downwind state ambient air pollutant concentrations. This issue is further analyzed in Subsection 5.2 through the evaluation of speciation data at the Granite City monitor.

Based on the magnitude of emissions alone, Missouri sources comprise a large percent of the region's overall emissions inventory. However, aggregate emissions in the MSA alone are not enough to determine the relative contribution of these emission sources to a particular $PM_{2.5}$ monitor violation. Analysis of emission point elevations, release parameters, and meteorological data are needed to perform quantitative dispersion/photochemical modeling and source apportionment analysis. However, despite limitations in quantitatively correlating aggregate emissions to unique monitored concentrations, a weight of evidence approach is used in this document to demonstrate the likelihood of whether Missouri sources are causing or contributing to the magnitude of the violating monitor in Granite City. This approach is discussed in the sections that follow and is appropriate since area wide monitored violations do not occur over the entire St. Louis MO-IL MSA.

Table 3 Direct $PM_{2.5}$ Emissions and Percentages by County and Source Category in the Illinois/Missouri St. Louis MSA in 2008 and 2011 *										
	2008 Direct $PM_{2.5}$ Emissions (Tons/Year)					2011 Direct $PM_{2.5}$ Emissions (Tons/Year)				
Missouri	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**
St. Louis	510.91	3,232.47	1,306.99	618.2	**5,668.57**	208.96	3,759.63	993.87	574.04	**5,536.50**
	9.41%	32.40%	42.26%	37.47%	**28.13%**	4.65%	30.80%	42.21%	38.07%	**26.93%**
St. Louis City	271.66	1,247.78	353.18	152.6	**2,025.22**	289.10	1,080.66	251.98	95.12	**1,716.86**
	5.00%	12.51%	11.42%	9.25%	**10.05%**	6.44%	8.85%	10.70%	6.31%	**8.35%**
St. Charles	316.21	630.05	302.58	205.09	**1,453.93**	445.05	1,120.96	313.41	180.06	**2,059.48**
	5.82%	6.32%	9.78%	12.43%	**7.22%**	9.91%	9.18%	13.31%	11.94%	**10.02%**
Jefferson	945.65	717.78	192.81	85.82	**1,942.06**	511.82	965.22	183.67	77.01	**1,737.72**
	17.42%	7.20%	6.23%	5.20%	**9.64%**	11.40%	7.91%	7.80%	5.11%	**8.45%**
Franklin	1,448.96	423.94	142.43	138.11	**2,153.44**	1,714.56	513.07	117.34	96.30	**2,441.27**
	26.68%	4.25%	4.61%	8.37%	**10.69%**	38.19%	4.20%	4.98%	6.39%	**11.87%**
Lincoln	0.27	222.5	41.46	65.30	**329.53**	0.33	255.15	44.99	44.69	**345.16**
	0.00%	2.23%	1.34%	3.96%	**1.64%**	0.01%	2.09%	1.91%	2.96%	**1.68%**
Warren	0.86	140.14	53.66	28.75	**223.41**	-	191.73	56.54	25.66	**273.93**
	0.02%	1.40%	1.74%	1.74%	**1.11%**	0.00%	1.57%	2.40%	1.70%	**1.33%**
Missouri MSA	**3,494.52**	**6,614.66**	**2,393.11**	**1,293.87**	**13,796.16**	**3,169.82**	**7,886.42**	**1,961.80**	**1,092.88**	**14,110.92**
	64.35%	**66.31%**	**77.38%**	**78.43%**	**68.47%**	**70.61%**	**64.60%**	**83.33%**	**72.48%**	**68.64%**
	2008 Direct $PM_{2.5}$ Emissions (Tons/Year)					2011 Direct $PM_{2.5}$ Emissions (Tons/Year)				
Illinois	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**
Clinton	60.20	265.07	32.85	47.06	**405.18**	48.22	289.05	20.89	50.61	**408.77**
	1.11%	2.66%	1.06%	2.85%	**2.01%**	1.07%	2.37%	0.89%	3.36%	**1.99%**
Jersey	0.87	151.43	17.98	25.99	**196.27**	0.00	147.72	9.44	27.70	**184.86**
	0.02%	1.52%	0.58%	1.58%	**0.97%**	0.00%	1.21%	0.40%	1.84%	**0.90%**
Madison	1,781.41	1,492.74	311.41	142.27	**3,727.84**	1,232.23	1,438.24	176.97	154.79	**3,002.23**
	32.81%	14.96%	10.07%	8.62%	**18.50%**	27.45%	11.78%	7.52%	10.27%	**14.60%**
Monroe	3.35	268.6	38.36	31.25	**341.57**	0.51	228.94	20.26	59.62	**309.33**
	0.06%	2.69%	1.24%	1.89%	**1.70%**	0.01%	1.88%	0.86%	3.95%	**1.50%**
St. Clair	89.73	1,182.78	298.97	109.30	**1,680.78**	38.32	2,217.24	165.03	122.19	**2,542.77**
	1.65%	11.86%	9.67%	6.63%	**8.34%**	0.85%	18.16%	7.01%	8.10%	**12.37%**
Illinois MSA	**1,935.56**	**3,360.62**	**699.58**	**355.88**	**6,351.64**	**1,319.28**	**4,321.19**	**392.58**	**414.92**	**6,447.97**
	35.65%	**33.69%**	**22.62%**	**21.57%**	**31.53%**	**29.39%**	**35.40%**	**16.67%**	**27.52%**	**31.36%**
MSA Total	**5,430.08**	**9,975.28**	**3,092.69**	**1,649.75**	**20,147.80**	**4,489.10**	**12,207.61**	**2,354.38**	**1,507.80**	**20,558.89**

* Note: The percentages listed in the table above indicate each area's percentage of the total IL/MO St. Louis MSA Direct $PM_{2.5}$ emissions during the applicable year for the applicable source category. This table does not include direct $PM_{2.5}$ emissions from paved and unpaved roads or agricultural tilling operations.

Table 4 NO_X Emissions and Percentages by County and Source Category in the Illinois/Missouri St. Louis MSA in 2008 and 2011 *										
	2008 NO_X Emissions (Tons/Year)					2011 NO_X Emissions (Tons/Year)				
Missouri	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**
St. Louis	5,843.52	2,219.83	33,985.44	9,344.46	**51,393.25**	5,110.66	2,680.64	24,407.41	6,413.31	**38,612.02**
	12.84%	21.02%	42.75%	35.56%	**31.75%**	12.73%	39.44%	40.16%	30.61%	**30.01%**
St. Louis City	1,415.83	1,033.57	9,165.29	4,078.51	**15,693.20**	1,096.90	1,061.87	6,078.28	2,064.89	**10,301.94**
	3.11%	9.79%	11.53%	15.52%	**9.70%**	2.73%	15.62%	10.00%	9.86%	**8.01%**
St. Charles	7,649.32	461.25	8,119.75	3,043.73	**19,274.05**	7,369.86	626.90	7,761.68	2,178.97	**17,937.41**
	16.80%	4.37%	10.21%	11.58%	**11.91%**	18.36%	9.22%	12.77%	10.40%	**13.94%**
Jefferson	7,016.40	383.49	5,476.95	1,199.29	**14,076.13**	5,608.14	368.80	4,600.80	886.91	**11,464.65**
	15.41%	3.63%	6.89%	4.56%	**8.70%**	13.97%	5.43%	7.57%	4.23%	**8.91%**
Franklin	9,178.19	282.40	4,187.48	3,056.58	**16,704.65**	9,898.13	227.38	2,896.06	1,712.41	**14,733.98**
	20.16%	2.67%	5.27%	11.63%	**10.32%**	24.66%	3.35%	4.77%	8.17%	**11.45%**
Lincoln	37.29	74.97	1,398.85	1,166.46	**2,677.57**	29.56	89.00	1,326.74	618.41	**2,063.71**
	0.08%	0.71%	1.76%	4.44%	**1.65%**	0.07%	1.31%	2.18%	2.95%	**1.60%**
Warren	10.24	78.27	1,740.09	385.24	**2,213.84**	0.11	57.09	1,553.57	298.03	**1,908.80**
	0.02%	0.74%	2.19%	1.47%	**1.37%**	0.00%	0.84%	2.56%	1.42%	**1.48%**
Missouri MSA	**31,150.79**	**4,533.78**	**64,073.85**	**22,274.27**	**122,032.69**	**29,113.36**	**5,111.68**	**48,624.54**	**14,172.93**	**97,022.51**
	68.43%	**42.94%**	**80.59%**	**84.77%**	**75.39%**	**72.54%**	**75.20%**	**80.01%**	**67.65%**	**75.42%**
	2008 NO_X Emissions (Tons/Year)					2011 NO_X Emissions (Tons/Year)				
Illinois	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**
Clinton	2,338.04	747.56	1,050.72	588.95	**4,725.27**	3,025.57	131.99	688.74	750.24	**4,596.53**
	5.14%	7.08%	1.32%	2.24%	**2.92%**	7.54%	1.94%	1.13%	3.58%	**3.57%**
Jersey	0.04	319.44	513.01	281.28	**1,113.77**	-	67.98	323.13	466.31	**857.42**
	0.00%	3.03%	0.65%	1.07%	**0.69%**	0.00%	1.00%	0.53%	2.23%	**0.67%**
Madison	11,384.21	1,869.27	6,722.10	1,586.61	**21,562.18**	7,648.65	731.19	5,411.02	2,258.69	**16,049.56**
	25.01%	17.70%	8.46%	6.04%	**13.32%**	19.06%	10.76%	8.90%	10.78%	**12.48%**
Monroe	10.86	1,328.75	832.78	359.07	**2,531.46**	8.25	108.04	654.08	1,452.80	**2,223.18**
	0.02%	12.58%	1.05%	1.37%	**1.56%**	0.02%	1.59%	1.08%	6.93%	**1.73%**
St. Clair	635.92	1,759.76	6,309.87	1,187.16	**9,892.71**	337.23	646.36	5,069.61	1,848.07	**7,901.27**
	1.40%	16.67%	7.94%	4.52%	**6.11%**	0.84%	9.51%	8.34%	8.82%	**6.14%**
Illinois MSA	**14,369.07**	**6,024.78**	**15,428.48**	**4,003.07**	**39,825.39**	**11,019.69**	**1,685.57**	**12,146.58**	**6,776.12**	**31,627.96**
	31.57%	**57.06%**	**19.41%**	**15.23%**	**24.61%**	**27.46%**	**24.80%**	**19.99%**	**32.35%**	**24.58%**
MSA Total	**45,519.86**	**10,558.56**	**79,502.33**	**26,277.34**	**161,858.08**	**40,133.05**	**6,797.25**	**60,771.12**	**20,949.05**	**128,650.47**

* Note: The percentages listed in the table above indicate each area's percentage of the total IL/MO St. Louis MSA NO_X emissions during the applicable year for the applicable source category.

Table 5 SO_X Emissions and Percentages by County and Source Category in the Illinois/Missouri St. Louis MSA in 2008 and 2011										
	2008 SO_X Emissions (Tons/Year)					2011 SO_X Emissions (Tons/Year)				
Missouri	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**
St. Louis	20,861.90	5,445.70	242.70	329.92	**26,880.22**	15,315.56	141.63	112.61	239.45	**15,809.25**
	9.18%	44.96%	45.54%	56.18%	**11.18%**	11.02%	25.17%	38.01%	50.92%	**11.27%**
St. Louis City	5,729.67	3,273.63	68.87	101.01	**9,173.18**	3,030.44	52.31	28.69	28.29	**3,139.73**
	2.52%	27.03%	12.92%	17.20%	**3.82%**	2.18%	9.30%	9.68%	6.02%	**2.24%**
St. Charles	48,595.17	895.18	55.44	57.55	**49,603.34**	5,323.84	33.58	34.81	49.67	**5,441.90**
	21.39%	7.39%	10.40%	9.80%	**20.63%**	3.83%	5.97%	11.75%	10.56%	**3.88%**
Jefferson	68,569.28	904.61	36.88	19.29	**69,530.06**	43,702.04	35.11	20.45	20.04	**43,777.64**
	30.18%	7.47%	6.92%	3.28%	**28.92%**	31.45%	6.24%	6.90%	4.26%	**31.20%**
Franklin	57,944.69	991.04	30.12	36.52	**59,002.37**	57,948.83	37.28	13.14	25.81	**58,025.06**
	25.50%	8.18%	5.65%	6.22%	**24.54%**	41.70%	6.63%	4.43%	5.49%	**41.36%**
Lincoln	0.06	87.53	9.36	29.67	**126.62**	0.04	16.00	10.88	12.11	**39.03**
	0.00%	0.72%	1.76%	5.05%	**0.05%**	0.00%	2.84%	3.67%	2.58%	**0.03%**
Warren	0.06	205.98	9.66	6.79	**222.49**	-	5.36	10.96	7.10	**23.42**
	0.00%	1.70%	1.81%	1.16%	**0.09%**	0.00%	0.95%	3.70%	1.51%	**0.02%**
Missouri MSA	**201,700.83**	**11,803.67**	**453.03**	**580.75**	**214,538.28**	**125,320.75**	**321.27**	**231.54**	**382.47**	**126,256.03**
	88.78%	**97.46%**	**85.01%**	**98.90%**	**89.23%**	**90.18%**	**57.10%**	**78.14%**	**81.34%**	**90.00%**
	2008 SO_X Emissions (Tons/Year)					2011 SO_X Emissions (Tons/Year)				
Illinois	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**
Clinton	414.81	18.28	4.57	1.51	**439.17**	357.78	12.88	3.77	3.70	**378.14**
	0.18%	0.15%	0.86%	0.26%	**0.18%**	0.26%	2.29%	1.27%	0.79%	**0.27%**
Jersey	0.01	8.46	2.16	0.53	**11.16**	-	7.27	1.91	18.10	**27.28**
	0.00%	0.07%	0.41%	0.09%	**0.00%**	0.00%	1.29%	0.64%	3.85%	**0.02%**
Madison	24,956.78	136.62	35.35	2.16	**25,130.91**	13,136.21	101.01	28.49	15.00	**13,280.71**
	10.98%	1.13%	6.63%	0.37%	**10.45%**	9.45%	17.95%	9.62%	3.19%	**9.47%**
Monroe	0.19	34.75	4.40	0.66	**39.99**	0.10	11.17	3.58	38.72	**53.56**
	0.00%	0.29%	0.83%	0.11%	**0.02%**	0.00%	1.98%	1.21%	8.23%	**0.04%**
St. Clair	127.98	109.33	33.40	1.62	**272.34**	147.38	108.99	27.00	12.24	**295.62**
	0.06%	0.90%	6.27%	0.28%	**0.11%**	0.11%	19.37%	9.11%	2.60%	**0.21%**
Illinois MSA	**25,499.77**	**307.44**	**79.88**	**6.48**	**25,893.58**	**13,641.47**	**241.33**	**64.76**	**87.74**	**14,035.30**
	11.22%	**2.54%**	**14.99%**	**1.10%**	**10.77%**	**9.82%**	**42.90%**	**21.86%**	**18.66%**	**10.00%**
MSA Total	**227,200.60**	**12,111.11**	**532.91**	**587.23**	**240,431.86**	**138,962.22**	**562.60**	**296.30**	**470.21**	**140,291.33**

* Note: The percentages listed in the table above indicate each area's percentage of the total IL/MO St. Louis MSA SO_X emissions during the applicable year for the applicable source category.

Table 6 VOC Emissions and Percentages by County and Source Category in the Illinois/Missouri St. Louis MSA in 2008 and 2011										
	2008 VOC Emissions (Tons/Year)					2011 VOC Emissions (Tons/Year)				
Missouri	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**
St. Louis	1,689.72	20,196.53	13,093.35	6,513.17	**41,492.77**	615.49	16,227.59	7,769.30	5,936.10	**30,548.48**
	17.87%	27.66%	42.86%	39.72%	**32.06%**	8.29%	40.58%	39.62%	43.89%	**37.93%**
St. Louis City	1,155.67	7,656.98	3,278.08	1,146.65	**13,237.38**	852.38	5,095.47	1,668.63	985.94	**8,602.42**
	12.22%	10.49%	10.73%	6.99%	**10.23%**	11.49%	12.74%	8.51%	7.29%	**10.68%**
St. Charles	936.97	5,758.92	3,663.73	1,934.74	**12,294.36**	802.09	4,791.81	2,627.92	1,700.07	**9,921.89**
	9.91%	7.89%	11.99%	11.80%	**9.50%**	10.81%	11.98%	13.40%	12.57%	**12.32%**
Jefferson	600.04	3,127.96	2,552.86	914.76	**7,195.62**	483.33	3,157.62	1,637.25	846.05	**6,124.25**
	6.35%	4.28%	8.36%	5.58%	**5.56%**	6.51%	7.90%	8.35%	6.26%	**7.60%**
Franklin	685.48	1,603.65	1,574.13	1,036.21	**4,899.47**	640.66	1,469.19	912.88	918.33	**3,941.06**
	7.25%	2.20%	5.15%	6.32%	**3.79%**	8.63%	3.67%	4.66%	6.79%	**4.89%**
Lincoln	79.04	880.44	744.21	520.81	**2,224.50**	66.11	909.00	494.68	444.22	**1,914.01**
	0.84%	1.21%	2.44%	3.18%	**1.72%**	0.89%	2.27%	2.52%	3.28%	**2.38%**
Warren	171.17	674.21	633.81	272.85	**1,752.04**	206.12	663.71	448.78	231.33	**1,549.94**
	1.81%	0.92%	2.07%	1.66%	**1.35%**	2.78%	1.66%	2.29%	1.71%	**1.92%**
Missouri MSA	**5,318.09**	**39,898.69**	**25,540.17**	**12,339.19**	**83,096.14**	**3,666.18**	**32,314.39**	**15,559.44**	**11,062.04**	**62,602.05**
	56.24%	**54.64%**	**83.60%**	**75.24%**	**64.20%**	**49.41%**	**80.82%**	**79.34%**	**81.80%**	**77.73%**
	2008 VOC Emissions (Tons/Year)					2011 VOC Emissions (Tons/Year)				
Illinois	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**
Clinton	155.87	4,583.87	428.35	959.02	**6,127.11**	208.70	623.59	253.05	338.31	**1,423.65**
	1.65%	6.28%	1.40%	5.85%	**4.73%**	2.81%	1.56%	1.29%	2.50%	**1.77%**
Jersey	9.74	4,445.62	208.14	336.64	**5,000.14**	7.44	377.85	129.21	166.99	**681.49**
	0.10%	6.09%	0.68%	2.05%	**3.86%**	0.10%	0.94%	0.66%	1.23%	**0.85%**
Madison	3,215.56	9,849.25	2,116.34	1,459.46	**16,640.61**	2,985.15	3,230.54	1,762.02	1,059.03	**9,036.73**
	34.01%	13.49%	6.93%	8.90%	**12.86%**	40.23%	8.08%	8.99%	7.83%	**11.22%**
Monroe	18.17	4,988.85	264.60	340.76	**5,612.38**	15.05	514.86	232.92	182.31	**945.14**
	0.19%	6.83%	0.87%	2.08%	**4.34%**	0.20%	1.29%	1.19%	1.35%	**1.17%**
St. Clair	738.10	9,259.40	1,994.64	964.34	**12,956.47**	537.71	2,924.06	1,673.50	714.89	**5,850.16**
	7.81%	12.68%	6.53%	5.88%	**10.01%**	7.25%	7.31%	8.53%	5.29%	**7.26%**
Illinois MSA	**4,137.43**	**33,127.00**	**5,012.06**	**4,060.22**	**46,336.71**	**3,754.04**	**7,670.91**	**4,050.70**	**2,461.52**	**17,937.17**
	43.76%	**45.36%**	**16.40%**	**24.76%**	**35.80%**	**50.59%**	**19.18%**	**20.66%**	**18.20%**	**22.27%**
MSA Total	**9,455.52**	**73,025.69**	**30,552.23**	**16,399.41**	**129,432.85**	**7,420.22**	**39,985.30**	**19,610.14**	**13,523.56**	**80,539.22**

* Note: The percentages listed in the table above indicate each area's percentage of the total IL/MO St. Louis MSA VOC emissions during the applicable year for the applicable source category.

