Missouri Department of Natural Resources

Appendix B

Evaluation of the IEPA-RAPS Trailer $PM_{2.5}$ Monitor Located in East St. Louis, Illinois (AQS Site ID: 17-163-0010)

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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 are not 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 $PM_{2.5}$ 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 is 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 East St. Louis, 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 fine particulate matter ($PM_{2.5}$) concentrations recorded by the "IEPA-RAPS Trailer" $PM_{2.5}$ monitor located in St. Clair County, East St. Louis, Illinois (hereafter referred to as the East St. Louis monitor) with a 2010 – 2012 annual $PM_{2.5}$ design value in violation of the 2012 Annual $PM_{2.5}$ National Ambient Air Quality Standard (NAAQS), the Missouri Department of Natural Resources has performed an evaluation of the following: monitoring data from the East St. Louis Monitor and other ambient $PM_{2.5}$ monitors located in the MSA, the emissions sources located in the MO/IL St. Louis MSA, seasonal variations in monitored concentrations at the site, the wind directions on days with the top 20% and bottom 20% recorded 24-hour $PM_{2.5}$ concentrations at the East St. Louis monitor from 2010 – 2012, and modeled wind trajectories for these same days.

1.4 Episode Days Evaluated

Much of the evaluation performed to determine the contributing sources to the current violation at the East St. Louis 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 these days 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 20 percent 24-hour value concentrations recorded at this monitor in each year from 2010 – 2012 were evaluated. The value of 20 percent equates to 11 days in the year as this monitor recorded $PM_{2.5}$ concentrations an average of 56 days per year during the 2010 – 2012 time frame. This was determined to be both a sufficient and manageable number of episode days to evaluate to ensure that enough data is used to get representative trends, while keeping the amount of resources necessary for the evaluation at a manageable level.

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

Table 1. Episode Days Evaluated at the East St. Louis Monitor

East St. Louis High Days			East St. Louis Low Days		
2010	2011	2012	2010	2011	2012
12/10/2010	1/3/2011	11/17/2012	6/7/2010	8/25/2011	5/3/2012
12/28/2010	6/8/2011	1/10/2012	8/30/2010	4/27/2011	6/26/2012
3/9/2010	1/27/2011	9/6/2012	6/19/2010	10/18/2011	4/21/2012
8/24/2010	7/2/2011	6/8/2012	5/2/2010	4/15/2011	3/22/2012
10/11/2010	5/27/2011	7/8/2012	3/15/2010	10/30/2011	11/11/2012
2/1/2010	1/15/2011	12/29/2012	1/8/2010	11/17/2011	6/2/2012
12/4/2010	12/5/2011	1/22/2012	4/26/2010	9/6/2011	9/24/2012
2/23/2010	8/1/2011	3/28/2012	9/11/2010	11/29/2011	2/21/2012
4/14/2010	9/12/2011	8/7/2012	4/8/2010	2/2/2011	2/3/2012
8/12/2010	3/10/2011	12/17/2012	5/8/2010	5/15/2011	11/23/2012
11/16/2010	5/9/2011	12/23/2012	2/7/2010	9/30/2011	10/24/2012

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

2.1 2010 – 2012 Annual $PM_{2.5}$ 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 was 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 East St. Louis, Illinois. A separate evaluation was performed for the violating monitor located in Granite City, Illinois, which can be found in Appendix A.

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

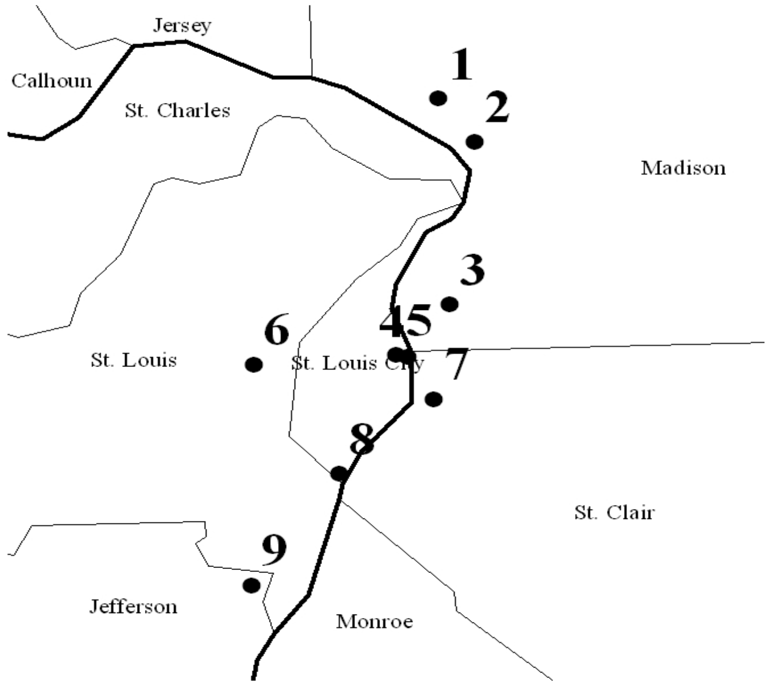
** Note: All values have been rounded to the nearest 0.1 microgram/cubic meter

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: 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 Average $PM_{2.5}$ Concentration Trends in the Illinois/Missouri St. Louis Area (2002 – 2013 year-to-date)

It is important to note that as a result of federal and local control measures in place in the St. Louis area on both the Illinois and Missouri sides, along with regional emission control measures that have been implemented across the country, average annual $PM_{2.5}$ concentrations have been declining steadily in the St. Louis over the past several years. Table 3 shows the annual average concentrations at the neighborhood scale monitoring sites listed above in Table 2 for each year from 2002 through 2012 and also includes the year-to-date annual average concentrations for 2013. For the Illinois monitors, AQS was used for the year-to-date 2013 data. All Illinois monitors have reported data through 7/31/13. It is noted that none of the data for 2013 has yet been certified and submitted to EPA, which will not happen until May 2014. For the Missouri monitors the 2013 year-to-date data is based on air quality monitoring data at FEM and FRM monitors that are used for comparison to the annual $PM_{2.5}$ NAAQS. The Missouri 2013 year-to-date data covers the time period from 1/1/13 – 9/16/13. This data has also not yet been quality assured or certified. Table 3 also includes the 2013 critical value for the annual average $PM_{2.5}$

concentration at each monitor. If the annual average $PM_{2.5}$ concentration at any of these monitors in 2013 is greater than or equal to the critical value it would trigger a violation of 2012 Annual $PM_{2.5}$ NAAQS at the respective monitor.