Table 7 NH_3 Emissions and Percentages by County and Source Category in the Illinois/Missouri St. Louis MSA in 2008 and 2011										
	2008 NH_3 Emissions (Tons/Year)					2011 NH_3 Emissions (Tons/Year)				
Missouri	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**
St. Louis	720.41	1,036.69	582.99	7.33	**2,347.42**	666.26	718.37	369.32	7.46	**1,761.41**
	50.90%	8.51%	43.02%	36.28%	**15.68%**	54.31%	6.41%	38.09%	36.46%	**13.12%**
St. Louis City	568.40	129.50	169.20	2.21	**869.31**	514.75	148.42	94.89	1.47	**759.53**
	40.16%	1.06%	12.49%	10.94%	**5.81%**	41.96%	1.32%	9.79%	7.18%	**5.66%**
St. Charles	8.04	883.43	132.82	2.58	**1,026.87**	4.78	899.54	113.53	2.46	**1,020.31**
	0.57%	7.25%	9.80%	12.77%	**6.86%**	0.39%	8.02%	11.71%	12.02%	**7.60%**
Jefferson	8.97	165.26	90.42	1.06	**265.71**	7.61	175.35	66.35	1.03	**250.34**
	0.63%	1.36%	6.67%	5.25%	**1.77%**	0.62%	1.56%	6.84%	5.03%	**1.86%**
Franklin	2.82	1,300.09	77.75	1.74	**1,382.40**	3.07	1,265.49	43.05	1.23	**1,312.84**
	0.20%	10.67%	5.74%	8.61%	**9.23%**	0.25%	11.29%	4.44%	6.01%	**9.78%**
Lincoln	-	1,010.92	22.93	0.79	**1,034.64**	-	863.00	18.42	0.58	**882.00**
	0.00%	8.30%	1.69%	3.91%	**6.91%**	0.00%	7.70%	1.90%	2.83%	**6.57%**
Warren	0.77	681.24	28.70	0.34	**711.05**	-	647.55	21.77	0.32	**669.64**
	0.05%	5.59%	2.12%	1.68%	**4.75%**	0.00%	5.78%	2.25%	1.56%	**4.99%**
Missouri MSA	**1,309.41**	**5,207.13**	**1,104.81**	**16.05**	**7,637.40**	**1,196.47**	**4,717.72**	**727.33**	**14.55**	**6,656.07**
	92.52%	**42.75%**	**81.53%**	**79.43%**	**51.02%**	**97.53%**	**42.08%**	**75.01%**	**71.11%**	**49.56%**
	2008 NH_3 Emissions (Tons/Year)					2011 NH_3 Emissions (Tons/Year)				
Illinois	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**	**Point**	**Area**	**On-Road**	**Non-Road**	**Total**
Clinton	0.33	3,124.86	16.84	0.48	**3,142.51**	0.31	2,995.71	14.31	0.64	**3,010.98**
	0.02%	25.66%	1.24%	2.36%	**20.99%**	0.03%	26.72%	1.48%	3.15%	**22.42%**
Jersey	-	546.91	8.09	0.25	**555.24**	-	490.11	7.36	0.39	**497.86**
	0.00%	4.49%	0.60%	1.24%	**3.71%**	0.00%	4.37%	0.76%	1.92%	**3.71%**
Madison	82.99	1,233.37	109.94	1.74	**1,428.04**	23.49	1,113.03	106.17	2.21	**1,244.90**
	5.86%	10.13%	8.11%	8.63%	**9.54%**	1.91%	9.93%	10.95%	10.79%	**9.27%**
Monroe	0.12	870.42	13.77	0.34	**884.65**	0.16	808.97	13.52	0.92	**823.57**
	0.01%	7.15%	1.02%	1.66%	**5.91%**	0.01%	7.21%	1.39%	4.49%	**6.13%**
St. Clair	22.43	1,196.94	101.72	1.35	**1,322.45**	6.29	1,087.04	100.90	1.75	**1,195.97**
	1.59%	9.83%	7.51%	6.66%	**8.83%**	0.51%	9.69%	10.41%	8.54%	**8.91%**
Illinois MSA	**105.87**	**6,972.50**	**250.36**	**4.16**	**7,332.89**	**30.25**	**6,494.86**	**242.25**	**5.91**	**6,773.28**
	7.48%	**57.25%**	**18.47%**	**20.57%**	**48.98%**	**2.47%**	**57.92%**	**24.99%**	**28.89%**	**50.44%**
MSA Total	**1,415.28**	**12,179.63**	**1,355.17**	**20.21**	**14,970.29**	**1,226.72**	**11,212.58**	**969.58**	**20.46**	**13,429.35**

* Note: The percentages listed in the table above indicate each area's percentage of the total IL/MO St. Louis MSA NH_3 emissions during the applicable year for the applicable source category.

3.2 Emission Source Location

Emissions source location is important to determine if particular sources are impacting the concentrations at violating monitoring sites. Figure 3 provides a map with point sources in the Illinois/Missouri St. Louis MSA along with the location of the Granite City monitor. The map also includes one source located in the Baldwin Township of Randolph County, Illinois because this area was included in the 1997 St. Louis IL/MO $PM_{2.5}$ nonattainment area, and there is a significant emissions source located here. Each of the sources included in Figure 3 are numbered. These numbers correspond to the sources, which are listed according to these numbers in Table 8 along with the numeric emissions in 2011 for each of these sources. Table 8 also provides the distance in miles from each of these sources to the Granite City monitor.

Sources on the map include point sources with emissions in 2011 of 100 or more tons of direct $PM_{2.5}$ or any individual $PM_{2.5}$ precursor. The sources are sized by the total sum of all direct $PM_{2.5}$ and $PM_{2.5}$ precursor emissions in 2011. The smaller points indicate sources with fewer emissions, while the larger points on the map indicate sources with higher emissions as indicated in the legend. Missouri sources are shown in red on the map, while Illinois sources are shown in blue. The green dot on the map indicates the location of the Granite City monitor. Figure 4 provides a map with the same sources as Figure 3, but breaks the emissions from these sources into pollutant categories in order to show the specific pollutant(s) that is relevant to each source.

Figure 3

MO - IL 1997 PM 2.5 Nonattainment Area with Sources Sized by Sum of Total 2011 Direct and Precursor PM 2.5 Emissions (NH3, NOx, PM 2.5, SO2, VOC) With Granite City Monitor

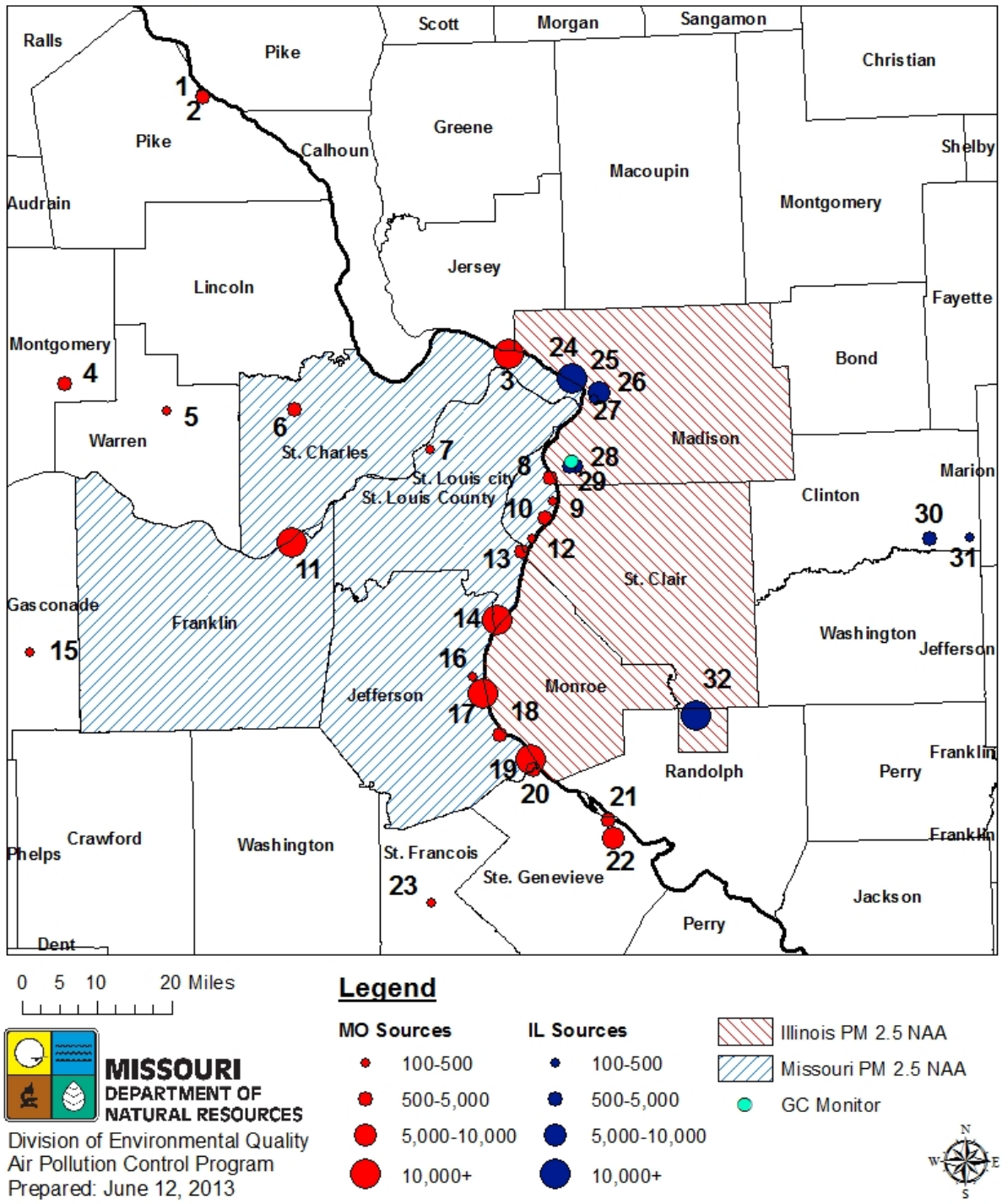


Figure 4

MO - IL 1997 PM 2.5 Nonattainment Area with Sources of Direct and Precursor PM 2.5 Emissions Breakdown (NH3, NOx, PM 2.5, SO2, VOC) (2011) With Granite City Monitor

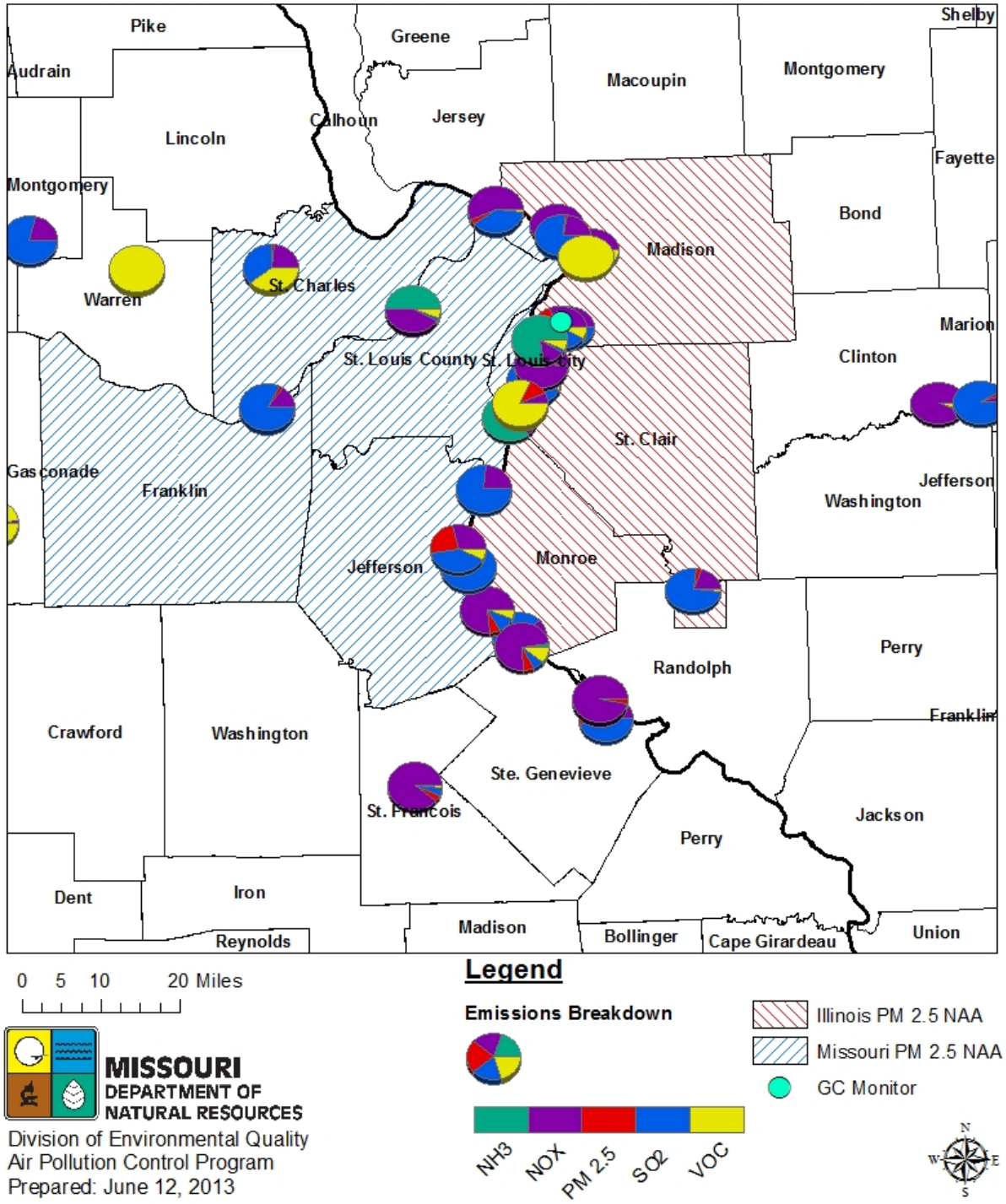


Table 8 **2011 Facility Level $PM_{2.5}$ and $PM_{2.5}$ Precursor Emissions (tons/year) from Significant Point Sources in the St. Louis Area (Sources with 100 + annual tons of emissions of Direct $PM_{2.5}$ or any Individual $PM_{2.5}$ Precursor) ***

Missouri Facilities								
Figure 3 Map Number	County Name	Facility Name	NH_3	NO_X	PM_{25}-PRI	SO_2	VOC	Distance to Granite City Monitor (mi.)
1	Pike	ASHLAND INC-MISSOURI CHEMICAL WORKS	2.68	295.33	7.67	1,835.56	58.76	69.32
			0.19%	0.65%	0.14%	0.81%	0.62%	
2	Pike	DYNO NOBEL INC-LOMO PLANT	20.59	462.41	52.99	0.02	0.16	69.32
			1.45%	1.02%	0.98%	0.00%	0.00%	
3	St. Charles	AMEREN MISSOURI-SIOUX PLANT	0.8	7,073.99	413.53	4,899.10	156.51	16.61
			0.06%	15.54%	7.62%	2.16%	1.66%	
4	Montgomery	CHRISTY MINERALS, LLC-HIGH HILL	-	147.7	0.1	549.5	-	68.45
			-	0.32%	0.00%	0.24%	-	
5	Warren	CASCADES PLASTICS INC-WARRENTON	-	-	-	-	163.27	54.5
			-	-	-	-	1.73%	
6	St. Charles	GENERAL MOTORS LLC-WENTZVILLE CENTER	0.31	270.5	26.16	424.24	480.06	37.64
			0.02%	0.59%	0.48%	0.19%	5.08%	
7	St. Louis	MSD, MISSOURI RIVER WWTP-MO RIVER WASTERWATER TREATMENT PLANT	103.16	89.32	0.27	3.66	11.12	19.10
			7.29%	0.20%	0.00%	0.00%	0.12%	
8	St. Louis city	METROPOLITAN ST. LOUIS SEWER DISTRICT-BISSELL POINT WWTP	476.95	80.58	3.44	15.47	40.2	3.67
			33.70%	0.18%	0.06%	0.01%	0.43%	
9	St. Louis city	HERTZ ST. LOUIS ONE, LLC-LACLEDE GAS BUILDING	-	197.05	1.68	0.05	2.57	5.98
			-	0.43%	0.03%	0.00%	0.03%	
10	St. Louis city	ANHEUSER-BUSCH INC-ST. LOUIS	31.8	467.42	158.07	2,998.41	215.07	8.40
			2.25%	1.03%	2.91%	1.32%	2.27%	
11	Franklin	AMEREN MISSOURI-LABADIE PLANT	3.04	9,891.46	1,712.14	57,948.81	323.15	39.00
			0.21%	21.73%	31.53%	25.51%	3.42%	
12	St. Louis city	JW ALUMINUM-ST. LOUIS	-	21.63	36.66	0.16	275.68	11.65
			0.00%	0.05%	0.68%	0.00%	2.92%	
13	St. Louis	METROPOLITAN ST. LOUIS SEWER DISTRICT-LEMAY WWTP	467.9	44.39	1.6	1.78	16.11	13.82
			33.06%	0.10%	0.03%	0.00%	0.17%	
14	St. Louis	AMEREN MISSOURI-MERAMEC PLANT	1.13	4,789.24	171.93	15,281.50	105.65	23.42
			0.08%	10.52%	3.17%	6.73%	1.12%	
15	Gasconade	RR DONNELLEY - OWENSVILLE-OWENSVILLE	0.06	1.84	0.14	0.01	122.75	76.82
			0.00%	0.00%	0.00%	0.00%	1.30%	
16	Jefferson	SAINT-GOBAIN CONTAINERS INC-PEVELY	-	107.22	87.02	149.07	26.35	31.66
			-	0.24%	1.60%	0.07%	0.28%	

Missouri Facilities continued…								
Figure 3 Map Number	**County Name**	**Facility Name**	**NH_3**	**NO_X**	**PM_{25}-PRI**	**SO_2**	**VOC**	**Distance to Granite City Monitor (mi.)**
17	Jefferson	DOE RUN COMPANY-HERCULANEUM SMELTER	0.29	9.6	4.35	15,234.49	1.71	33.22
			0.02%	0.02%	0.08%	6.71%	0.02%	
18	Jefferson	RIVER CEMENT CO. DBA BUZZI UNICEM USA-SELMA PLANT	5.85	2,029.21	168.35	282.62	151.57	37.71
			0.41%	4.46%	3.10%	0.12%	1.60%	
19	Jefferson	AMEREN MISSOURI-RUSH ISLAND PLANT	1.4	3,441.72	246.31	28,035.57	149.11	40.16
			0.10%	7.56%	4.54%	12.34%	1.58%	
20	Ste. Genevieve	HOLCIM (US) INC-STE. GENEVIEVE PLANT	54.27	1,975.59	194.9	170.63	279.9	41.52
			3.83%	4.34%	3.59%	0.08%	2.96%	
21	Ste. Genevieve	LHOIST NORTH AMERICA OF MISSOURI-STE. GENEVIEVE	-	1,262.89	36.64	9.98	7.77	48.07
			-	2.77%	0.67%	0.00%	0.08%	
22	Ste. Genevieve	MISSISSIPPI LIME COMPANY-STE. GENEVIEVE	0.01	3,630.42	576.67	3,536.37	53.79	50.54
			0.00%	7.98%	10.62%	1.56%	0.57%	
23	St. Francois	PIRAMAL GLASS USA INC-PARK HILLS	3.31	363.23	15.88	19.01	6.27	61.75
			0.23%	0.80%	0.29%	0.01%	0.07%	
Illinois Facilities								
Figure 3 Map Number	**County Name**	**Facility Name**	**NH_3**	**NO_X**	**PM_{25}-PRI**	**SO_2**	**VOC**	**Distance to Granite City Monitor (mi.)**
24	Madison	Alton Steel Inc.	0.71	131.94	9.14	45.9	3.99	12.34
			0.05%	0.29%	0.17%	0.02%	0.04%	
25	Madison	Dynegy Midwest Generation Inc.	0.62	2,490.76	172.51	8,556.18	60.26	11.00
			0.04%	5.47%	3.18%	3.77%	0.64%	
26	Madison	ConocoPhillips Co	0.17	2,909.80	209.09	1,814.49	1,844.48	9.89
			0.01%	6.39%	3.85%	0.80%	19.51%	
27	Madison	Explorer Pipeline Co	-	-	-	-	120.96	8.79
			-	-	-	-	1.28%	
28	Madison	Gateway Energy & Coke Co LLC	-	406.73	69.46	1,201.41	10.57	0.73
			-	0.89%	1.28%	0.53%	0.11%	
29	Madison	US Steel Granite City	9.07	1,188.86	747.65	1,430.43	293.06	0.82
			0.64%	2.61%	13.77%	0.63%	3.10%	
30	Clinton	Natural Gas Pipeline Co of America	0.09	2,989.76	35.72	0.45	170.05	48.78
			0.01%	6.57%	0.66%	0.00%	1.80%	
31	Clinton	W G Murray Development Center	-	22.79	11.54	355.47	0.16	53.98
			-	0.05%	0.21%	0.16%	0.00%	
32	Randolph	Dynegy Midwest Generation Inc.	128.84	4,771.57	941.17	19,066.03	353.63	37.77
			9.10%	10.48%	17.33%	8.39%	3.74%	

* Note: The percentages listed above indicate each source's percentage of the total 2011 point source emissions in the IL/MO St. Louis MSA for the applicable pollutant.

3.3 Local Emissions Sources in Granite City, Illinois

Figure 5 displays a satellite image of the Granite City area. This map shows the location of the Gateway Energy and Coke Company LLC facility (property boundary outlined in blue) along with the US Steel Granite City facility (property boundary outlined in red) with their proximity to the violating Granite City monitor. As depicted in the map, these two sources are each located less than one mile from the Granite City monitor, with U.S. Steel's operations wrapping around the monitor to the southeast, south, and southwest, and Gateway Energy Coke Company located less than one mile to the southeast of the monitor. The geographic location of these two sources relative to the Granite City monitor will be considered along with meteorology data in the next Section.

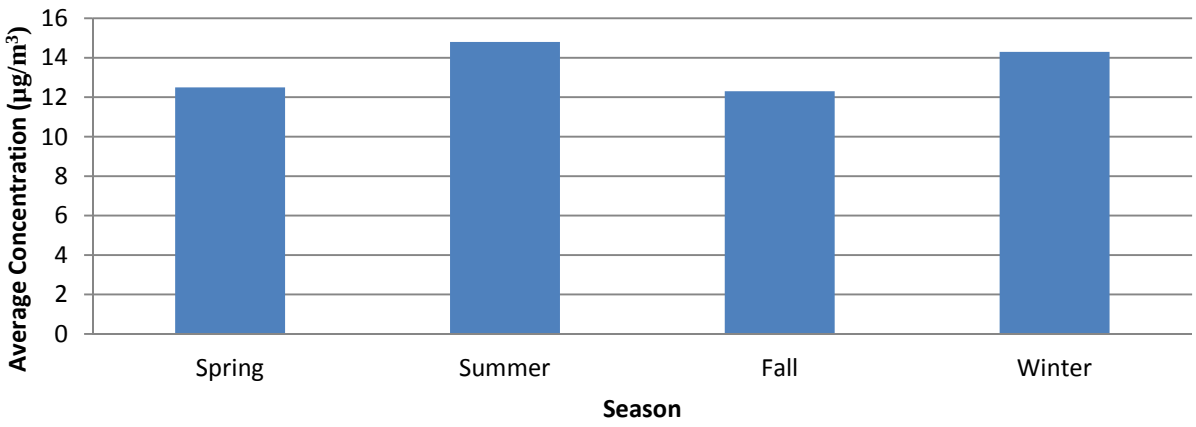
Figure 5 Satellite Image of the Granite City Monitor with Significant Local Emissions Sources' Property Boundaries

4. Meteorology Data

4.1 Seasonal Variation

In an effort to more fully understand the impacts that meteorology has on $PM_{2.5}$ concentrations at this site, the Air Program analyzed the seasonal average $PM_{2.5}$ concentrations at the Granite City monitor from 2010 – 2012. For the purposes of this analysis, the months of December – February were considered winter months, the months of March – May were considered spring months, the months of June – August were considered summer months, and the months of September – November were considered fall months. Figure 6 displays the average seasonal $PM_{2.5}$ concentrations at the Granite City monitor from 2010 – 2012. As can be seen, during the winter and summer months $PM_{2.5}$ concentrations averaged over 14 micrograms/cubic meter ($\mu g/m^3$), and during the spring and fall months the $PM_{2.5}$ concentrations averaged just over 12 $\mu g/m^3$. Therefore, the meteorological conditions during the summer and winter are slightly more conducive to higher $PM_{2.5}$ concentrations in Granite City than meteorological conditions during the spring and fall. However, as indicated in Figure 6, the average $PM_{2.5}$ concentrations at the Granite City monitor from 2010 - 2012, are above the level of the NAAQS in all four seasons, and therefore any analysis of $PM_{2.5}$ concentrations or contributing sources at this site must take into consideration a full year's worth of data.

Figure 6 Granite City Average $PM_{2.5}$ Concentrations by Season (2010 - 2012)



4.2 Wind Rose Data

The next step in the evaluation was to determine the emission source origins on days with high and low $PM_{2.5}$ concentrations at the Granite City monitor. For each date in Table 1, hourly wind speed and direction data was gathered from the International Airport Weather Station at the St. Louis Regional Airport in Cahokia, IL. Figure 7 displays the wind rose for all of the hours in the days where the Granite City monitor recorded its highest 5 percent $PM_{2.5}$ concentrations during the years 2010 – 2012. As seen in Figure 7, calms represent 50% of the hours during the high days at the Granite City monitor for the years evaluated. These calm winds indicate that emissions from local sources are not dissipating from the area and are most likely impacting the monitored $PM_{2.5}$ concentrations significantly. Nearly all of the remaining hours are associated with low wind speeds coming from the south and southeast. As shown in Figure 5, there are two point sources with significant direct $PM_{2.5}$ emissions located within one mile of the Granite City monitor. These two sources surround the area southwest, south, and southeast of the monitor. The proximity of these two sources to the Granite City monitor combined with the calm and low speeds coming from the south and southeast indicates that $PM_{2.5}$ concentrations in the area are likely greatly impacted by these two sources. This conclusion is further investigated and supported in Section 5, where daily monitoring values at locations upwind and downwind of the two sources in Granite City are evaluated on these same days.

In an effort to further understand the cause of elevated concentrations at the Granite City monitor, the wind directions were also evaluated on days where Granite City recorded its lowest $PM_{2.5}$ concentrations. Figure 8 displays the wind rose for all of the hours in the days where the Granite City monitor recorded its lowest 5 percent $PM_{2.5}$ concentrations during the years 2010 – 2012. As seen in Figure 8, calms only represented 10% of the hours during these days and virtually all of the lowest concentrations of $PM_{2.5}$ at Granite City are associated with higher wind speeds blowing from the Northwest quadrant. Looking on the map, the counties located to the northwest of the Granite City monitor include the northern part of St. Louis city, St. Louis County, and St. Charles County. However, of greater relevance is the fact that when wind is blowing from the northwest, the Granite City monitor is upwind of the two point sources in Illinois located within one mile to the south of the monitor. Thus, when winds are blowing emissions from these two sources away from the monitor, it results in the lowest $PM_{2.5}$ concentrations recorded at the site. This supports the conclusion that the elevated concentrations recorded at this site are the result of these two sources, and that Missouri sources are not likely contributing to the violation at this monitor.

Figure 7 Wind Directions and Speeds for All Hours of the Day on High $PM_{2.5}$ Concentration Days at Granite City in 2010 – 2012

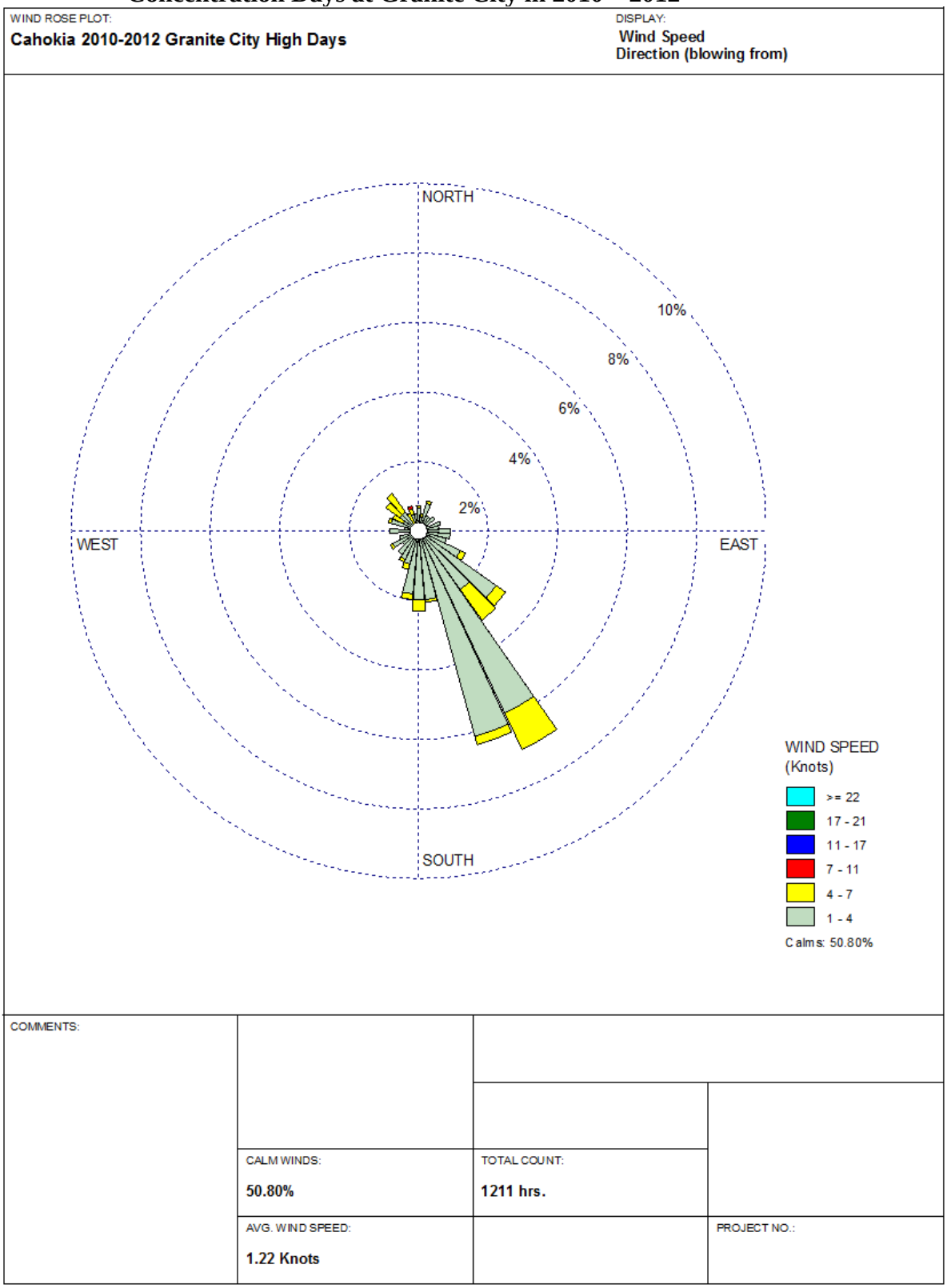
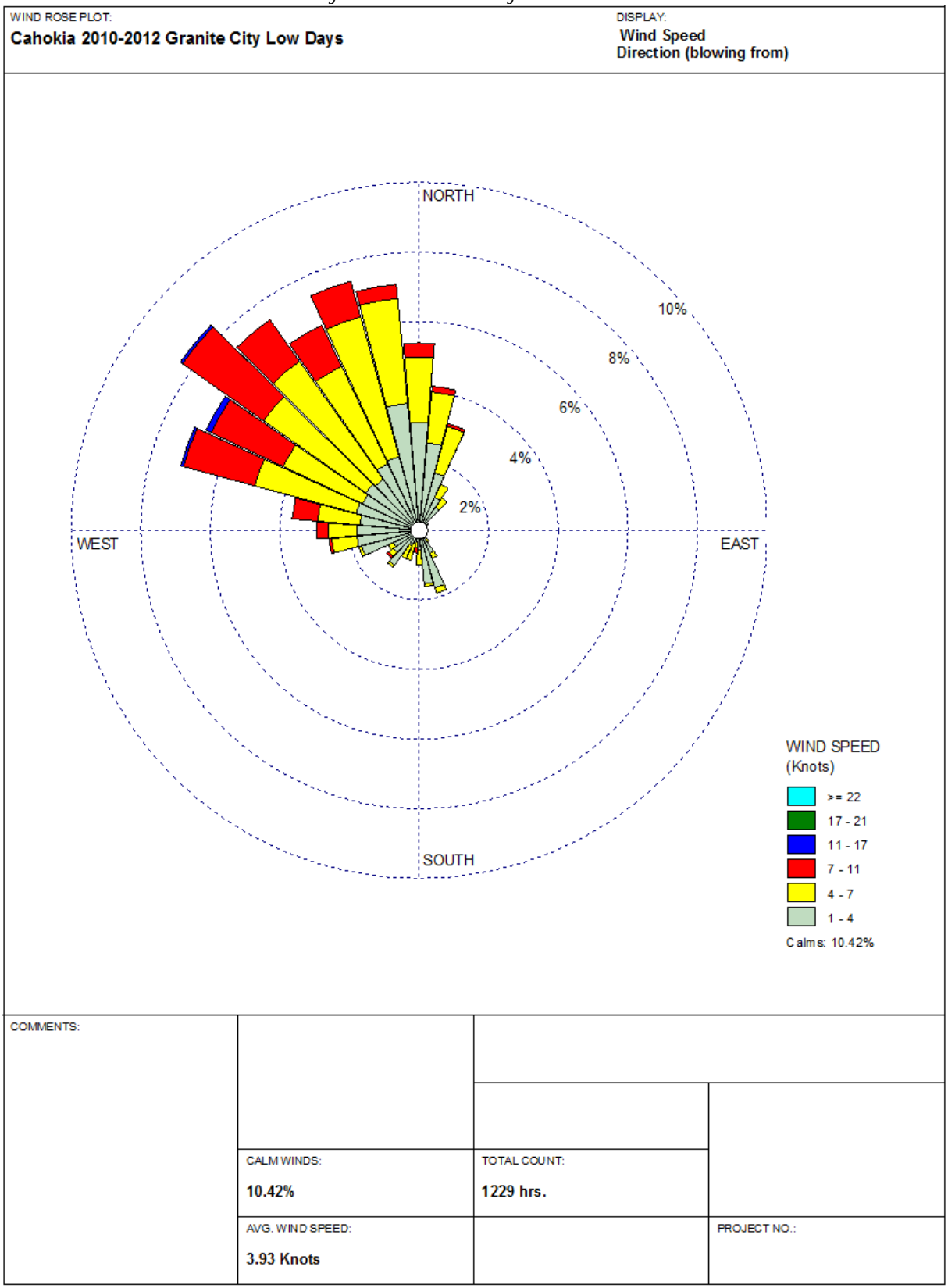