As seen in Table 3, the 2013 critical value for the East St. Louis monitor is 12.5 µg/m^3, and the year-to-date annual average is only 11.0 µg/m^3. It is noted, that the 2013 year-to-date average for East St. Louis is only based on seven months' worth of monitoring data, and therefore it is still too early to tell if the monitor will come into compliance with the 2012 Annual $PM_{2.5}$ NAAQS. However, considering the critical value at the East St. Louis monitor and the fact that the year-to-date annual average over 7 months is 11.0 µg/m^3, the monitor would need to average a $PM_{2.5}$ concentration of 14.48 µg/m^3 or higher in the remaining five months of the year in order to violate the standard. Additionally, as seen in Table 3, the average annual $PM_{2.5}$ concentrations across the St. Louis area have been on a declining trend over the past decade indicating that air quality across the region is steadily improving. Taking all of these factors into consideration, it is very possible that the East St. Louis monitor could come into compliance with the 2012 Annual $PM_{2.5}$ NAAQS once 2013 is over and the more recent monitoring data is factored into the design value at this monitor.

Table 3. St. Louis Area Annual Average $PM_{2.5}$ Concentrations (2002 – 2013 year-to-date) ($\mu g/m^3$) *														
Missouri Monitors														
Monitor Location	**AQS Site ID**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009 ******	**2010**	**2011**	**2012**	**2013 (ytd) ****	**2013 Critical Value**
Arnold West	29-099-0019	15.1	13.9	12.6	15.4	12.6	13.8	12.2	10.5	10.5	9.9	9.8	10.1	16.5
South Broadway	29-510-0007	15.3	14.4	13.1	15.9	13.1	14.0	12.5	11.9	12.3	11.7	9.1	11.2	15.4
Blair Street	29-510-0085	15.4	14.1	13.2	16.1	13.4	13.9	12.7	11.5	12.6	11.9	10.5	11.0	13.8
Ladue	29-189-3001	14.6	13.6	12.2	15.5	11.8	13.1	12.0	11.1	11.2	10.6	10.8	11.9	14.8
Illinois Monitors														
Monitor Location	**AQS Site ID**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009 ******	**2010**	**2011**	**2012**	**2013 (ytd) *****	**2013 Critical Value**
Alton	17-119-2009	14.7	14.0	11.5	16	13.1	14.9	12.5	10.1	13.3	11.5	10.4	9.8	14.3
Wood River	17-119-3007	15.1	14.0	13.2	16	13.1	14.2	12.2	11.0	12.0	12.4	10.6	11.1	13.3
East St. Louis	17-163-0010	16.7	16.6	14.7	17.1	14.5	15.6	12.5	11.7	13.0	12.8	10.9	11.0	12.5
Granite City	17-119-1007	17.7	17.5	15.4	18.2	16.3	15.1	15.7	11.3	14.3	13.3	12.8	11.2	10.1

* Note: 2013 year-to-date annual averages at all monitors could increase or decrease as more monitoring days are recorded. All values have been rounded to the nearest 0.1 $\mu g/m^3$

** Note: Missouri 2013 year-to-date average is based on FEM/FRM monitoring data from 1/1/13 – 6/10/13. The data has not yet been quality assured or certified.

*** Note: Illinois 2013 year-to-date average is based on monitoring data reported to AQS. $PM_{2.5}$ monitoring data for the Illinois monitors include data from 1/1/13 – 7/31/13. The data has not yet been quality assured or certified.

**** Note: In 2009, a significant direct $PM_{2.5}$ and $PM_{2.5}$ precursor emissions source was shutdown throughout much of year. This resulted in lower annual average concentrations of $PM_{2.5}$ across the St. Louis Region. Additional information regarding an evaluation of this source and the temporary shutdown during 2009 can be found in Appendix A, Section 5 of the Missouri 2012 $PM_{2.5}$ Boundary Recommendations.

2.3 Monitoring Frequency at the East St. Louis Monitor

It must be taken into consideration that the FRM monitor located in East St. Louis used for comparison with the annual $PM_{2.5}$ NAAQS only monitors $PM_{2.5}$ concentration levels once every six days. This reduces the number of days that can be evaluated making it more difficult to determine the trends if any that are associated with elevated $PM_{2.5}$ concentrations being recorded by the monitor. In addition to being only a 1-6 day monitor, this site lacks a Chemical Speciation Network (CSN) monitor that could be used to evaluate the various species that comprise the $PM_{2.5}$ concentrations at this monitor. For these reasons, it is difficult to perform a conclusive evaluation to determine the sources that are causing/contributing to the violation at this monitor.

3. Emissions Data

3.1 Emissions Inventory Data

Tables 4 – 8 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 East St. Louis monitor. Although it is noted that a marginal percentage direct $PM_{2.5}$ emissions from paved and unpaved roads nearby the East St. Louis monitor in St. Clair County could have an impact on the $PM_{2.5}$ concentrations recorded by the East St. Louis 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 East St. Louis. 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 4 to allow for a more focused evaluation on emissions that may be impacting the violating monitor in East St. Louis.

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 and some pollutant categories in St. Clair County (the location of the East St. Louis 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 – 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 helps prevent high concentrations of these pollutants 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, so they contribute more to regional background levels than they do to the local MSA. These types of emissions sources have typically been controlled through regional emission programs aimed at reducing the impact of emissions on downwind state ambient air pollutant concentrations. As noted in the next subsection, there are not any local point sources in St. Clair County with emissions in 2011 exceeding 100 tons per year for direct $PM_{2.5}$ or any individual $PM_{2.5}$ precursor that are in close proximity to the East St. Louis monitor; however there are several sources with emissions that are not insignificant that could be causing or contributing to the elevated $PM_{2.5}$ concentrations in East St. Louis.