Figure 8 Wind Directions and Speeds for All Hours of the Day on Low $PM_{2.5}$ Concentration Days at Granite City in 2010 – 2012



4.3 HYSPLIT Modeling

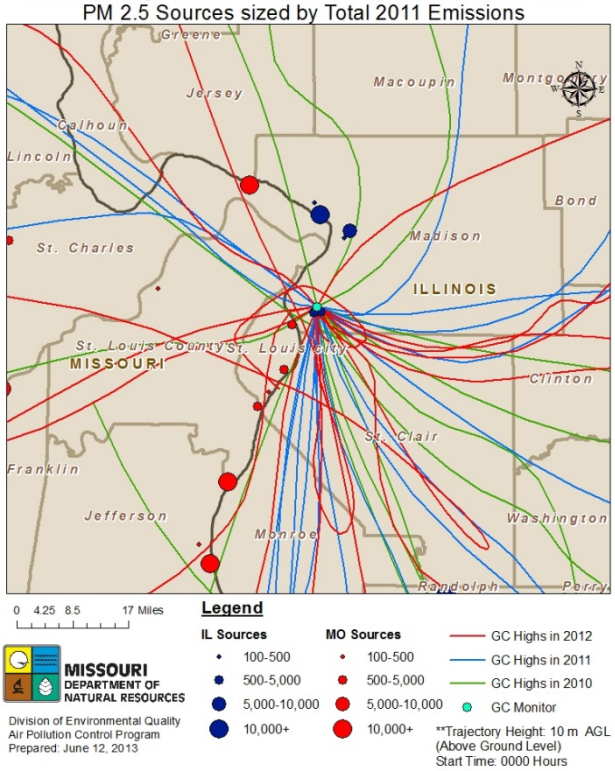
The Air Program also evaluated 24-hour back trajectories of the air masses on both the high days and low days recorded at the Granite City monitor from 2010 – 2012. In order to perform this analysis, the back trajectories were generated with the Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT). This model is capable of back casting the path that an air mass traveled through prior to arriving at a specific location at a specific point in time. HYSPLIT was used to generate the paths that the air masses came from at the beginning, middle, and end of each day listed in Table 1. It is important to note, that HYSPLIT generates the wind trajectory for a parcel of air at a specific location for one specific point in time. By using HYSPLIT to generate the back trajectories for these three times of the day and considering them all together, it can help determine how air masses were moving over the region during the episode days evaluated. However, because the $PM_{2.5}$ concentrations evaluated are based on a 24-hour average, back casting the wind trajectories from these three specific points in time during the episode days does not necessarily capture the specific path that the air mass traveled prior to the specific point in time of each day when $PM_{2.5}$ concentrations were at their peak.

Figures 9 and 10 give the back trajectories at 12:00 in the morning, 12:00 noon, and 11:00 p.m. for each of the high $PM_{2.5}$ and low $PM_{2.5}$ days respectively, as listed in Table 1. These figures also display the largest point sources located in the Illinois/Missouri MSA along with the location of the Granite City Monitor for reference. As seen in Figure 9, from 2010 – 2012 the high days are generally associated with air masses traveling from the Southeast and passing over the two Illinois point sources located nearby to the southwest and southeast of the Granite City monitor. It is noted that on a few of the high days, HYSPLIT indicates that air masses were traveling from the southwest and passed over Missouri sources along the Mississippi River on the days in question. However, when winds are blowing out of the southwest, the air masses always pass over the Illinois source located just southwest of the Granite City monitor (U.S. Steel), thus increasing the $PM_{2.5}$ concentration levels of the air mass before they reach the Granite City monitor. Furthermore, as can be seen in Figure 10, from 2010 – 2012 the low days are generally associated with air masses traveling from the Northwest, much of the time passing directly over the northern Missouri portion of the St. Louis MSA, which aligns with the data from the wind rose in Figure 8. Also, as noted above, it is less relevant to analyze where the winds are coming from on low $PM_{2.5}$ concentration days than it is to analyze and understand where they are not coming from on those same days. Just as is indicated by the wind rose data, the HYSPLIT trajectories on the low days show that $PM_{2.5}$ concentrations recorded at the Granite City monitor are lowest when the wind is blowing emissions from the two nearby Illinois sources away from the monitor. Further supporting this conclusion is the fact that there is a cluster of four significant point sources located in Illinois only 10 – 20 miles north of the Granite City monitor, and yet the air masses only pass through this cluster of sources on one (1) or two (2) of high $PM_{2.5}$ concentration days, while the air masses do pass over these sources on a substantial amount of the low $PM_{2.5}$ concentration days at the Granite City monitor. This supports the conclusion that the two sources surrounding the southeast, south, and southwest of the monitor are the controlling factors in the elevated $PM_{2.5}$ concentrations at this site. The meteorology data for both the high $PM_{2.5}$ concentration days and the low $PM_{2.5}$ concentration days supports the conclusion that Missouri sources are not contributing to the violation at the Granite City monitor.

Figure 9 HYSPLIT Wind Trajectories for High $PM_{2.5}$ Concentration Days at Granite City in 2010 – 2012 (12:00 a.m., 12:00 p.m., and 11:00 p.m.)

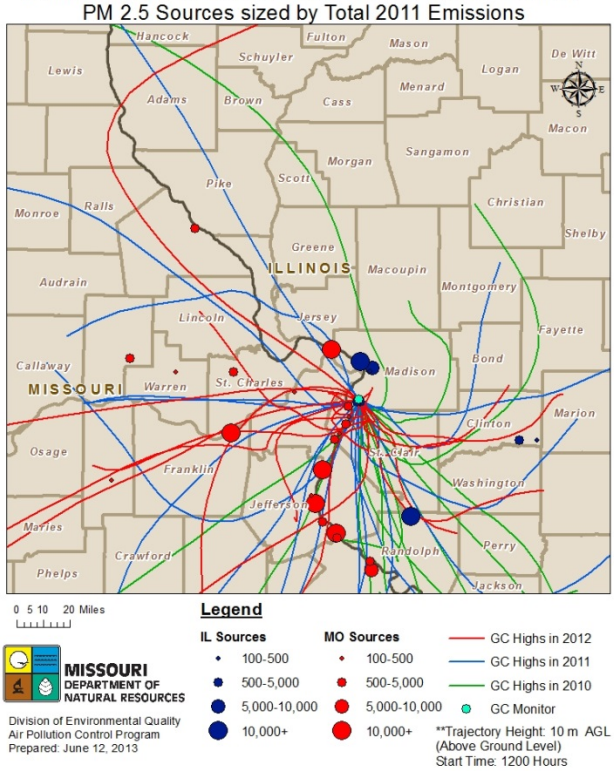
12:00 a.m. (Morning)

PM2.5: 24 Hr Back Trajectories** for Granite City
Monitored Highs in 2010, 2011, 2012, with Direct/Precursor
PM 2.5 Sources sized by Total 2011 Emissions



12:00 p.m. (Noon)

PM2.5: 24 Hr Back Trajectories** for Granite City
Monitored Highs in 2010, 2011, 2012, with Direct/Precursor
PM 2.5 Sources sized by Total 2011 Emissions



11:00 p.m.

PM2.5: 24 Hr Back Trajectories** for Granite City
Monitored Highs in 2010, 2011, 2012, with Direct/Precursor
PM 2.5 Sources sized by Total 2011 Emissions

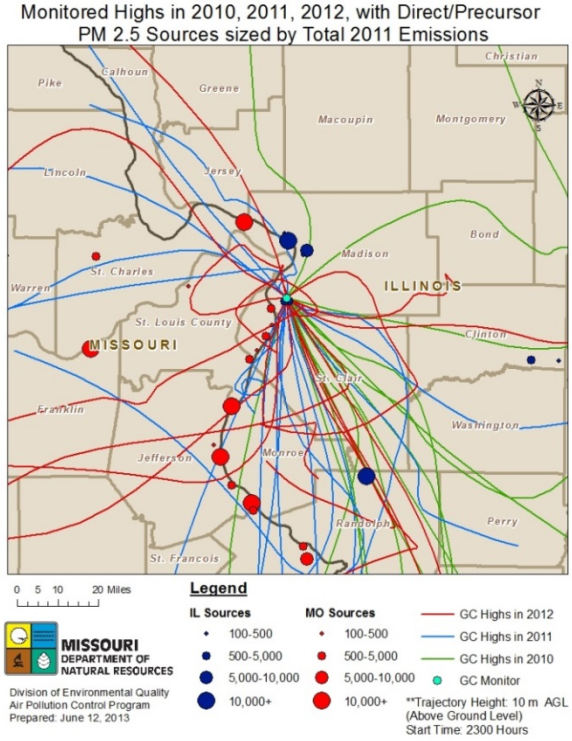
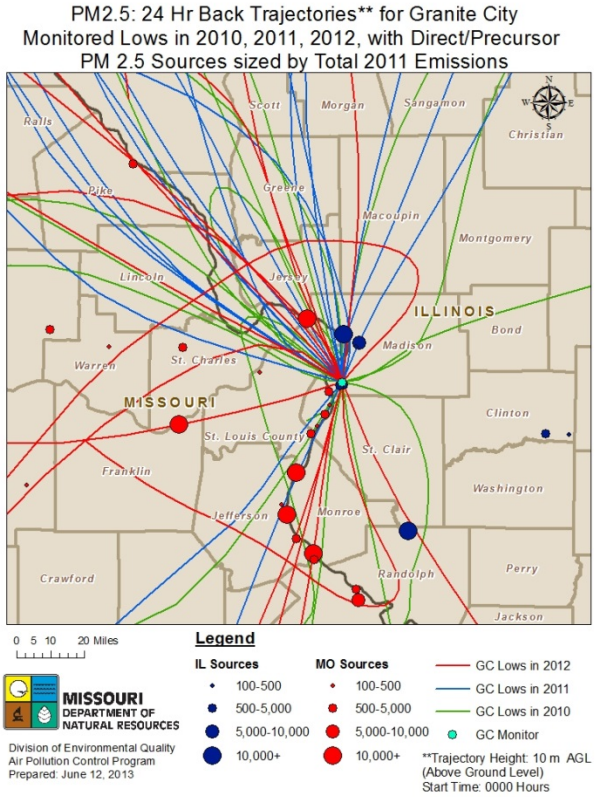
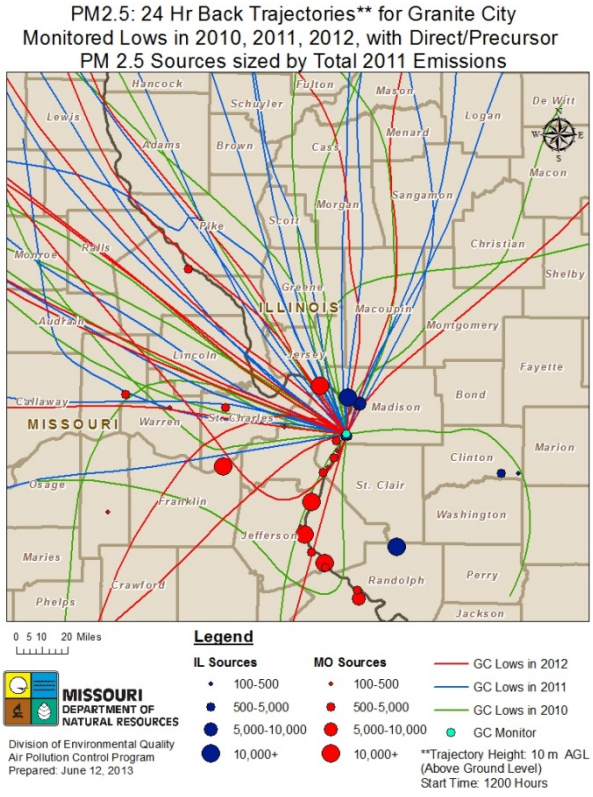


Figure 10 HYSPLIT Wind Trajectories for Low $PM_{2.5}$ Concentration Days at Granite City in 2010 – 2012 (12:00 a.m., 12:00 p.m., and 11:00 p.m.)

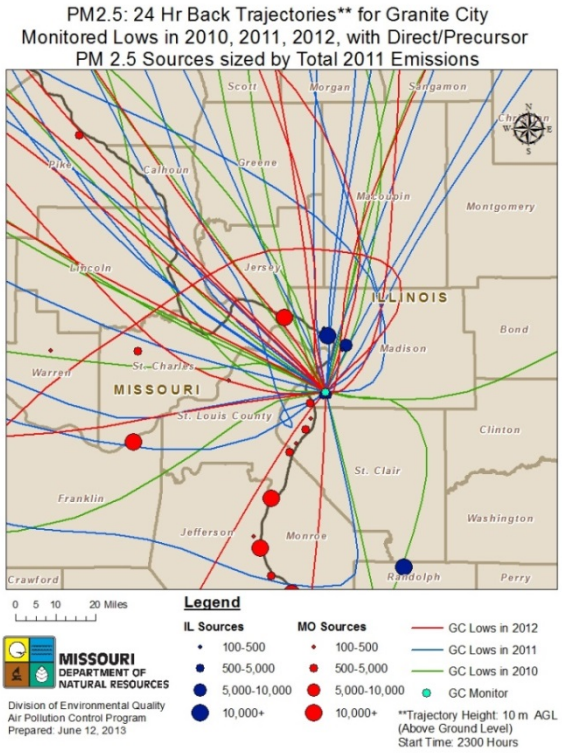
12:00 a.m. (Morning)



12:00 p.m. (Noon)



11:00 p.m.



5. Comparison of $PM_{2.5}$ Concentrations at Blair Street and Granite City

5.1 Comparison of 24-hour $PM_{2.5}$ Concentrations

Table 9 displays the distance in miles between each of the St. Louis area monitors included in Figure 1. As seen in the table, the Blair Street Monitor and the Granite City monitor are 4.6 miles apart. It would be expected that due to the proximity of these two monitors, they would monitor very similar $PM_{2.5}$ concentrations from day to day unless immediate local sources of direct $PM_{2.5}$ or $PM_{2.5}$ precursors are impacting one monitor but not the other. It has already been established in Section 4 of this Appendix that calm and low wind speeds are associated with high $PM_{2.5}$ concentrations in Granite City, which indicates that local emissions sources are responsible for the elevated $PM_{2.5}$ concentrations being recorded by this monitor.

Depending on wind direction, the Blair Street monitor provides relevant upwind or downwind concentrations that can be used for comparison against the concentrations recorded at the Granite City, Illinois site. The Air Program retrieved the 24-hour $PM_{2.5}$ concentrations at the Blair Street and Granite City monitors for the top 5 percent episode days listed in Table 1 and compared these values, which are listed below in Tables 10, 11, and 12 for the years 2010, 2011, and 2012, respectively. As can be seen, the 24-hour values at the highest 5 percent episode days at the Granite City are roughly 10% – 15% higher on average than the 24-hour values recorded at the Blair Street site on those same days. In fact, on a few select days, the concentrations at Granite City are 25% - 100% higher than the concentrations recorded at Blair Street, which have been highlighted in Tables 10 – 12. These outlier days, where the concentrations at Granite City far exceed those recorded at Blair Street, drive the design value at Granite City much higher than it is across the rest of the St. Louis Region. For this reason, wind rose and HYSPLIT trajectory runs were developed for these specific outlier days in an effort to determine the conditions and sources that might be causing these localized episodes that drive the Granite City monitor's design value higher than all other monitors across the St. Louis Region. Figures 11 and 12 display the wind rose and HYSPLIT results, respectively, for these outlier days at Granite City.

As noted in Section 4, the HYSPLIT and wind rose data evaluated indicates that nearly all of the days where the highest $PM_{2.5}$ concentrations were recorded at the Granite City monitor are associated with low to calm wind speeds and air masses traveling from southeast, south, and southwest of the monitor. Monitoring values on these same days average 10% – 15% higher in Granite City when compared to Blair Street. The conclusion is that source(s) located downwind of the Blair Street monitor but upwind of the Granite City monitor are contributing to the Granite City concentrations on the highest $PM_{2.5}$ concentration days, causing $PM_{2.5}$ concentrations in Granite City to exceed the levels experienced across the rest of the St. Louis urban core on these same days. The meteorology data analyzed for the outlier days suggests that when wind speeds are low and air masses are not being transported across the river from either direction, $PM_{2.5}$ concentrations in Granite City are much higher than concentrations experienced only 4.6 miles away at Blair Street just across the river. This is further evidence that the local sources surrounding the Granite City monitor are the predominant cause of a handful of high episode days in Granite City. Further support for these conclusions is discussed below in Subsection 5.3 showing that the average $PM_{2.5}$ concentration is below the level of the 2012 NAAQS during the year in which the U.S. Steel Mill was shutdown, yet above the level of the standard in all other years evaluated.

Table 9. Distance Between Monitors in Miles (St. Louis Area $PM_{2.5}$ Monitoring Network)									
Site Name:	**Arnold West**	**South Broadway**	**Blair Street**	**Branch Street**	**Ladue**	**Alton**	**Wood River**	**East St. Louis**	**Granite City**
Arnold West	X	9.77	17.97	18.26	14.15	34.26	32.54	17.13	22.54
South Broadway	9.77	X	8.61	8.82	8.79	25.72	23.55	7.36	13.04
Blair Street	17.97	8.61	X	0.47	8.22	17.28	14.95	3.7	4.6
Branch Street	18.26	8.82	0.47	X	8.7	17.21	14.8	3.45	4.28
Ladue	14.15	8.79	8.22	8.7	X	20.73	19.63	10.61	12
Alton	34.26	25.72	17.28	17.21	20.73	X	3.55	20.11	13.7
Wood River	32.54	23.55	14.95	14.8	19.63	3.55	X	17.41	10.93
East St. Louis	17.13	7.36	3.7	3.45	10.61	20.11	17.41	X	6.48
Granite City	22.54	13.04	4.6	4.28	12	13.7	10.93	6.48	X

Table 10. Top 5% Days for Granite City vs. Same Day Value for Blair (2010) *		
Date	**Granite City 24-Hour Concentration (µg/m^3)**	**Blair 24-Hour Concentration (µg/m^3)**
3/9/2010	39.0	24.1
2/4/2010	38.1	41.8
2/3/2010	32.4	34.6
8/8/2010	31.9	31.0
12/19/2010	30.0	26.1
1/15/2010	29.3	29.9
12/20/2010	29.2	18.6
8/7/2010	28.8	26.8
1/16/2010	28.4	26.5
12/28/2010	28.1	22.0
2/21/2010	27.8	31.6
4/13/2010	26.7	15.9
1/23/2010	26.2	13.6
8/9/2010	26.1	23.1
12/10/2010	26.1	23.0
12/9/2010	25.9	23.0
3/8/2010	25.4	26.8
Average Value for top 5% at Granite City	**29.4**	**25.8**

* Note: All values have been rounded to the nearest 0.1 µg/m^3

** Note: Outlier days, where the Granite City monitor's 24-hour average concentration is at least 25% higher than the concentration recorded at Blair Street

Table 11. Top 5% Days for Granite City vs. Same Day Value for Blair (2011) *		
Date	**Granite City 24-Hour Concentration (µg/m^3)**	**Blair 24-Hour Concentration (µg/m^3)**
1/28/2011	37.1	35.7
1/17/2011	35.1	31.2
7/16/2011	34.3	31.2
6/8/2011	31.0	24.9
2/4/2011	30.8	25.7
1/24/2011	30.2	29.6
1/27/2011	27.9	24.5
6/9/2011	27.3	26.0
1/25/2011	27.1	29.7
6/3/2011	26.7	24.4
1/18/2011	26.4	24.0
3/31/2011	26.3	26.0
9/2/2011	26.3	21.9
8/2/2011	25.5	25.0
6/7/2011	25.4	18.7
6/4/2011	25.1	23.1
8/1/2011	24.9	20.7
5/10/2011	24.5	21.7
Average Value for top 5% at Granite City	**28.4**	**25.8**

* Note: All values have been rounded to the nearest 0.1 µg/m^3

** Note: Outlier days, where the Granite City monitor's 24-hour average concentration is at least 25% higher than the concentration recorded at Blair Street are highlighted in yellow

Table 12. Top 5% Days for Granite City vs. Same Day Value for Blair (2012) *		
Date	**Granite City 24-Hour Concentration (µg/m^3)**	**Blair 24-Hour Concentration (µg/m^3)**
11/17/2012	35.0	31.5
11/21/2012	34.5	32.7
11/18/2012	28.0	23.6
7/4/2012	27.3	24.1
12/24/2012	26.8	25.5
6/29/2012	26.2	19.4
7/2/2012	25.8	21.6
11/28/2012	25.5	18.1
2/17/2012	24.6	15.3
11/20/2012	24.6	21.1
9/6/2012	24.3	10.1
11/16/2012	24.2	27.5
6/30/2012	23.6	21.0
7/7/2012	23.4	20.4
1/10/2012	23.3	22.0
4/2/2012	23.0	17.6
11/15/2012	23.0	27.3
Average Value for top 5% at Granite City	**26.1**	**22.3**

* Note: All values have been rounded to the nearest 0.1 µg/m^3

** Note: Outlier days, where the Granite City monitor's 24-hour average concentration is at least 25% higher than the concentration recorded at Blair Street

Figure 11 Wind Directions and Speeds for All Hours of the Day on Outlier $PM_{2.5}$ Concentration Days at Granite City in 2010 – 2012

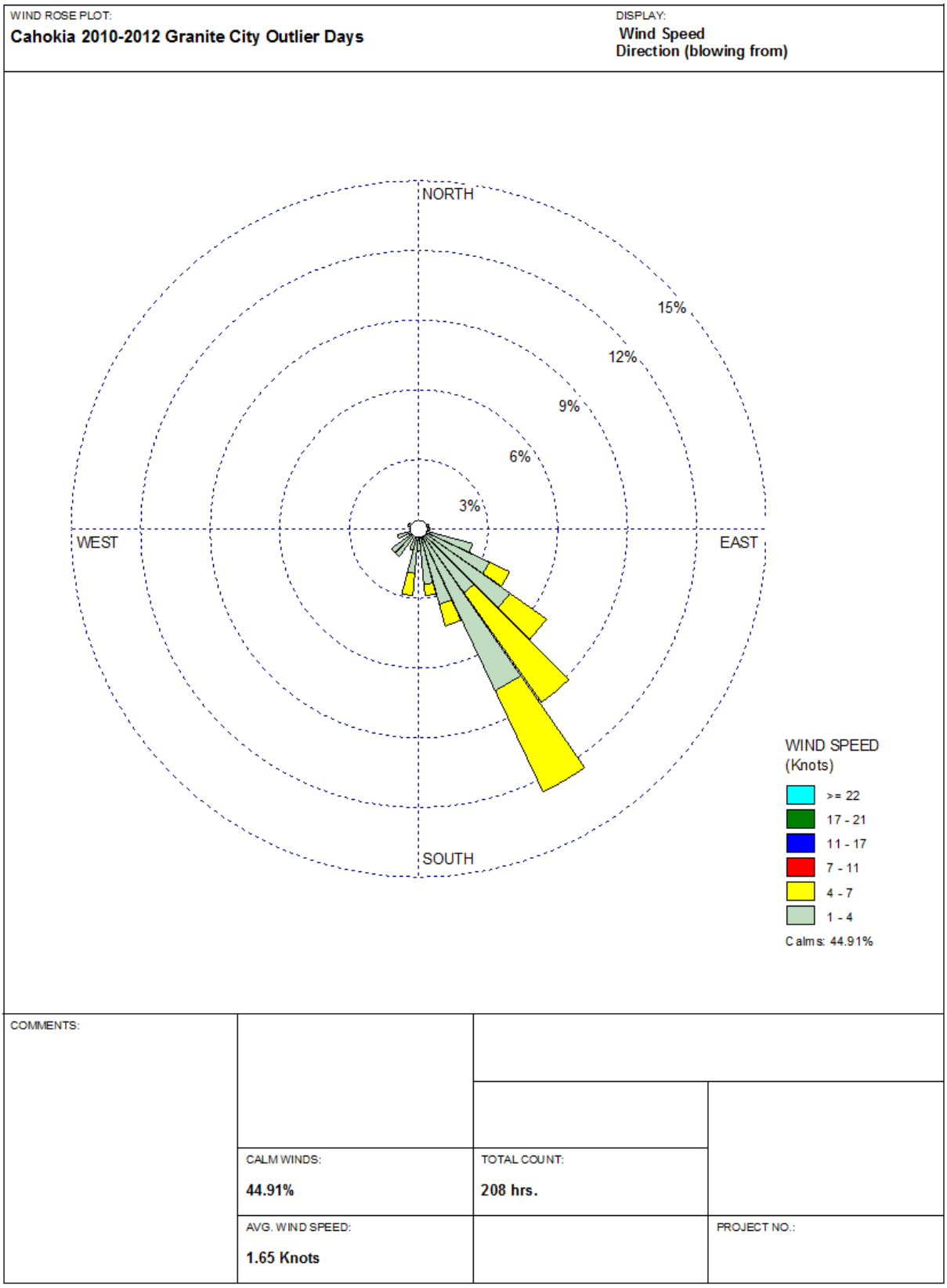
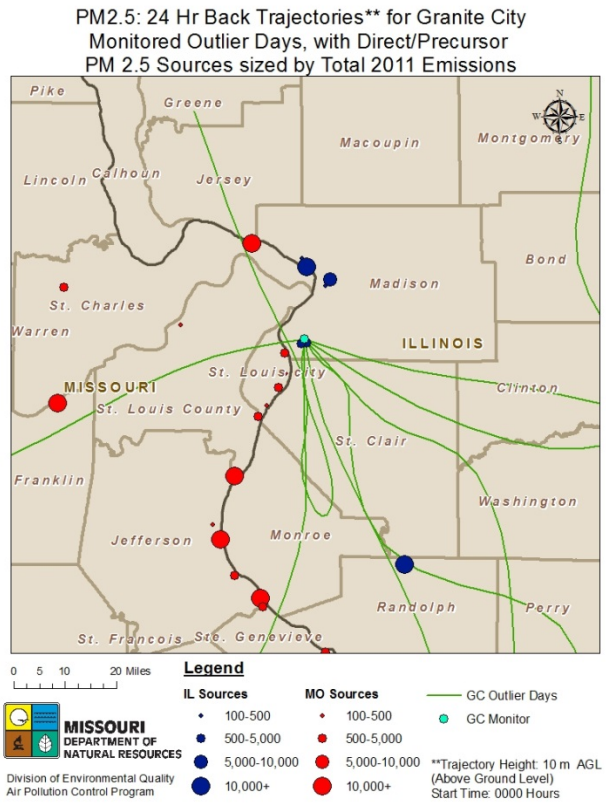
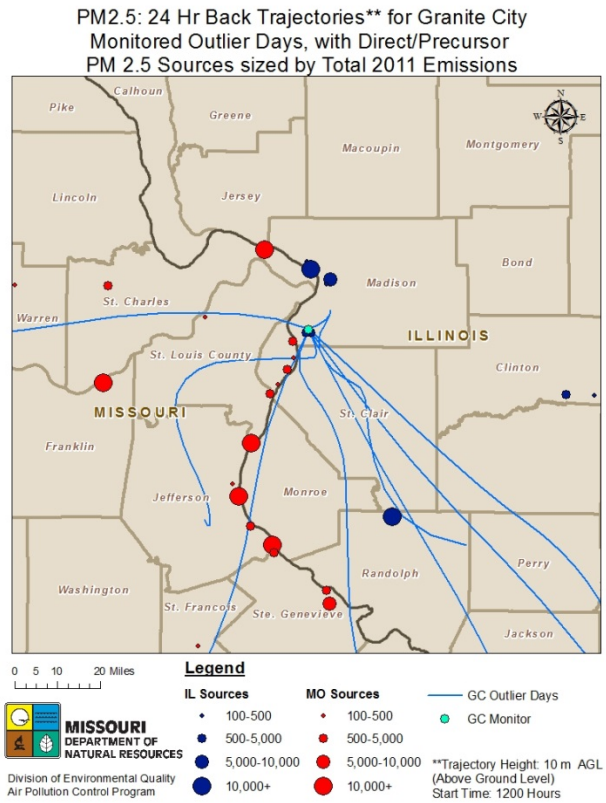


Figure 12 HYSPLIT Wind Trajectories for Outlier $PM_{2.5}$ Concentration Days at Granite City in 2010 – 2012 (12:00 a.m., 12:00 p.m., and 11:00 p.m.)

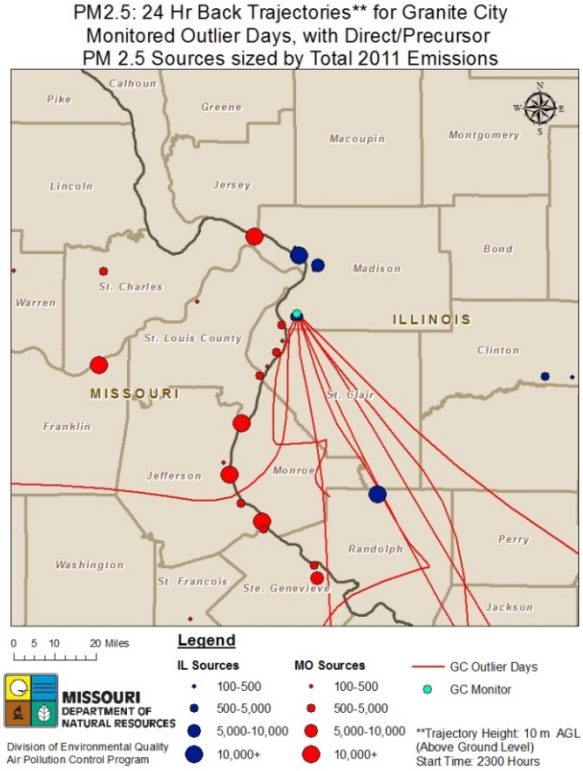
12:00 a.m. (Morning)



12:00 p.m. (Noon)



11:00 p.m.



5.2 Speciation Data Analysis at Blair Street and Granite City

As noted in Section 3, emissions of SO_X and NO_X from electric generating units, and their impact on $PM_{2.5}$ concentrations, have typically been controlled in the past through regional emissions programs. Per analyses performed by EPA when developing the Clean Air Interstate Rule:

> *For our analysis of States' ability to attain the $PM_{2.5}$ standards, we developed a group of emissions reduction measures for SO_2, NO_X, direct $PM_{2.5}$, and volatile organic compounds (VOC) as a surrogate for measures that States would potentially implement prior to 2009 in an effort to reach attainment. The measures address a broad range of source types. We analyzed the effect of applying this group of local controls in two different ways. First, we analyzed the impact of the emission controls on the immediate area in which they were applied. We applied the local control measures in three sample cities: Philadelphia, Birmingham, and Chicago. The group of local emissions controls was estimated to achieve ambient annual average $PM_{2.5}$ reductions ranging from about 0.5 µg/m3 to about 0.9 µg/m3, which was less than the amount needed to bring any of the three cities into attainment in 2010. The detailed results of this three-city analysis are provided in section IV. (69 FR 4582 January 30, 2004)*

And EPA goes on to state:

> *These analyses further conclude that sources of SO_2 and NO_X emissions continue to play a strong role in transported $PM_{2.5}$. They suggest that nearly all the particulate sulfate in the cities we examined appears to result from transport from upwind sources outside the local urban area, while upwind and local contributions for the particle nitrate and carbonaceous components of $PM_{2.5}$ are likely to come from both upwind and local sources. These findings are consistent with what is known about the location of emissions sources for these pollutants and their atmospheric formation and transport mechanisms. (69 FR 4582 January 30, 2004)*

Therefore, based on EPA's studies, it is concluded that sulfate components of $PM_{2.5}$ concentrations result from emissions across an entire region of the country including sources well outside the local urban area; whereas, the nitrate and carbonaceous mass components of $PM_{2.5}$ concentrations result from emissions both inside and outside the local urban area. This information is critical in determining the cause of the violation at the Granite City monitor. Speciation data must be analyzed at the Granite City monitor; a monitor that is representative of the St. Louis Region as a whole; and also a monitor that is outside the St. Louis urban core, but in the same region of the country. By comparing speciation data from three such monitors, the data can be used to determine the nature of the $PM_{2.5}$ concentrations in the region, the St. Louis area and the immediate area surrounding the Granite City monitor, which can then aide in determining the sources that are likely responsible for the elevated concentrations being recorded at the Granite City monitor.

Figure 13 compares the averaged SANDWICHED CSN speciation data for the years 2009 – 2010 at Granite City, Blair Street, and the Mingo National Wildlife Refuge in Stoddard County.

Mingo is located approximately 150 miles south of the St. Louis urban core, and the speciation data at this monitor is helpful in determining regional background levels. As seen in Figure 13, sulfate and organic carbon species comprise a majority of the $PM_{2.5}$ concentrations at Blair Street and Granite City (approximately 70% of the total $PM_{2.5}$ concentrations at each site). Sulfates appear to be uniform across all three sites. Nitrates are higher at Blair Street and Granite City than they are in Mingo. Organic carbon species vary significantly among all three sites. Elemental carbon particulates appear to be uniform with all sites averaging less than 1 $\mu g/m^3$. Crustal particulates are highest at Granite City and Mingo, but are less than 1 $\mu g/m^3$ at Blair Street.

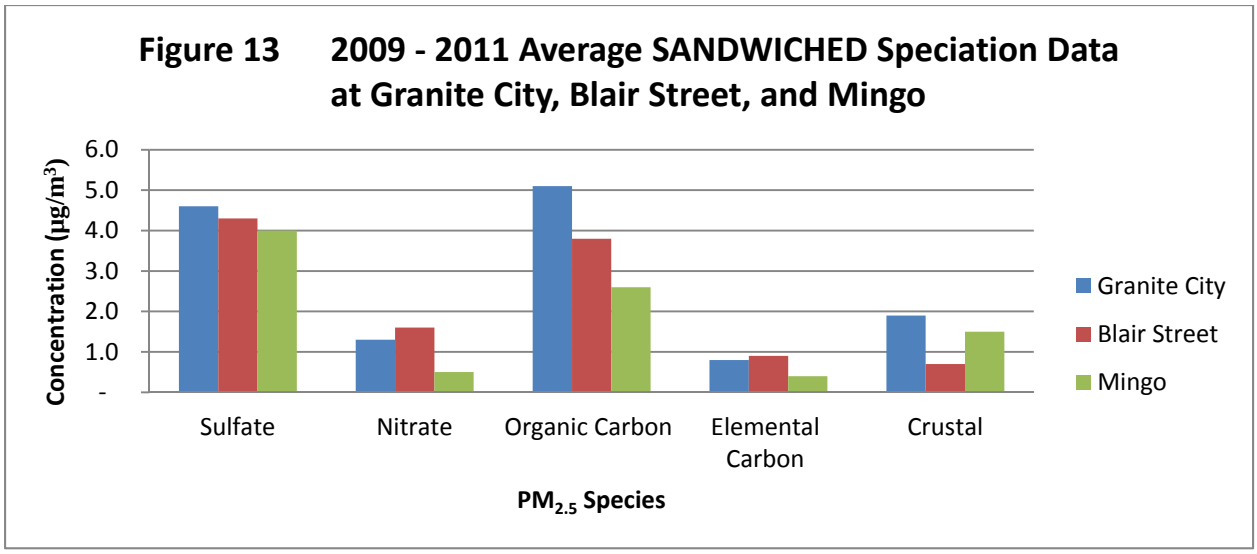


Figure 13 generated with data taken from EPA's 2012 $PM_{2.5}$ Designation Guidance and Tools Webpage: http://www.epa.gov/pmdesignations/2012standards/techinfo.htm

As discussed above, sulfate particulates usually result from emissions across an entire region of the country including sources well outside the local urban area. This conclusion is supported for the St. Louis area through Figure 13. The average sulfate concentrations range from 4.0 $\mu g/m^3$ to 4.6 $\mu g/m^3$ at each of these three sites over the three years analyzed. Therefore, although SO_X emissions on the Missouri side of the St. Louis MSA comprise 90 percent of the total SO_X emissions in the MO/IL St. Louis MSA, when evaluating the sulfate particulate species upwind and downwind of these sources, the contribution from Missouri sources seems to have a very limited impact on the sulfate $PM_{2.5}$ concentrations experienced in the St. Louis area. However, sulfates do comprise approximately 30% - 40% of the total $PM_{2.5}$ concentrations in the St. Louis area, which will likely need to be addressed in order for the Granite City monitor to attain the 2012 $PM_{2.5}$ NAAQS in the future. Because the background concentrations of sulfate particulates are so uniform across the region both inside and outside the St. Louis urban area, this will likely most effectively be addressed through a federal interstate transport rule that requires SO_X emissions reductions across broad regions of the country to address upwind states' significant contribution to downwind states concerning the 2012 $PM_{2.5}$ NAAQS.