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 analyze the likelihood of whether Missouri sources are causing or contributing to the magnitude of the violating monitor in East St. Louis. This approach is discussed in the sections that follow and is appropriate since area wide monitored violations do not occur over the entire MO/IL St. Louis MSA.

Table 4 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 5 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 6 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 7 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 8 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 2 provides a map with point sources in the Illinois/Missouri St. Louis MSA along with the location of the East St. Louis 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 2 are numbered. These numbers correspond to the sources, which are listed according to these numbers in Table 9 along with the numeric emissions in 2011 for each of these sources. Table 9 also provides the distance in miles from each of these sources to the East St. Louis 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 East St. Louis monitor. Figure 3 provides a map with the same sources as Figure 2, 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 2

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 East St. Louis Monitor

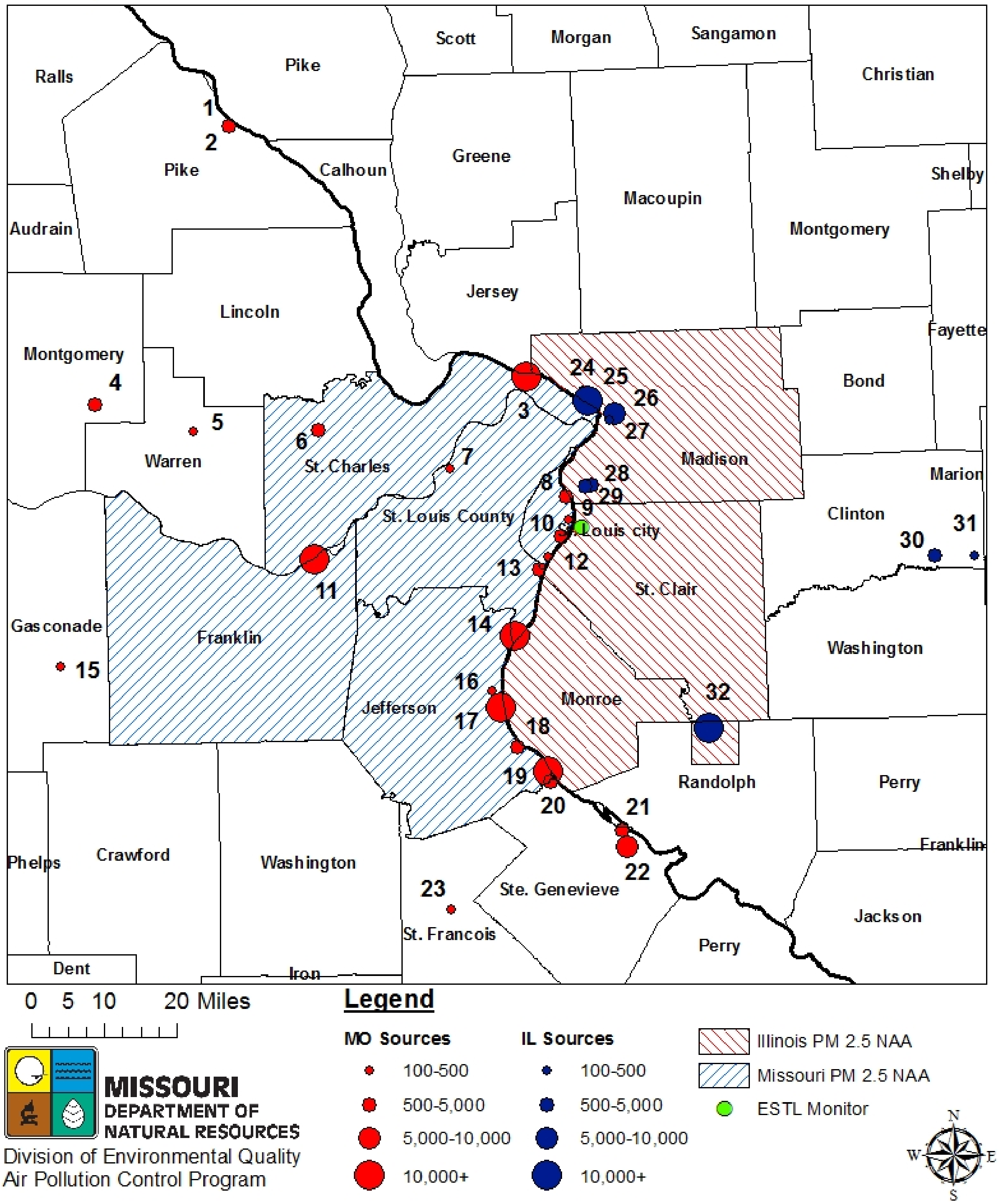


Figure 3

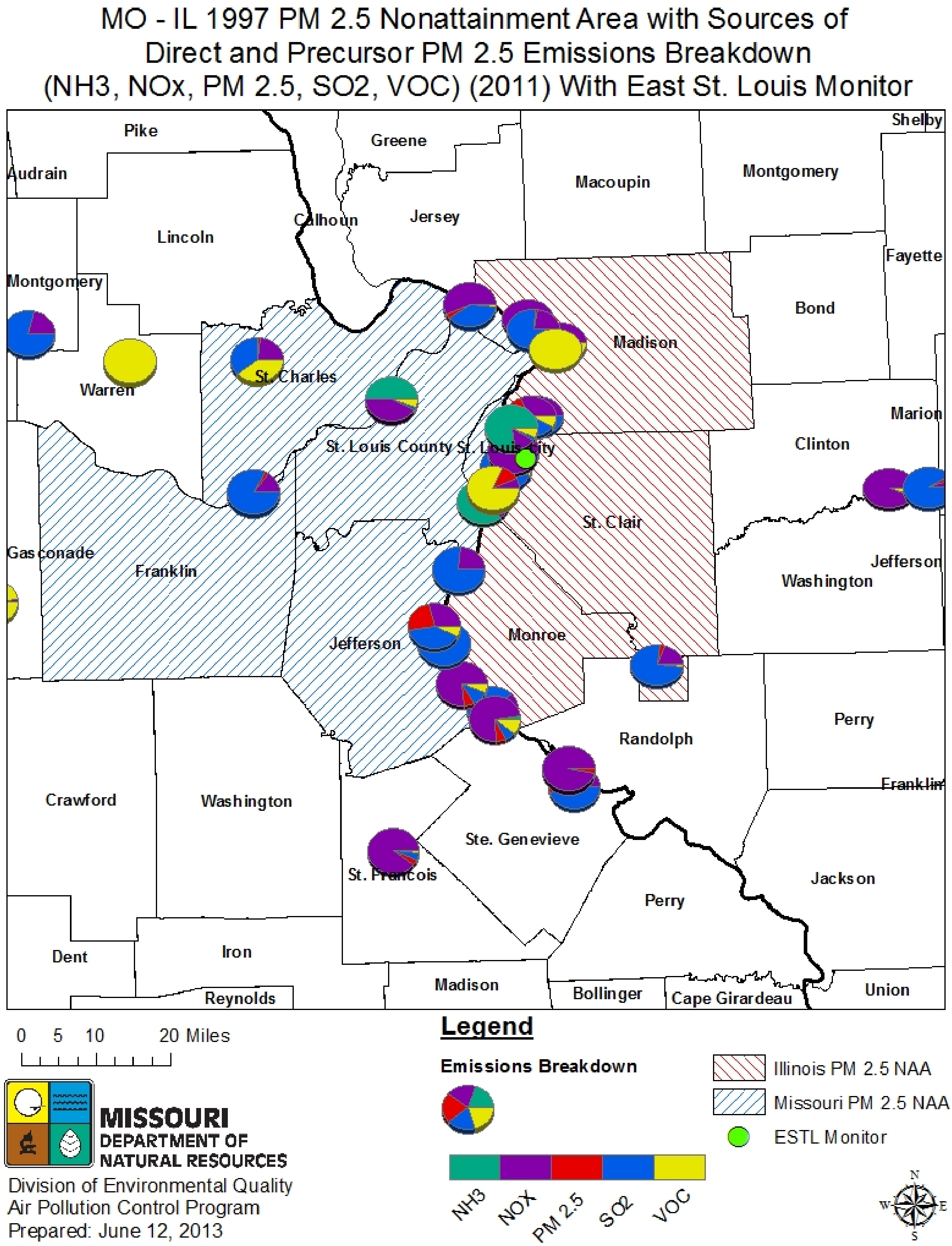

MO - IL 1997 PM 2.5 Nonattainment Area with Sources of Direct and Precursor PM 2.5 Emissions Breakdown (NH3, NOx, PM 2.5, SO2, VOC) (2011) With East St. Louis Monitor
Pike
Greene
Shelby
Audrain
Macoupin
Montgomery
Calhoun
Jersey
Lincoln
Fayette
Montgomery
Bond
Madison
St. Charles
Warren
Marion
St. Louis County
St. Louis City
Clinton
St. Clair
Gasconade
Franklin
Jefferson
Washington
Jefferson
Monroe
Randolph
Perry
Franklin
Crawford
Washington
Ste. Genevieve
St. Francois
Jackson
Perry
Dent
Iron
Reynolds
Madison
Bollinger
Cape Girardeau
Union
0 5 10 20 Miles
Legend
Emissions Breakdown
NH3
NOX
PM 2.5
SO2
VOC
Illinois PM 2.5 NAA
Missouri PM 2.5 NAA
ESTL Monitor
MISSOURI DEPARTMENT OF NATURAL RESOURCES
Division of Environmental Quality
Air Pollution Control Program
Prepared: June 12, 2013
N
W
E
S

Table 9 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 2 Map Number	County Name	Facility Name	NH_3	NO_X	PM_{25}-PRI	SO_2	VOC	Distance to East St. Louis Monitor (mi.)
1	Pike	ASHLAND INC-MISSOURI CHEMICAL WORKS	2.68	295.33	7.67	1,835.56	58.76	73.38
			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	73.35
			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	22.03
			0.06%	15.54%	7.62%	2.16%	1.66%	
4	Montgomery	CHRISTY MINERALS, LLC-HIGH HILL	-	147.7	0.1	549.5	-	68.82
			-	0.32%	0.00%	0.24%	-	
5	Warren	CASCADES PLASTICS INC-WARRENTON	-	-	-	-	163.27	54.76
			-	-	-	-	1.73%	
6	St. Charles	GENERAL MOTORS LLC-WENTZVILLE CENTER	0.31	270.5	26.16	424.24	480.06	38.45
			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	19.81
			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	4.64
			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	2.06
			-	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	2.99
			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	36.80
			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	5.95
			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	8.11
			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	17.33
			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	74.04
			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	25.51
			-	0.24%	1.60%	0.07%	0.28%	

Missouri Facilities continued…

Figure 2 Map Number	County Name	Facility Name	NH_3	NO_X	PM_{25}-PRI	SO_2	VOC	Distance to East St. Louis Monitor (mi.)
17	Jefferson	DOE RUN COMPANY-HERCULANEUM SMELTER	0.29	9.6	4.35	15,234.49	1.71	26.94
			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	31.28
			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	33.68
			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	35.05
			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	41.81
			-	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	44.30
			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	55.37
			0.23%	0.80%	0.29%	0.01%	0.07%	

Illinois Facilities

Figure 2 Map Number	County Name	Facility Name	NH_3	NO_X	PM_{25}-PRI	SO_2	VOC	Distance to East St. Louis Monitor (mi.)
24	Madison	Alton Steel Inc.	0.71	131.94	9.14	45.9	3.99	18.74
			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	17.45
			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	16.27
			0.01%	6.39%	3.85%	0.80%	19.51%	
27	Madison	Explorer Pipeline Co	-	-	-	-	120.96	15.2
			-	-	-	-	1.28%	
28	Madison	Gateway Energy & Coke Co LLC	-	406.73	69.46	1,201.41	10.57	5.99
			-	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	5.72
			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	54.07
			-	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	32.62
			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 East St. Louis, Illinois