Particulate organic carbon is different from sulfates as it is the result of both regional and local source contributions. As seen in Figure 13, the organic particulate species are higher at Blair Street and Granite City when compared to Mingo, indicating that there is an urban contribution

to this species. However, organic particulates measured at Granite City over the three year period analyzed exceed the levels recorded at Blair Street by more than 1 $\mu g/m^3$. Therefore, while there does appear to be an urban increment for organic particulates, there is also an intra-urban increment for this particulate species that is impacting the Granite City monitor more so than the rest of the St. Louis area. Taking this into consideration in combination with the wind directions and HYSPLIT trajectories on the high and low days, the data indicates that the two sources about 1 mile south of the Granite City Monitor could be causing the organic particulate levels at Granite City to exceed the levels measured in the St. Louis Urban core.

Nitrate and elemental carbon particulates, similarly to organic particulates, are also attributable to both regional and local source contributions. Comparing the nitrate speciation data from the three monitors, shows that nitrate levels are higher at Blair Street and Granite City than they are in Mingo, which indicates there is likely urban component of nitrate levels in St. Louis. However, the nitrate levels at Granite City are lower than the levels at Blair Street, and only 0.8 $\mu g/m^3$ higher than the levels experienced at the background site in Mingo. Therefore, the urban nitrate component, even if completely eliminated, would have a minimal impact on the $PM_{2.5}$ concentrations measured at the violating monitor in Granite City. Elemental carbon particulate levels are lower than 1 $\mu g/m^3$ at all three sites, meaning the urban contribution for this particulate species is relatively insignificant on the $PM_{2.5}$ concentrations measured at Granite City.

Finally, looking at the crustal components, which include metals such as calcium, iron, cadmium, manganese, silicon, and aluminum, Granite City averages over 100% higher levels of crustal particulate than Blair Street. This is a clear indication that an intra-urban crustal particulate component is impacting the Granite City monitor more so than the rest of the St. Louis area. Iron is the predominant crustal species at Granite City. Because iron is the main ingredient in steel production, it is likely that the U.S. Steel facility is responsible for the majority of the crustal particulate component measured at Granite City. Subsection 5.3 analyzes this theory by comparing $PM_{2.5}$ concentrations and particulate speciation data at Granite City during and after the shutdown and reopening of the U.S. Steel facility. The crustal particulate levels at Mingo are also much higher than they are at Blair Street. However, the high crustal particulate levels at Mingo can be explained by examining the predominant crustal species, silicon, which is found in earthen materials such as sands and quartz. Unpaved areas with winds disturbing natural dirt and sands along with agricultural tilling operations can cause high silicon levels.

In addition to the three year annual averaged speciation data at Granite City, the Air Program analyzed daily speciation at Granite City and Blair Street during days in which the $PM_{2.5}$ concentrations were at their highest levels in Granite City from 2010 – 2012. Speciation samplers did not operate on the same schedule as the FRM/FEM monitors located at Granite City and Blair Street. Therefore, not all of the high $PM_{2.5}$ episode days listed in Table 1 could be evaluated. Table 13 lists the SANDWICHED speciation data for each of the high $PM_{2.5}$ episode days where the speciation data was also available. It is noted that this SANDWICHED speciation data was developed using a spreadsheet that was developed by Washington University during the development of the attainment demonstration for the St. Louis area for the 1997 Annual $PM_{2.5}$ NAAQS. The method of converting CSN speciation data into SANDWICHED data is a relatively new concept and has been refined over the last few years. Because the Air Program does not possess the tools to convert CSN data into SANDWICHED data using the latest EPA methods and calculations, this tool was used to develop the SANDWICHED data

presented in Table 13. While the methods of developing the SANDWICHED data listed in Table 13 may not exactly align with EPA's latest methods, it is still useful in analyzing the $PM_{2.5}$ species at both Granite City and Blair Street on these days where Granite City measured some of its highest $PM_{2.5}$ concentrations from 2010 – 2012.

As seen in the table, the predominant $PM_{2.5}$ species on several of the episode days evaluated was organic particulates. However, on two of the days evaluated, the crustal particulate component at Granite City was more than all of the other species calculated for that monitor, and on 1/27/11, nitrate was the predominant component at both monitors. Two of the days analyzed below were also identified as outlier days (3/9/10 and 9/6/12) in Tables 10 – 12, because the total $PM_{2.5}$ concentrations at Granite City were greater than 25% higher than the concentrations recorded at Blair Street (highlighted in yellow in Table 13). Note that on 9/6/12 the organic particulates at Granite City were calculated to be 65.65 $\mu g/m^3$. This is an extremely high number, well above the value calculated for Blair Street (+1,100%). As seen in Table 12, the total $PM_{2.5}$ concentrations at Granite City and Blair Street were 24.1 $\mu g/m^3$ and 10.1 $\mu g/m^3$, respectively. Ignoring this outlier day, the average organic particulates for the days analyzed at Granite City would equal 7.53 $\mu g/m^3$, which is comparable to the average organic particulate levels at Blair Street during the days evaluated. Therefore, the only significant difference between the species measured at Granite City and Blair Street on these high episode days is the crustal particulate species. The average crustal particulate levels calculated at Granite City for the episode days evaluated are over 350% higher than the levels calculated for the Blair Street site. This evaluation further supports the fact that direct emissions of crustal particulates comprise the majority of the increment between these two sites and are likely causing the difference in the design values at these two sites, and in turn, the violation at the Granite City Monitor.

Table 13. Daily SANDWICHED Speciation Data at Granite City and Blair Street During High $PM_{2.5}$ Episode Days at Granite City (all values rounded to nearest 0.01 $\mu g/m^3$)

Date	Granite City Sulfate	Blair Sulfate	Granite City Nitrate	Blair Nitrate	Granite City Organic Matter	Blair Organic Matter	Granite City Elemental Carbon	Blair Elemental Carbon	Granite City Crustal	Blair Crustal
3/9/2010	5.78	5.3	3.84	3.98	9.11	7.43	0.76	0.94	2.34	0.42
12/10/2010	3.21	3.23	4.52	4.65	5.42	7.82	1.43	2.38	9.24	0.71
12/28/2010	2.85	3.23	4.31	4.33	4.29	7.68	1.05	1.47	6.74	0.73
1/27/2011	3.21	3.15	9.25	9.53	1.11	1.17	1.44	1.17	1.71	0.5
8/1/2011	7.51	7.28	0	0	5.7	8.65	0.98	1.25	1.96	0.67
1/10/2012	1.21	1.05	3.59	3.5	11.18	10.99	0	2.81	1.79	1.78
7/2/2012	3.15	4.68	0	0	15.87	10.2	0	1.36	4.37	1.94
9/6/2012	0.04	2.46	0	0	65.65	5.59	0	1.14	0.02	1.11
Average For Days Analyzed	**3.37**	**3.80**	**3.19**	**3.25**	**14.79**	**7.44**	**0.71**	**1.57**	**3.52**	**0.98**

5.3 Analysis of $PM_{2.5}$ Concentrations and Speciation Data During and After the U.S. Steel Facility Shutdown and Reopening

In December of 2008, U.S. Steel shutdown much of the operations at their steel mill located in Granite City, Illinois, but in late 2009 the mill restarted operations. The quarterly average $PM_{2.5}$ concentrations at this monitor were evaluated before, during, and after this 1- year period to determine the impact that this source had on ambient $PM_{2.5}$ concentrations at the Granite City monitor. Table 14 lists the quarterly average $PM_{2.5}$ concentrations at the Granite City site along with the annual averages from 2007 – 2010 (values listed in red are during the period of the facility shutdown), and Figure 14 displays these values graphically. As can be seen, in 2009 the Granite City monitor had an annual average $PM_{2.5}$ concentration of 11.3 $\mu g/m^3$, which is typical of $PM_{2.5}$ concentrations in the St. Louis area and below the level of the 2012 $PM_{2.5}$ NAAQS. However, during the years before and after the shutdown, the average annual concentrations were over 14 $\mu g/m^3$, which is well above the level of the 2012 $PM_{2.5}$ NAAQS. Through this simple analysis, it is clear that this source has a significant impact on the ambient $PM_{2.5}$ concentrations at this location, and is most likely causing the violation of the standard. With a regional annual average $PM_{2.5}$ concentration over the same period in the St. Louis, Missouri area ranging from approximately 10.0 $\mu g/m^3$ – 12.0 $\mu g/m^3$ (Figure 2 in Subsection 2.2), it is clear that without the influence of this local source in Granite City the entire region on both sides of the MSA would be in compliance with the 2012 $PM_{2.5}$ NAAQS.

In addition to gauging the level of the design values at the Granite City monitor, the speciation data at Granite City and Blair Street in 2009 is compared with the speciation data in 2010 and 2011. Figures 15 – 17 display the speciation data at these two monitors for 2009 – 2011, respectively. The species of sulfate, nitrate, and elemental carbon are relatively unchanged at both monitors from 2009 – 2011. However, similar to the design value evaluation above, while the U.S. Steel plant was shut down during 2009, all species of the $PM_{2.5}$ were very similar at both Blair Street and Granite City, but in 2010 and 2011, after the plant re-opened, organic carbon and crustal emissions at Granite City far exceed the levels at Blair Street. This aligns with the meteorology, emissions data and source location, and the general speciation data analysis at these two sites. All of these facts further support the conclusion that although there is an urban contribution from much of the MSA on both sides of the river to the Region as a whole, this individual source is causing the excess levels of organic and crustal particulate measured at the Granite City monitor that is causing the violation of the 2012 $PM_{2.5}$ NAAQS.

Table 14 Quarterly and Annual Average concentrations at the Granite City Monitor (2007 – 2010)																				
	2007					2008					2009					2010				
	Qtr-1	Qtr-2	Qtr-3	Qtr-4	2007 Annual Avg.	Qtr-1	Qtr-2	Qtr-3	Qtr-4	2008 Annual Avg.	Qtr-1	Qtr-2	Qtr-3	Qtr-4	2009 Annual Avg.	Qtr-1	Qtr-2	Qtr-3	Qtr-4	2010 Annual Avg.
Average $PM_{2.5}$ Concentration ($\mu g/m^3$)	14.3	15.3	17.6	13.2	15.1	15.6	15.7	18.7	11.9	15.7	12.7	10.4	11.7	10.5	11.3	14.2	13.8	14.4	14.7	14.3

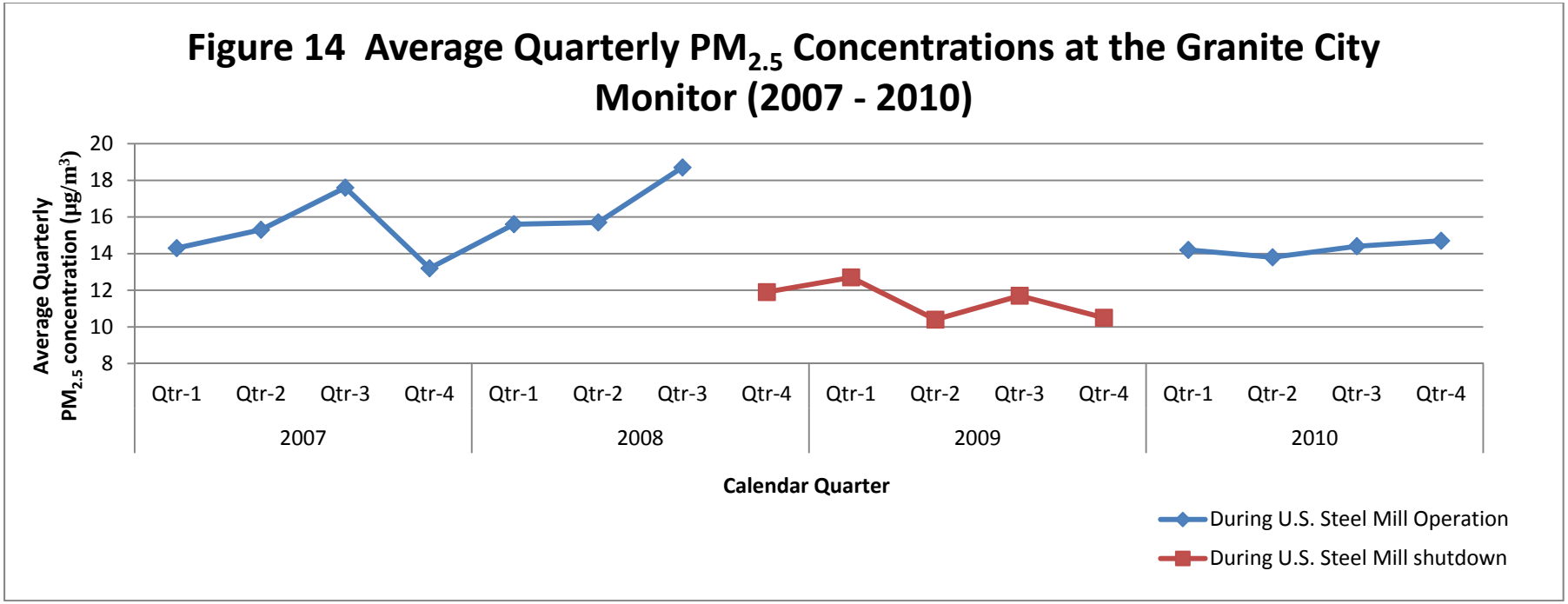


Figure 15 2009 Average SANDWICH Speciation Data from CSN Monitors at Granite City and Blair Street

(During the Shutdown of U.S. Steel Facility)

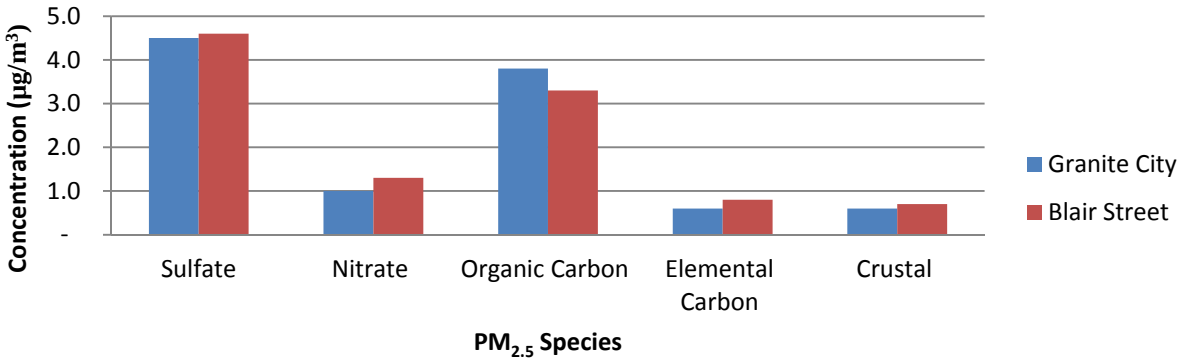


Figure 16 2010 Average SANDWICH Speciation Data from CSN Monitors at Granite City and Blair Street

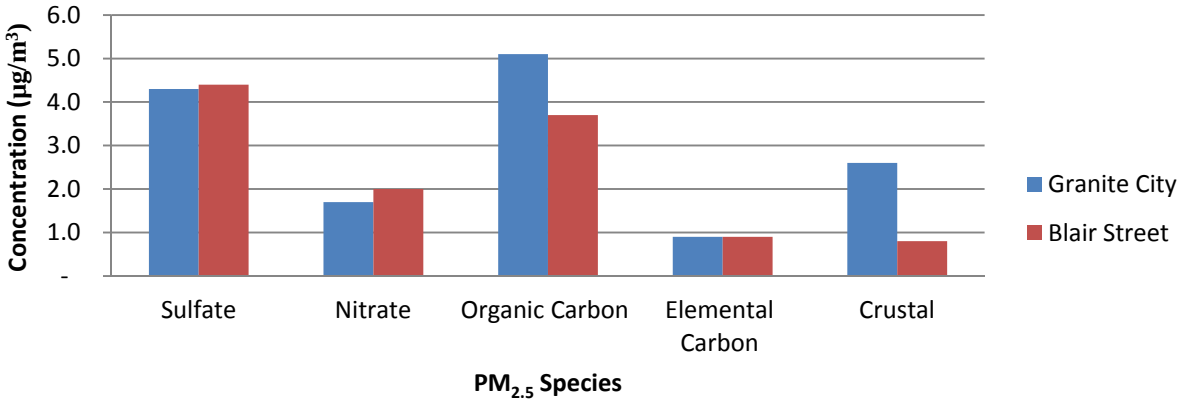
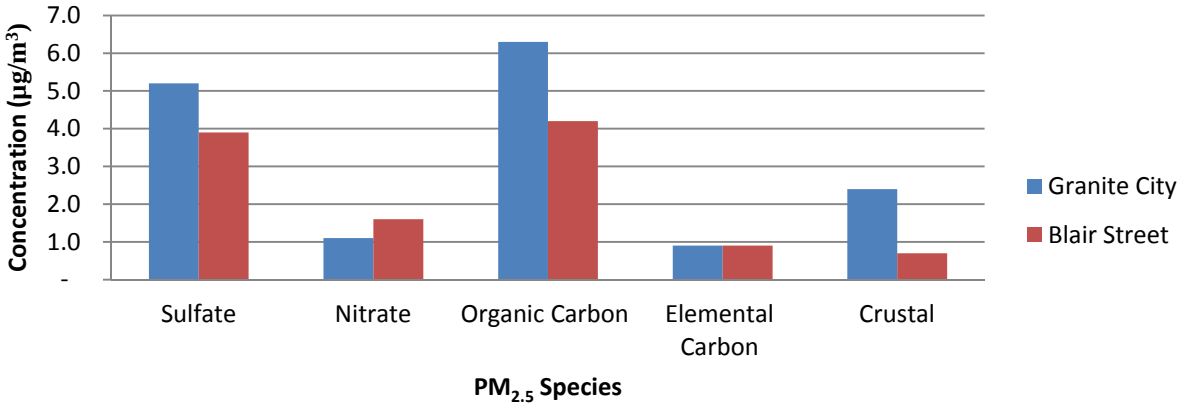


Figure 17 2011 Average SANDWICH Speciation Data from CSN Monitors at Granite City and Blair Street



Figures 15 - 17 generated with data taken from EPA's 2012 $PM_{2.5}$ Designation Guidance and Tools Webpage: http://www.epa.gov/pmdesignations/2012standards/techinfo.htm

5.4 Annual $PM_{2.5}$ Concentrations in Granite City vs. U.S. Steel Emissions

Subsection 5.3 analyzes the $PM_{2.5}$ concentrations in Granite City in the time period surrounding the shutdown of the U.S. Steel facility. It is also important to note that some control strategies have been implemented at the U.S. Steel facility since 2002, resulting in a reduction of direct $PM_{2.5}$ and $PM_{2.5}$ precursor emissions from the facility. To more fully understand how emissions from this facility are impacting $PM_{2.5}$ concentrations, $PM_{2.5}$ and $PM_{2.5}$ precursor emissions from this facility must be compared to the annual average $PM_{2.5}$ concentrations recorded by the Granite City monitor over a longer period of time. Table 15 lists the $PM_{2.5}$ and $PM_{2.5}$ precursor emissions from the U.S. Steel facility in Granite City for the years 2002, 2005, 2008, and 2011. Figure 18 displays the annual average $PM_{2.5}$ concentrations recorded by the Granite City monitor from 2000 – 2012. As seen in Table 15, $PM_{2.5}$ and $PM_{2.5}$ precursor emissions from the facility have decreased from 2002 to 2011. These emissions reductions combined with other regional emissions reductions have resulted in a reduction in $PM_{2.5}$ concentrations recorded by the Granite City monitor from 17.4 $\mu g/m^3$ in 2000 down to 12.8 $\mu g/m^3$ in 2012.

Although some controls have been implemented at the U.S. Steel facility resulting in reductions in direct $PM_{2.5}$ emissions, in 2011, the source still emitted approximately 748 tons of direct $PM_{2.5}$ emissions and approximately 2,912 tons of $PM_{2.5}$ precursor emissions. This information combined with the analysis of the shutdown of the facility in subsection 5.3 shows that emissions at the U.S. Steel facility have a direct impact on the $PM_{2.5}$ concentrations in the area. The correlation of emissions from this source with the annual $PM_{2.5}$ concentrations in Granite City further supports the conclusion that this source is causing the violation at the Granite City monitor.

Table 15 Emissions from the U.S. Steel Facility in Granite City, IL

	2002	2005	2008	2011
Direct $PM_{2.5}$ Emissions (tons/year)	1,489.12	518.76	526.38	747.65
SO_2 Emissions (tons/year)	4,652.45	6,396.65	5,598.62	1,430.34
NO_X Emissions (tons/year)	3,464.14	3,735.56	3,420.02	1,188.86
VOC Emissions (tons/year)	230.79	240.937	221.79	293.06
NH_3 Emissions (tons/year)	8.70	32.7972	10.82	9.07

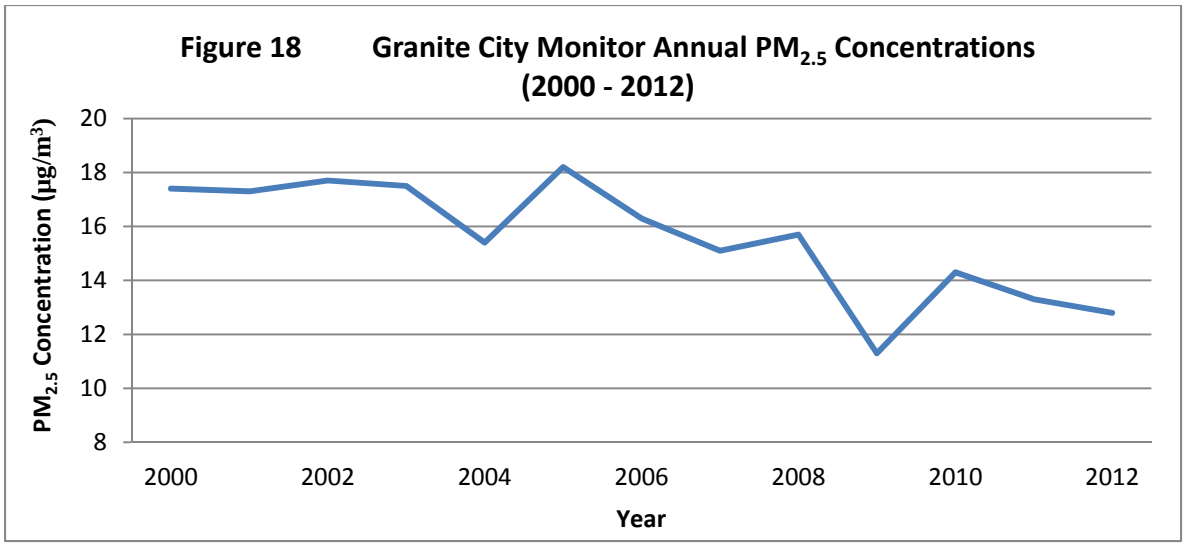


Figure 18 Granite City Monitor Annual PM2.5 Concentrations (2000 - 2012)
PM2.5 Concentration (µg/m3)
20
18
16
14
12
10
8
2000
2002
2004
2006
2008
2010
2012
Year

6. Consideration of Potential Control Strategies for Missouri Sources in the St. Louis Area

It is important to note that the St. Louis area is currently designated nonattainment for the 1997 $PM_{2.5}$ NAAQS. The nonattainment area includes the City of St. Louis and the Counties of Jefferson, St. Louis, St. Charles, and Franklin on the Missouri side, as well as the Township of Baldwin and the Counties of Monroe, St. Clair, and Madison on the Illinois side. The area has obtained clean data based on 2007 – 2009 monitoring data, and Missouri has submitted a maintenance plan and redesignation request for the Missouri side of the nonattainment area to be redesignated to attainment under the 1997 standard. A large bi-state effort between Missouri and Illinois to install controls to reduce emissions of direct $PM_{2.5}$ and $PM_{2.5}$ precursors was performed to meet the Clean Air Act requirements that were triggered when the area was designated nonattainment for the 1997 $PM_{2.5}$ NAAQS. Additionally, many large sources of $PM_{2.5}$ precursor emissions (NO_X and SO_X) have traditionally been controlled through regional emissions programs aimed at reducing background $PM_{2.5}$ concentrations and long-range transport of these emissions, which has also played an important role in reducing annual average $PM_{2.5}$ concentrations across the St. Louis area. Finally, there are numerous federal rules coming into place that will help control $PM_{2.5}$ and $PM_{2.5}$ precursor emissions from some of the largest source categories. This section analyzes the local control measures developed for the 1997 $PM_{2.5}$ NAAQS, the various federal control measures currently being phased in, and the expectation of interstate transport requirements. All of these measures have been compared to Missouri's sources to determine if other additional control measures would be feasible that could produce tangible benefits in terms of $PM_{2.5}$ concentrations in the St. Louis area.

Area sources are difficult to control, and there is uncertainty in the inventory which is largely based on generic emissions calculations. Mobile sources, both on-road and non-road, continue to decline based on federal motor vehicle and non-road engine standards, and this trend is only expected to continue not only in St. Louis but across the country. Furthermore, most states, including Missouri, do not control mobile source emissions through state-specific motor vehicle and non-road engine standards. Most states rely upon federal regulations to control these emissions. Therefore, the only source category that states can typically control through regulations and state implementation plans are permitted point sources. For this reason, much of the analysis in this section compares individual source emissions to total point source emissions in the MO/IL St. Louis MSA.

6.1 Electric Generating Units on the Missouri-Side of the St. Louis Area

Table 16 displays the direct $PM_{2.5}$ and $PM_{2.5}$ precursor emissions in 2011 for the four major electric generating units located on the Missouri side of the St. Louis MSA. These four units are all owned by Ameren and make up a substantial portion of the MSA's point source emissions of direct $PM_{2.5}$, NO_X, and SO_X. Each of these facilities is currently subject to the EPA's Clean Air Interstate Rule (CAIR), which is a regional emission trading program aimed at reducing the $PM_{2.5}$ precursor emissions of NO_X, and SO_2 from electric generating units in the eastern half of the country. It is noted that CAIR has been remanded to EPA; however the courts have directed EPA to continue implementing CAIR until a suitable replacement rule is promulgated. In 2015,

if CAIR has not been replaced, CAIR phase II will begin, which will require further reductions of NO_X and SO_2 emissions from electric generating units that are subject to the rule.

In addition to CAIR, or its expected replacement, the EPA promulgated the Mercury and Air Toxics Standards (Utility MATS) for electric generating units in 2011. Utilities have up to three years to comply with the requirements of this rule with an option for a fourth year if the additional year is necessary for the installation of controls. The Utility MATS requires emissions reductions in mercury and acid gases. It also requires reductions in other hazardous air pollutants, which are measured using $PM_{2.5}$ as a surrogate. Therefore, direct $PM_{2.5}$ emissions are expected to be controlled directly through the Utility MATS rule. Furthermore, while NO_X and SO_2 may not be controlled directly through Utility MATS at EGUs, some control strategies for controlling emissions of acid gases, mercury, and direct $PM_{2.5}$ are expected to have co-benefits for reducing SO_2 and NO_X emissions. It is noted that as part of Ameren's long range planning for environmental compliance, they installed flue-gas desulfurization on their two stacks in their Sioux plant located in St. Charles County in late 2010. This resulted in the reduction of nearly 40,000 tons/year of SO2 emissions, and further demonstrates that these federal rules are resulting in actual significant emissions reductions not only in St. Louis but across the entire country, which is helping to lower the background $PM_{2.5}$ concentrations across the U.S. and in turn the $PM_{2.5}$ concentrations in urbanized areas, such as St. Louis.

Table 16 2011 Missouri EGU Emissions and Percentages in the St. Louis MSA

Facility Name	NH_3	NO_X	PM_{25}-PRI	SO_2	VOC
AMEREN MISSOURI-LABADIE PLANT EMISSIONS (TONS/YEAR)	3.04	9,891.46	1,712.14	57,948.81	323.15
Labadie Percent of Total MSA Point Source Emissions	0.25%	24.65%	38.14%	41.70%	4.35%
Labadie Percent of Total MSA Emissions	0.02%	7.68%	4.97%	41.31%	0.40%
AMEREN MISSOURI-RUSH ISLAND PLANT EMISSIONS (TONS/YEAR)	1.40	3,441.72	246.31	28,035.57	149.11
Rush Island Percent of Total MSA Point Source Emissions	0.11%	8.58%	5.49%	20.17%	2.01%
Rush Island Percent of Total MSA Emissions	0.01%	2.67%	0.72%	19.98%	0.19%
AMEREN MISSOURI-SIOUX PLANT EMISSIONS (TONS/YEAR)	0.80	7,073.99	413.53	4,899.10	156.51
Sioux Percent of Total MSA Point Source Emissions	0.07%	17.63%	9.21%	3.53%	2.11%
Sioux Percent of Total MSA Emissions	0.01%	5.50%	1.20%	3.49%	0.19%
AMEREN MISSOURI-MERAMEC PLANT EMISSIONS (TONS/YEAR)	1.13	4,789.24	171.93	15,281.50	105.65
Meramec Percent of Total MSA Point Source Emissions	0.09%	11.93%	3.83%	11.00%	1.42%
Meramec Percent of Total MSA Emissions	0.01%	3.72%	0.50%	10.89%	0.13%
Combined Missouri EGU Percent of Total MSA Point Source Emissions	0.52%	62.78%	56.67%	76.40%	9.90%
Combined Missouri EGU Percent of Total MSA Emissions	0.05%	19.58%	7.39%	75.67%	0.91%

As seen in Table 16, these four EGUs, which will be controlled through the Utility MATS and either CAIR or its replacement, comprised 62.8%, 56.7%, and 76.4% of total point source NO_X, direct $PM_{2.5}$, and SO_2 emissions respectively for the entire IL/MO St. Louis MSA in 2011. Because these four sources will be controlled through these two federal rules, it is unlikely that controls beyond what will be required by these two rules would be feasible/necessary even if these sources are included in the nonattainment area that will result from the violating Granite City Monitor.

6.2 Maximum Achievable Control Technology for Industrial/Commercial/Institutional Boilers (Boiler MACT)

On March 21, 2011, EPA promulgated maximum achievable control technology requirements for industrial/commercial/institutional boilers (Boiler MACT) (76 FR 1541). However, implementation of this rule was delayed while EPA reconsidered certain aspects of the rule. The revised rule was released on January 31, 2013 (78 FR 7138). This rule requires existing industrial/commercial/institutional boilers that meet major source threshold requirements to reduce their emissions of acid gases, mercury, dioxin/furans, organic hazardous air pollutants (HAPs), and non-mercury metallic HAPs. While, this rule is intended to control emissions of air toxics, compliance for the limits on the non-mercury metallic HAPs will be determined using filterable $PM_{2.5}$ emissions as the surrogate. Therefore, direct $PM_{2.5}$ emissions will be controlled through this regulation for existing sources subject to the rule. Additionally, the control requirements for acid gases, mercury, dioxin/furans, and organic HAPs will likely have co-benefits for NO_X, SO_X, and VOC emissions for existing sources subject to the rule.

The Air Program has performed preliminary research to determine the existing facilities with boilers that will be subject to this rule. The facilities that are located in the Missouri portion of the St. Louis MSA as well as the facilities located in Missouri counties bordering the St. Louis MSA have been listed below in Table 17. As seen in the table, 23 facilities located in or surrounding the Missouri portion of the St. Louis MSA have a total of 115 emissions units that will be subject to the Boiler MACT, and will be required to comply with the rule beginning January 31, 2016. This is expected to result in further point source emissions reductions of direct $PM_{2.5}$ and $PM_{2.5}$ precursors. In addition, the Boiler MACT established limits for new sources that are more stringent than the requirements for existing sources, ensuring that any industrial/commercial/institutional boilers that are constructed in the future will be well controlled under this federal rule.

Table 17 Missouri Facilities in and Around the St. Louis MSA with Units Subject to the Boiler MACT			
County	**Plant ID**	**Facility Name**	**Number of Boilers Subject to Boiler MACT**
Franklin	0014	CANAM STEEL CORP	1
Franklin	0132	SPORLAN VALVE DIVSION	1
Jefferson	0002	RIVER CEMENT CO. DBA BUZZI UNICEM USA	1
Jefferson	0003	DOE RUN COMPANY	4
Jefferson	0016	Ameren Missouri	4
St. Charles	0001	Ameren Missouri	2
St. Charles	0010	BOEING COMPANY	3
St. Charles	0076	GENERAL MOTORS LLC	9
Ste. Genevieve	0001	MISSISSIPPI LIME COMPANY	13
Ste. Genevieve	0035	CHEMICAL LIME COMPANY	4
St. Louis	0226	GREIF-FENTON	3
St. Louis	0230	BOEING COMPANY	16
St. Louis	0231	CHRYSLER GROUP LLC NORTH PLANT	3
St. Louis	1012	BELT SERVICE CORP	2
St. Louis	1489	GKN AEROSPACE NORTH AMERICA, INC.	3
St. Louis City	0003	ANHEUSER-BUSCH INC	4
St. Louis City	0017	MALLINCKRODT INC	9
St. Louis City	0027	PRECOAT METALS	9
St. Louis City	0040	WASHINGTON UNIV MEDICAL SCHOOL	10
St. Louis City	0697	SIGMA - ALDRICH MFG LLC	7
St. Louis City	1123	U. S. RINGBINDER CORP	2
St. Louis City	1460	ALLIED HEALTH CARE PRODUCTS	1
St. Louis City	2433	NEW WORLD PASTA	4

6.3 Implementation of Reasonably Available Control Technology (RACT) for Missouri Sources Under the 1997 $PM_{2.5}$ NAAQS

As mentioned above, the City of St. Louis and the Counties of St. Louis, St. Charles, Franklin, and Jefferson were included in the MO/IL St. Louis nonattainment areas under the 1997 Annual $PM_{2.5}$ NAAQS. As required by the Clean Air Act and the Implementation Rule for this standard, RACT evaluations were performed for all significant point sources located in the nonattainment area. Implementation of RACT under the 1997 $PM_{2.5}$ NAAQS in the St. Louis area required RACT analyses for all sources on the Missouri side that had direct $PM_{2.5}$ emissions above 10 tons/year and were within 10 miles of the Granite City monitor, as this was the design value monitor for the area. The 10 mile radius for sources of direct $PM_{2.5}$ emissions was selected for the RACT evaluation because direct $PM_{2.5}$ emissions have a very localized impact on $PM_{2.5}$ concentrations and do not have a significant impact on $PM_{2.5}$ concentrations in areas at greater distances downwind. The RACT implementation also included RACT analyses for all point sources with NO_X emissions greater than 50 tons/year and all point sources with SO_2 emissions greater than 25 tons/year.

Through the RACT evaluation several sources in the nonattainment area implemented control strategies that were determined to be RACT. Several sources also demonstrated that the control technologies already in place satisfied RACT because additional controls were either too costly or not feasible. Table 18 provides a list of the sources in St. Louis that were required to perform RACT evaluations under the 1997 $PM_{2.5}$ NAAQS for each of these three pollutants.