As seen from the Table 9 and Figures 2 and 3, no individual sources of direct $PM_{2.5}$ or $PM_{2.5}$ precursors located in St. Clair County Illinois emitted more than 100 tons of direct $PM_{2.5}$ or $PM_{2.5}$ precursor. However, there are local sources in the area that are potentially contributing to the $PM_{2.5}$ concentration levels recorded by the East St. Louis monitor. Figure 4 displays a satellite image of the area surrounding the East St. Louis monitor in Illinois and labels the location of sources with 10 or more tons/year of total $PM_{2.5}$ and $PM_{2.5}$ precursor emissions in 2011 that could be contributing to the $PM_{2.5}$ concentration levels in the area. Table 11 lists the 2011 emissions for each $PM_{2.5}$ pollutant category for each of the facilities identified in Figure 4 along with the distance between each source and the East St. Louis monitor. As can be seen in the figure, there is a cluster of industrial emissions sources within 1 – 2 miles southwest of the monitor and two rail yards and an airport to the southwest. The figure also displays the rail lines in the area and the I-70 and I-64 highways, with the major intersection of these highways labeled about 0.5 miles to the northwest of the monitor. As seen, in the figure the rail lines spider web around the area, also contributing to $PM_{2.5}$ and $PM_{2.5}$ precursor emissions in close proximity to this monitor. Because of this conglomerate of emissions sources in close proximity of the East St. Louis monitor, it is possible that these sources are contributing to the elevated $PM_{2.5}$ concentrations recorded by the East St. Louis monitor. These sources and their locations must be considered along with meteorological data in order to further analyze the causes and contributions to the violation at this monitor.

Figure 4 Satellite Image of the East St. Louis Monitor with Local Emissions Sources

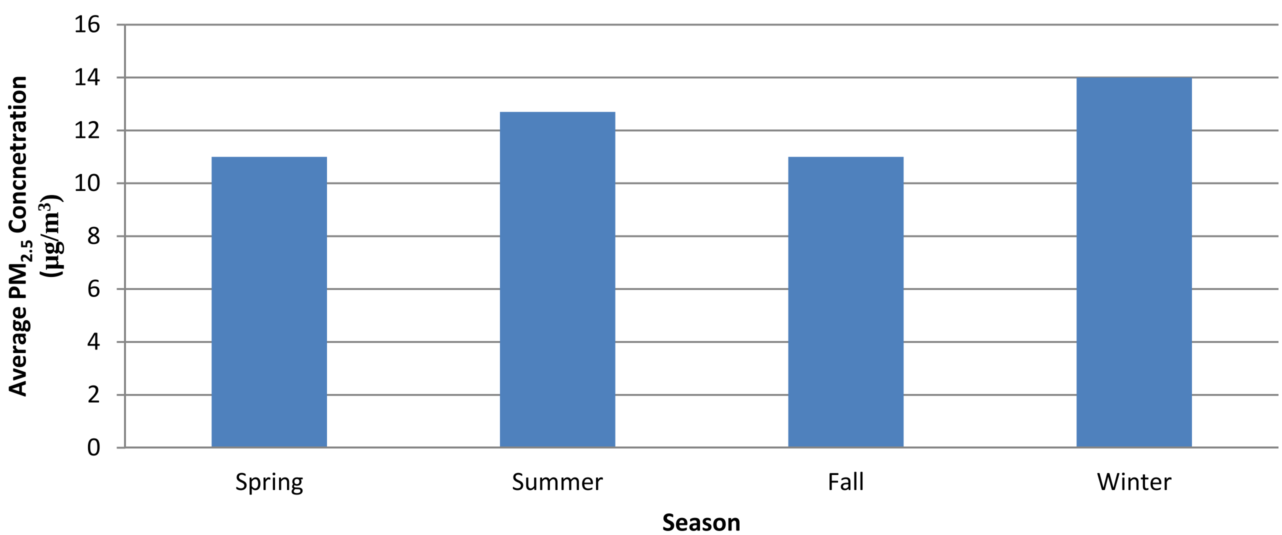
Table 10	East St. Louis Local $PM_{2.5}$/$PM_{2.5}$ Precursor Emissions Sources (2011 Emissions) (tons/year)						
County Name	Facility Name	NH_3	NO_X	$PM_{2.5}$-PRI	SO_2	VOC	**Distance to East St. Louis Monitor (mi.)**
St. Clair	Afton Chemical Corp	3.13	27.36	4.00	92.45	52.31	0.81
St. Clair	Center Ethanol Co	1.47	49.45	15.39	0.94	36.16	1.38
St. Clair	Cerro Flow Products LLC	0.09	3.27	0.46	0.02	23.26	1.53
St. Clair	Coapman Yard	0.01	18.49	0.56	0.16	1.40	1.97
St. Clair	Conoco Phillips Pipe Line Co	-	14.26	-	-	64.34	2.55
St. Clair	East St. Louis Yard	0.02	45.42	1.22	0.37	3.07	1.14
St. Clair	Jet Aviation St Louis Inc.	-	-	-	-	49.09	2.44
St. Clair	Joint American Bottoms & Sauget Treatment Facility	0.01	0.14	0.01	0.00	43.81	2.01
St. Clair	Metro East Industries Inc.	-	-	0.03	-	29.72	1.90
St. Clair	Nuplex Resins LLC	-	-	-	-	18.36	1.66
St. Clair	Resource Recovery Group	0.00	0.14	0.01	0.23	12.14	1.59
St. Clair	Solutia Inc.	0.07	2.73	5.65	0.79	19.25	1.11
St. Clair	St Louis Downtown Airport		4.70	5.18	0.94	8.39	2.87
St. Clair	Veolia ES Technical Solutions LLC	0.02	58.17	1.11	0.49	0.27	1.81

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 East St. Louis 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 5 displays the average seasonal $PM_{2.5}$ concentrations at the East St. Louis monitor from 2010 – 2012. As can be seen, during the winter months $PM_{2.5}$ concentrations averaged 14 $\mu g/m^3$, during the summer months $PM_{2.5}$ concentrations averaged 12.7 $\mu g/m^3$ and during the spring and fall months the $PM_{2.5}$ concentrations averaged just 11.3 $\mu g/m^3$. Therefore, winter meteorological conditions are most conducive to higher $PM_{2.5}$ concentrations, summer conditions are slightly more conducive to higher $PM_{2.5}$ concentrations, and spring and fall conditions are generally the least conducive to high $PM_{2.5}$ concentrations. Because all seasons still produce average $PM_{2.5}$ concentrations near the level of the NAAQS, a full year's worth of data must be taken into account when evaluating the $PM_{2.5}$ levels recorded by this monitor.

Figure 5 East St. Louis 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 East St. Louis 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 6 displays the wind rose for all of the hours in the days where the East St. Louis monitor recorded its highest 20 percent $PM_{2.5}$ concentrations during the years 2010 – 2012. As seen in Figure 6, calms represent 40% of the hours during the high days at the East St. Louis monitor for the years evaluated. These calm winds indicate that emissions from local sources are not dissipating from the area and could be significantly impacting the monitored $PM_{2.5}$ concentrations in the area. As stated in subsection 3.3, there are numerous local sources of $PM_{2.5}$ and $PM_{2.5}$ precursors in St. Clair County located nearby this monitor to the southwest, and southeast that could be contributing to the violation, particularly during calm wind events, when local emissions cannot disperse from the area. The second most predominant wind direction associated with high $PM_{2.5}$ days at the East St. Louis monitor are when winds are blowing out of the southeast, which indicates that Missouri sources would not be contributing during these hours on the high days evaluated. However, roughly 10% of the hours in which high $PM_{2.5}$ days were recorded at the East St. Louis monitor were associated with winds blowing out of the northwest quadrant, which could indicate that emissions from Missouri sources are contributing to elevated concentrations during some of the hours on the high $PM_{2.5}$ concentration days.

In an effort to further understand the cause of elevated concentrations at the East St. Louis monitor, the wind directions were also evaluated on days where East St. Louis recorded its lowest $PM_{2.5}$ concentrations. Figure 7 displays the wind rose for all of the hours in the days where the East St. Louis monitor recorded its lowest 20 percent $PM_{2.5}$ concentrations during the years 2010 – 2012. As seen in Figure 7, calms only represented 16% of the hours during these days, which would support a conclusion that higher winds are blowing local emissions out of the area on many of the low $PM_{2.5}$ concentration days, meaning that local sources in the area could be contributing to the violation. During the hours evaluated for the low $PM_{2.5}$ days at the East St. Louis monitor winds were predominantly blowing from the north and northwest quadrants at higher wind speeds. However, winds blowing from the southeast quadrant also make up a sizeable portion of the hours during the low $PM_{2.5}$ days evaluated. The fact that there is no single wind direction that is associated with high or low $PM_{2.5}$ days at this monitor makes it difficult to determine the source(s) that are contributing to the violation at this monitor.

When considering the data from both Figures 6 and 7 together the only consistent trend is that calm and low wind speed events trigger higher concentrations and higher wind events trigger lower concentrations, which supports a conclusion that local emissions sources could be causing the elevated $PM_{2.5}$ concentrations on a significant portion of the high $PM_{2.5}$ episode days. However, understanding that both high concentration days and low concentration days are associated with southeast and northwest winds, it is difficult to draw a conclusion about the sources responsible for the violation. Considering both wind speeds and wind directions, the data is inconclusive as to whether the elevated $PM_{2.5}$ concentrations recorded at this monitor are the result of regional level emissions across the St. Louis area, or if the concentrations are being significantly impacted by the numerous local sources in St. Clair County surrounding the monitor. The potential for local source contribution is discussed in greater detail in Section 5 through a comparison of 24-hour $PM_{2.5}$ concentrations at East St. Louis and Blair Street on the high $PM_{2.5}$ episode days. Finally, as described in subsection 2.3 the East St. Louis monitor only samples $PM_{2.5}$ concentrations every 6^{th} day, which limits the data set that can be used for analysis, contributing greater uncertainty to any conclusion that might be drawn from the wind rose data.

Figure 6 Wind Directions for All Hours of the Day on High $PM_{2.5}$ Concentration Days at East St. Louis in 2010 – 2012