Table 18	2011 Missouri Sources Required to Perform a RACT Evaluation Under the 1997 $PM_{2.5}$ NAAQS	
Direct $PM_{2.5}$ Sources		
County	**2008 Facility ID**	**Facility Name**
St. Louis City	510-0156	AMERICAN COMMERCIAL TERMINALS
St. Louis City	510-0040	WASHINGTON UNIVERSITY MEDICAL SCHOOL
St. Louis City	510-0809	PQ CORPORATION
St. Louis City	510-0003	ANHEUSER BUSCH - ST. LOUIS
St. Louis City	510-0072	FEDERAL MOGUL FRICTION PRODUCTION
St. Louis City	510-0053	ST. LOUIS METROPOLITAN SEWER DISTRICT - BISSEL
St. Louis City	510-0057	PROCTOR & GAMBLE
St. Louis City	510-2565	BEELMAN RIVER TERMINALS
St. Louis City	510-0017	MALLINCKRODT INC
NO_X Sources		
County	**2008 Facility ID**	**Facility Name**
Franklin	071-0003	AMERENUE - LABADIE
Jefferson	099-0002	RC CEMENT COMPANY (BUZZI UNICEM)
Jefferson	099-0016	AMERENUE - RUSH ISLAND
Jefferson	099-0068	SAINT - GOBAIN CONTAINERS - PEVELY
St. Charles	183-0001	AMERENUE - SIOUX
St. Charles	183-0076	GENERAL MOTORS - WENTZVILLE
St. Charles	183-0027	MEMC ELECTRONIC MATERIALS
St. Louis City	510-0003	ANHEUSER-BUSCH INC - ST. LOUIS
St. Louis City	510-2378	LACLEDE GAS
St. Louis City	510-0809	PQ CORPORATION
St. Louis City	510-0038	TRIGEN - ASHLEY STREET
St. Louis City	510-0017	MALLINCKRODT INC
St. Louis City	510-0053	ST. LOUIS METROPOLITAN SEWER DISTRICT - BISSEL
St. Louis County	189-0010	AMERENUE - MERAMEC
St. Louis County	189-0230	BOEING COMPANY
St. Louis County	189-0231	CHRYSLER CORP-NORTH PLANT
St. Louis County	189-1205	ST. LOUIS METROPOLITAN SEWER DISTRICT - MO RIVER
St. Louis County	189-1210	ST. LOUIS METROPOLITAN SEWER DISTRICT - COLDWATER
St. Louis County	189-0217	ST. LOUIS METROPOLITAN SEWER DISTRICT - LEMAY
SO_2 Sources		
County	**2008 Facility ID**	**Facility Name**
Franklin	071-0003	AMERENUE - LABADIE
Jefferson	099-0003	DOE RUN COMPANY - HERCULANEUM
Jefferson	099-0016	AMERENUE - RUSH ISLAND
Jefferson	099-0002	RC CEMENT COMPANY (BUZZI UNICEM)
Jefferson	099-0068	SAINT - GOBAIN CONTAINERS - PEVELY
St. Charles	183-0001	AMERENUE - SIOUX
St. Charles	183-0076	GENERAL MOTORS - WENTZVILLE
St. Louis City	510-0003	ANHEUSER-BUSCH INC - ST. LOUIS
St. Louis City	510-0017	MALLINCKRODT INC
St. Louis City	510-0809	PQ CORPORATION
St. Louis City	510-0038	TRIGEN - ASHLEY STREET
St. Louis City	510-0040	WASHINGTON UNIVERSITY MEDICAL SCHOOL
St. Louis City	510-0053	ST. LOUIS METROPOLITAN SEWER DISTRICT - BISSEL
St. Louis County	189-0010	AMERENUE - MERAMEC
St. Louis County	189-0230	BOEING COMPANY

Through the RACT evaluation performed in 2007 - 2009 for the direct $PM_{2.5}$ sources, no additional controls were required. Many of the sources included in the evaluation were already well controlled at levels of 50% control or greater for their $PM_{2.5}$ emissions. Additionally, due to the relatively low direct $PM_{2.5}$ emissions for the sources evaluated in Missouri and the fact that monitored concentrations on the Missouri side were not experiencing elevated levels like the Granite City monitor, which had two sources less than a mile away emitting over 1,500 tons/year of direct $PM_{2.5}$, it was determined that additional direct $PM_{2.5}$ controls at these facilities would not have a significant impact on the monitored $PM_{2.5}$ concentrations at Granite City.

Through the RACT evaluation performed in 2007 - 2009 for the NO_X sources, Washington University switched their coal fired boilers to natural gas. The Boeing company removed their two coal fired boilers. MEMC signed a consent agreement to continue operating their scrubbers to control NO_X from their acid bath/etching process. This consent agreement has since been terminated due to the retirement of the units for which the agreement applied. St. Gobain Containers installed oxy-fuel firing on both of their glass melting furnaces, and Buzzi Unicem (RC Cement) replaced their long wet kilns with a preheater/precalciner configuration, which lowered their permitted NO_X emissions by over 1,600 tons/year.

The non-utility boilers at General Motors, Trigen – Ashley Street Station, and Mallinckrodt had previously undergone a RACT evaluation under the 1997 Ozone NAAQS and are subject to 10 CSR 10-5.510 *Control of Emissions of Nitrogen Oxides*, which was determined to meet RACT requirements for the 1997 $PM_{2.5}$ NAAQS. The four Ameren facilities were determined to meet RACT after an evaluation of the existing controls and NO_X rates at these facilities combined with their requirements under CAIR. All other facilities were able to demonstrate that additional controls would exceed the requirements of RACT due to economic or logistical feasibility reasons.

Through the RACT evaluation performed in 2007 - 2009 for the SO_2 sources, the first group evaluated was non-boiler sources including PQ Corporation, St. Gobain Containers, Buzzi Unicem (RC Cement), the St. Louis Metropolitan Sewer District, and Doe Run – Herculaneum. The following three sources were not required to install additional SO_2 controls as a result of RACT due to high costs of control and their already relatively low SO_2 emissions: PQ Corporation, St. Gobain Containers, and the Metropolitan Sewer district. Buzzi Unicem (RC Cement) was determined to meet RACT requirements through the replacement of their long wet kilns with a state of the art preheater/precalciner configuration as mentioned above, which effectively reduced SO_2 emissions by 95% through the inherent scrubbing of the new system. Doe Run – Herculaneum was required to reduce SO_2 emissions through a tiered approach as required in 10 CSR 10-6.260 *Restriction of Emission of Sulfur Compounds*, in which SO_2 emissions are limited to 25,100 tons/year in 2012, 16,350 tons/year in 2014, and zero (0) tons/year in 2017. A more recent federal consent decree requires this facility to cease operations at their blast furnace and sinter plant by 2014, eliminating the SO_2 emissions from these units three years sooner than the state rule requires.

The second group evaluated for SO_2 controls through this RACT evaluation was the industrial/commercial/institutional boiler sources including Washington University, Boeing Company, Trigen-Ashley Street Station, Anheuser Busch, Mallinckrodt, and General Motors –

Wentzville. As noted above, Washington University switched their coal fired units to natural gas, and Boeing removed their two coal-fired units. Both of these control strategies were determined to meet RACT requirements. For the other companies, the RACT evaluations were performed and SO_X limits were established based on limits achievable through reasonable controls for each of the boilers and these limits were codified into 10 CSR 10-6.260 *Restriction of Emission of Sulfur Compounds*. Since the RACT evaluation, Trigen-Ashley Street station has retired their coal fired boiler units 5 and 6, and Anheuser Busch has retired its coal fired boiler unit 6.

The last group evaluated for SO_2 controls through this RACT evaluation included the four Ameren EGU facilities, which were determined to meet RACT requirements for SO_2 because of their participation in CAIR. The emissions and expected control measures for these four EGU facilities are discussed in greater detail in the subsection above.

These RACT evaluations for NO_X and SO_2 included an evaluation of the point sources in the St. Louis nonattainment area, accounting for 98% of all point source emissions for these pollutants in the area. The RACT evaluation and corresponding control requirements reduced sulfur dioxide (SO_2) and nitrogen oxides (NOx) emissions from Missouri sources by 20,133 tons/year and 1,067 tons/year, respectively after 2011. However, despite these significant reductions in Missouri's emissions inventory, the photochemical model used in Missouri's attainment demonstration for the 1997 Annual $PM_{2.5}$ NAAQS showed through a sensitivity analysis that these reductions would only decrease the annual $PM_{2.5}$ design value at Granite City by 0.13 $\mu g/m^3$ in 2012, which further supports the conclusion that emissions from Missouri sources do not have a significant impact on the $PM_{2.5}$ concentrations recorded at the Granite City monitor.

This RACT evaluation was submitted to EPA in September 2009 as part of the attainment demonstration for the 1997 $PM_{2.5}$ NAAQS, and because the RACT evaluations were performed so recently, it is unlikely that another RACT evaluation would result in any new control requirements for Missouri sources in the area. Furthermore, as a result of federal control measures discussed above, the required shutdown at the Doe Run facility, and the continued decline of mobile source emissions, it's unlikely that further state or local controls would even be necessary to meet reasonable further progress obligations if Missouri is included in the nonattainment area that will result from the violating monitor in Granite City. Therefore, if areas in Missouri are ultimately included in the nonattainment area that will result from the violating Granite City monitor, few if any new controls in Missouri, beyond what is already in place or expected in the near future, will actually be required for the area. This means there would be no net air quality benefit by designating areas in Missouri nonattainment based on the violating monitor in Granite City, it would only require Missouri to develop a resource intensive attainment demonstration for the area.

7. Jurisdictional Boundaries

It is also important to note that jurisdictional boundaries limit Missouri's ability to require emissions controls that will result in positive impacts to the monitored $PM_{2.5}$ concentrations at the Granite City monitor. The two sources located to the south of the monitor that are believed to be causing the violation at this monitor are located in Illinois, and Missouri has no authority to regulate the emissions from these facilities. Additionally, SO_X emissions from coal fired power plants located outside of both Illinois and Missouri are believed to be contributing to the regional sulfate concentrations that comprise a significant portion of the total $PM_{2.5}$ concentrations in the St. Louis area. Neither Missouri nor Illinois has the authority to control these upwind state emissions; however, these emissions are anticipated to be controlled in the future through a federal interstate transport rule that will address upwind states' significant contribution to nonattainment areas in downwind states under the 2012 $PM_{2.5}$ NAAQS.

Under the 1997 $PM_{2.5}$ NAAQS, Missouri was included in the bi-state MO/IL St. Louis nonattainment area. Much of the attainment related planning efforts including the attainment demonstration, and reasonably availably control technology evaluations focused on the impacts that sources have on the Granite City monitor. With the two Illinois sources less than one mile south of the Granite City monitor, there was little Missouri could do to lower $PM_{2.5}$ concentrations in Granite City. If areas in Missouri are designated nonattainment based on the violating monitor in Granite City under the 2012 $PM_{2.5}$ NAAQS, Missouri will be placed into this situation again where emissions reductions might be needed at these two sources to attain the NAAQS, but Missouri would have no authority to require the necessary controls at these facilities. If this occurs, then Missouri would be required to face the consequences for failing to attain the NAAQS through no fault of our own, which could require even more stringent measures to be adopted in Missouri that may not be cost effective, and still wouldn't have a significant impact on the violating monitor that would drive the design value for the area.

8. Other Considerations

As stated in Section 3 of this Appendix, aggregate emissions in the MSA alone are not enough to determine the relative contribution of these emission sources to a particular $PM_{2.5}$ monitor violation. Sophisticated tools such as dispersion/photochemical modeling and source apportionment analysis are needed to link emissions from particular sources/locations to $PM_{2.5}$ mass measured at monitors due to the complex, nonlinear atmospheric processes and chemistry involved. These types of analyses are time- and resource-intensive and could not be completed for the purpose of this designation process within the established timeline. However, in 2009 – 2010, EPA performed photochemical modeling for a 2012 base case scenario in support of the Federal Cross-State Air Pollution Rule (CSAPR), which provides some insight into impacts from Missouri sources on the Granite City monitor. Through this effort, source apportionment modeling was performed for Missouri sources to determine their contribution to downwind ambient $PM_{2.5}$ concentrations. Because the CSAPR focused on reductions to NO_X and SO_2, these are the two pollutants for which source apportionment modeling results have been displayed on EPA's website (http://www.epa.gov/crossstaterule/techinfo.html).

The source apportionment modeling results (http://www.epa.gov/crossstaterule/pdfs/CSAPR_Ozone%20and%20PM2.5_Contributions.xls) account for all of Missouri's NO_X and SO_2 emissions (all anthropogenic source categories statewide, including point, area, and mobile sources). The results show that all of Missouri's NO_X and SO_2 emissions contribute 1.223 µg/m^3 to the design value at the Granite City monitor in the 2012 base case. In other words, EPA's modeling indicates that eliminating 100% of Missouri's anthropogenic NO_X and SO_2 emissions statewide would only reduce the annual $PM_{2.5}$ design value at the Granite City monitor by 1.223 µg/m^3. Considering the 2010-2012 design value at this site is 13.5 µg/m3, zeroing out all NO_X and SO_2 emissions in the entire state of Missouri is still not enough to bring the area into attainment of the NAAQS. It is important to note, that this is based on statewide emissions, meaning the contribution from NO_X and SO_2 sources located in the Missouri portion of the St. Louis MSA would likely only be a fraction of this value. The department is unaware of any source apportionment modeling that has been performed to determine the impact of just St. Louis area sources in Missouri on the $PM_{2.5}$ concentrations recorded at the Granite City monitor.

As demonstrated in Section 5 of this Appendix, when the single source located near the Granite City monitor was temporarily shut down for a year in 2009, this alone was enough to bring the area's annual average under 12.0 µg/m^3 (back when the quarterly average concentrations at the monitor before and after the shutdown were 18.7 µg/m^3 and 14.2 µg/m^3, respectively). While regional controls in Missouri and across the rest of the country will help to lower background concentrations and interstate contribution to $PM_{2.5}$ concentrations it is clear that the vast majority of the $PM_{2.5}$ increment above the regional background levels experienced at the Granite City monitor are the result of this single source, and are negligibly impacted by nearby sources in Missouri.

As another consideration, U.S. Steel received a revised construction permit to install pollution control equipment at their facility in March of 2013 (http://www.epa.state.il.us/public-notices/2008/us-steel/sig-mod/revised/us-steel-final-revised-permit.pdf). While it is unclear

exactly what controls have been installed thus far, the average annual $PM_{2.5}$ concentrations year-to-date in 2013 have declined in Granite City. Through July, 31, 2013 the annual average concentration at the Granite City monitor is only 11.4 $\mu g/m^3$, which lends further support that this source is the sole significant contributor to the $PM_{2.5}$ increment experienced at the Granite City monitor.

9. Conclusion

In conclusion, when considering monitoring data, emissions data, meteorology, and the analysis of $PM_{2.5}$ concentrations during and surrounding the period of the shutdown of the U.S. Steel Facility in Granite City, it is clear that local sources in Granite City in combination with background $PM_{2.5}$ concentrations across the Midwest Region are causing the violation at the Granite City Monitor. The Blair Street Monitor, which is just a few miles upwind of the U.S. Steel Facility when wind is blowing from the south, shows average $PM_{2.5}$ concentrations 10% – 15% lower than the concentrations at the Granite City monitor, which is only a few hundred yards downwind of the facility on these same days. In addition, the comparison of the U.S. Steel facility's direct $PM_{2.5}$ and $PM_{2.5}$ precursor emissions to the $PM_{2.5}$ concentrations measured at the Granite City monitor from 2000 – 2012 show the impact that emissions from this facility have on $PM_{2.5}$ concentrations in Granite City. Furthermore, analysis of the periods before, during, and after the shutdown of this facility in 2009, shows that total average $PM_{2.5}$ concentrations recorded by the Granite City monitor dropped by over 30% during the period of shutdown, due to reductions of approximately 30% and 76% of organic carbon and crustal particulate species, respectively. This resulted in an annual average $PM_{2.5}$ concentration well below the level of the NAAQS during the period of shutdown.

Meteorology data supports this same conclusion that when winds are calm or are blowing from the south making the Granite City monitor downwind from the two nearby Illinois sources, this results in the highest $PM_{2.5}$ concentrations at the site and when winds are blowing from the northwest and the monitor is upwind of these two sources, this results in the lowest concentrations at the site. While wind directions do not indicate that there is a significant southwesterly component on high days, HYSPLIT modeling indicates that air masses traveling from southwest of the monitor may be passing over some Missouri sources on some of the high PM concentration days. However, these sources are not believed to be causing the elevated concentrations at the Granite City monitor, but rather contributing to regionally dispersed $PM_{2.5}$ concentrations.

Through the review of emissions data from 2008 and 2011, Missouri sources comprise a large percent of the region's overall emissions inventory. However, $PM_{2.5}$ is a complicated pollutant. There are both direct and indirect $PM_{2.5}$ emissions. Direct emissions contribute significantly to the concentrations to the immediate local area, and indirect emissions depending on the precursor pollutant being analyzed can come from hundreds of miles away before forming particulate at ground-level, or emissions could form at ground-level in the immediate local area based on meteorological conditions. Therefore it is difficult to draw a conclusion based on emissions data alone, but the data clearly does not support a conclusion that controlling Missouri sources of emissions will have any type of noticeable impact on the monitor located in Granite City.

The review of controls in place in Missouri in the St. Louis area along with the expected future controls that will help control emissions in the area indicates that a nonattainment designation for Missouri likely would not result in any more controls for the area other than the controls that will be required regardless of the designation for the area. Furthermore, because Missouri has no authority over the sources that are believed to be causing this violation, there would be little Missouri could do to improve the $PM_{2.5}$ concentrations being recorded in Granite City.

Through this weight of evidence analysis performed to evaluate the $PM_{2.5}$ concentrations at the Granite City monitor, Missouri's recommendation is not to include any Missouri counties in the nonattainment area that will result from the violating monitor located in Granite City, Illinois. The trend analysis for the St. Louis area $PM_{2.5}$ monitors shows that $PM_{2.5}$ concentrations have been on the decline over the past decade as a result of permanent regional and local controls that have been implemented, and this trend is only expected to continue for the region as new federal control measures continue to be phased in. If it is determined that Missouri sources are contributing to the violation in Granite City, then this contribution would be better addressed through an interstate transport SIP because any contribution from Missouri would be best described as regional contribution and not "nearby" as is required to be included in a nonattainment area if there are no violating monitors in the area in question. This analysis clearly supports the fact that there are "nearby" sources in close proximity to this monitor located in Illinois that are causing this violation.