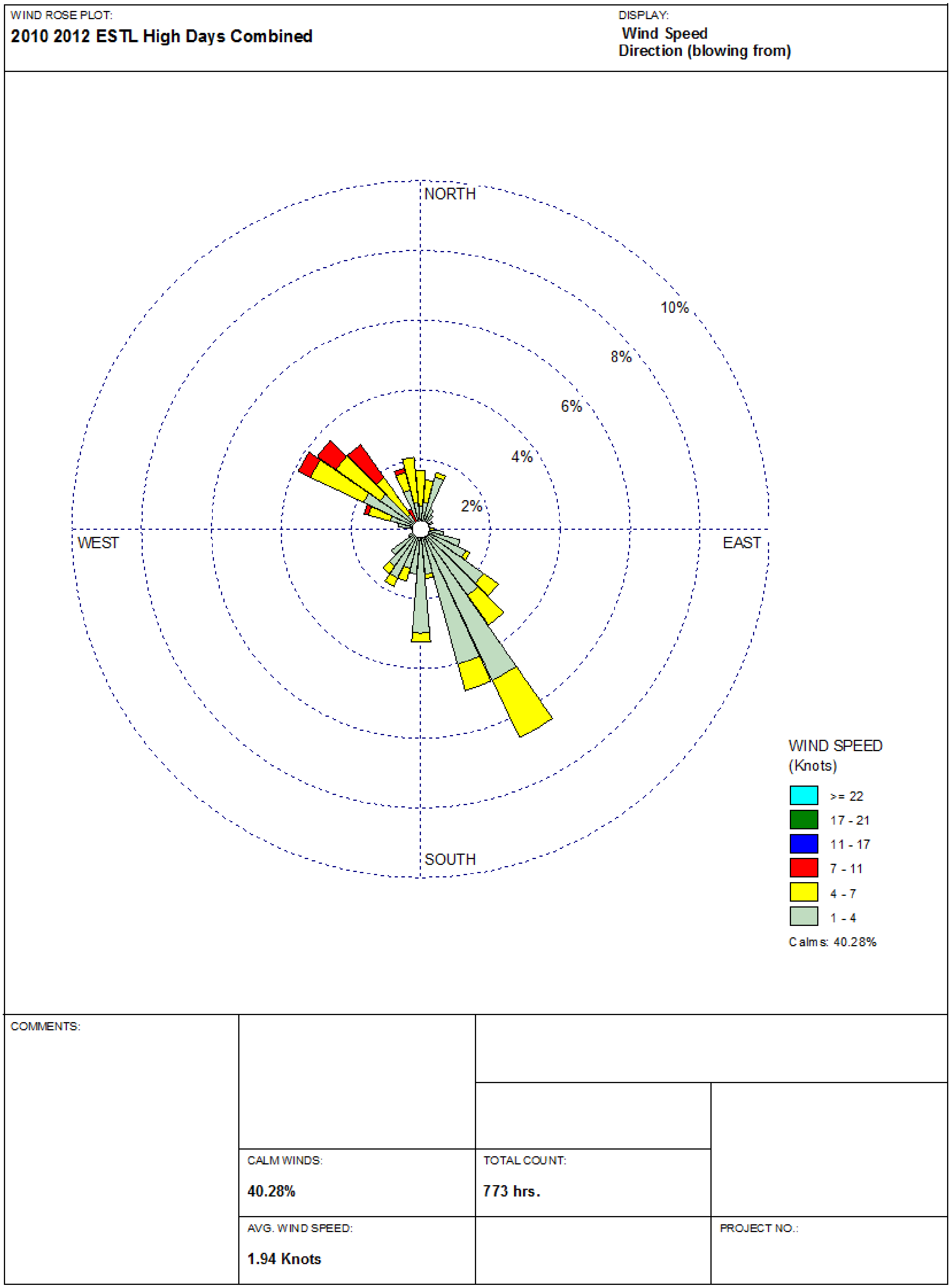
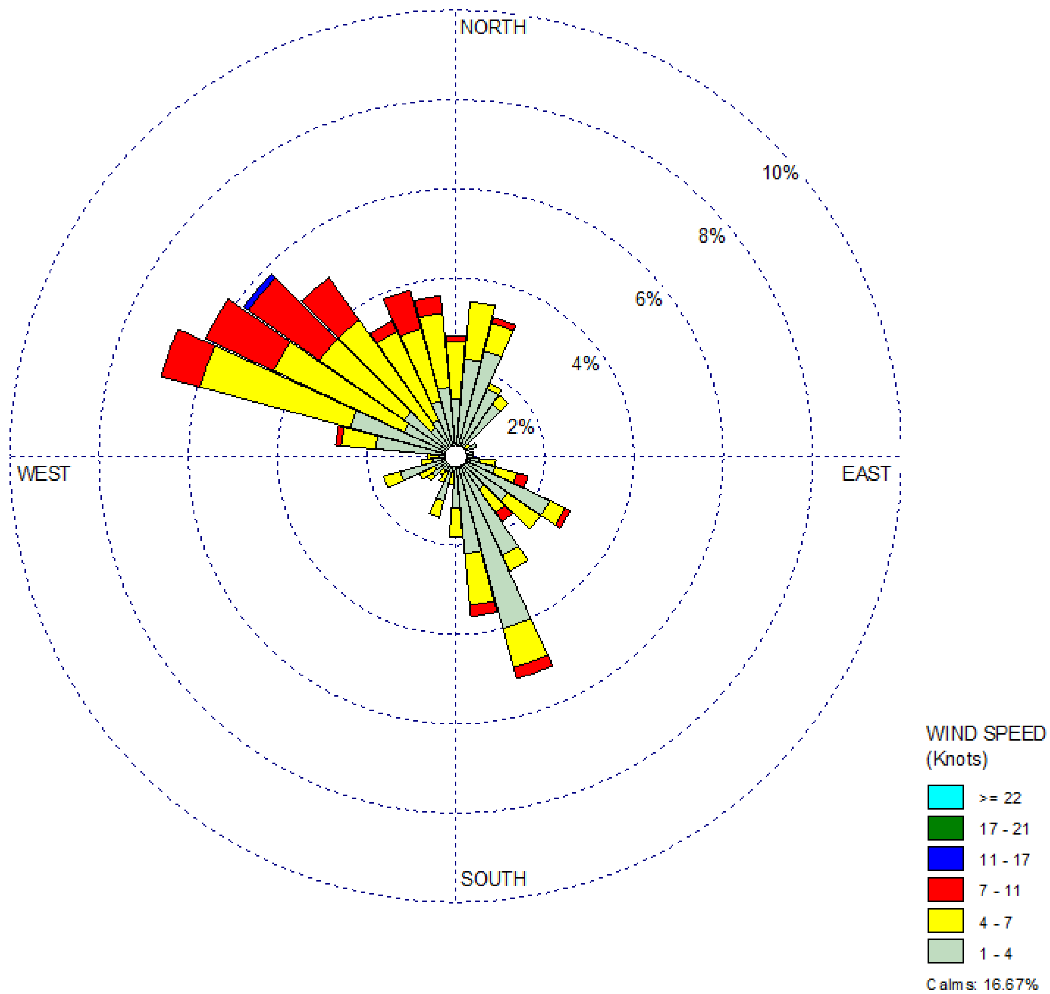


Figure 7 Wind Directions for All Hours of the Day on Low $PM_{2.5}$ Concentration Days at East St. Louis in 2010 – 2012

WIND ROSE PLOT:
2010 2012 ESTL Low Days Combined

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:

CALM WINDS:
16.67%

TOTAL COUNT:
776 hrs.

AVG. WIND SPEED:
3.34 Knots

PROJECT NO.:

4.2 HYSPLIT Modeling

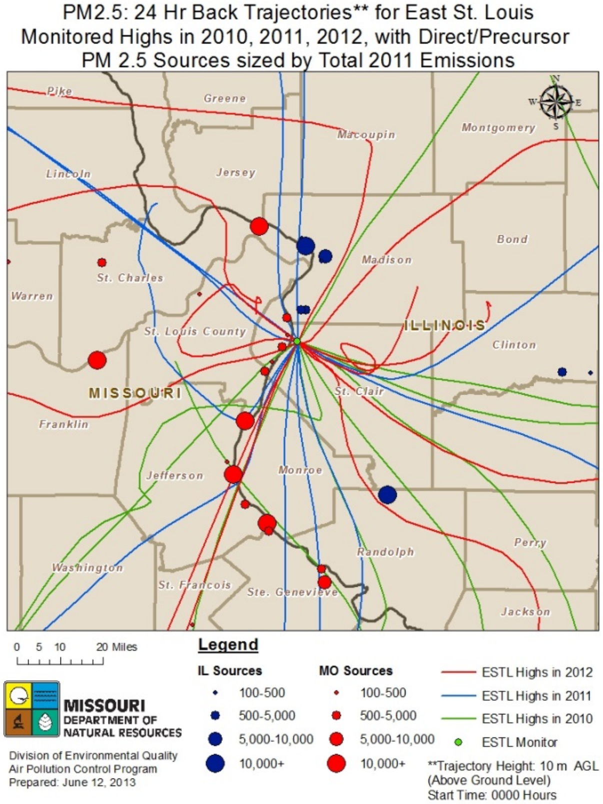
The Air Program also evaluated 24-hour back trajectories of the air masses on both the high days and low days recorded at the East St. Louis monitor from 2010 – 2012. In order to perform this analysis, the back trajectories were generated with the Hybrid Single Particle Lagrangian Integrated Trajectory 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 8 and 9 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 East St. Louis Monitor for reference. As seen in Figure 6, from 2010 – 2012 there is no trend indicating typical paths that air masses travel before arriving in East St. Louis on high $PM_{2.5}$ concentration days. According to the HYSPLIT evaluations air masses travel from virtually all directions on some percentage of the high $PM_{2.5}$ days evaluated. Looking at the low-$PM_{2.5}$ concentration days tells a similar story. The most predominant trend on low $PM_{2.5}$ concentration days appears to be when air masses are traveling from the northwest; however, just as with the high $PM_{2.5}$ concentration days air masses travel from all directions on at least a few of the low $PM_{2.5}$ days evaluated. Therefore it is difficult to draw conclusions about the sources that causing the peak $PM_{2.5}$ episodes at this monitor, because there are not any distinct trends that can be used to draw conclusions about the sources that are causing or contributing to the violation at this monitor.

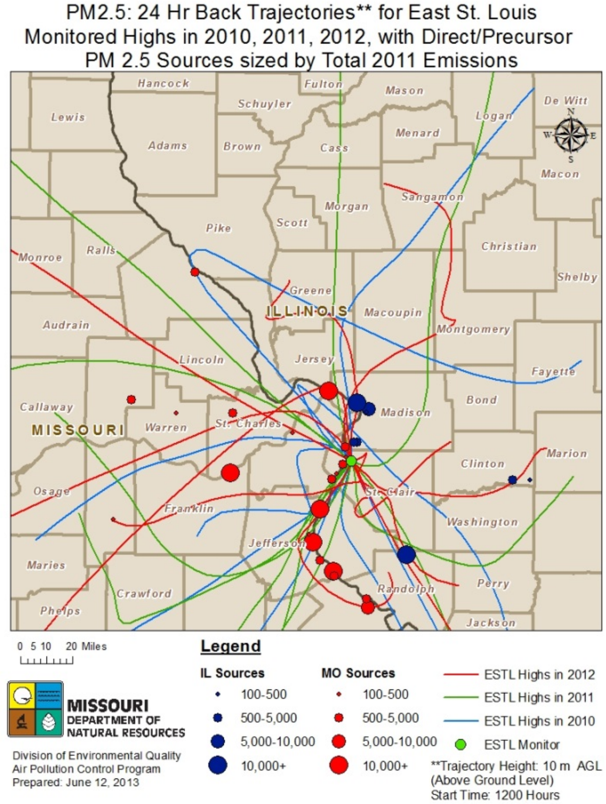
Combining the HYSPLIT, wind rose, and emissions data makes it difficult to draw conclusions about whether the entire urban region is causing the violation, if transported emissions from upwind states are largely responsible, or if the local sources surrounding the East St. Louis monitor are causing the violation. The fact that monitoring data on the Missouri side of the river located in urban core of St. Louis are complying with the NAAQS supports the conclusion that local sources are likely causing the peak $PM_{2.5}$ episodes at the East St. Louis monitor. Additionally, calm and low wind speeds tend to result in more high $PM_{2.5}$ concentrations recorded by the monitor, which also supports the conclusion that local sources are likely causing elevated $PM_{2.5}$ concentrations. However, on some high $PM_{2.5}$ days, air masses are passing over Missouri sources in the St. Louis area, which could support a conclusion that Missouri sources are contributing to elevated $PM_{2.5}$ concentrations on some days. Finally, as stated throughout this analysis, the East St. Louis monitor only samples every 6^{th} day, limiting the amount of data available for analysis, which adds uncertainty, making it difficult to draw conclusions about the contributing sources to this monitor.

Figure 8 HYSPLIT Wind Trajectories for High $PM_{2.5}$ Concentration Days at East St. Louis 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.

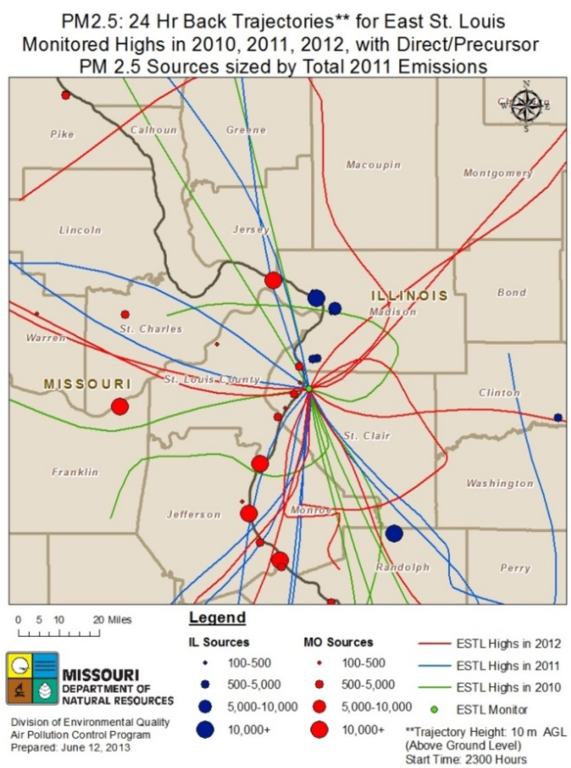
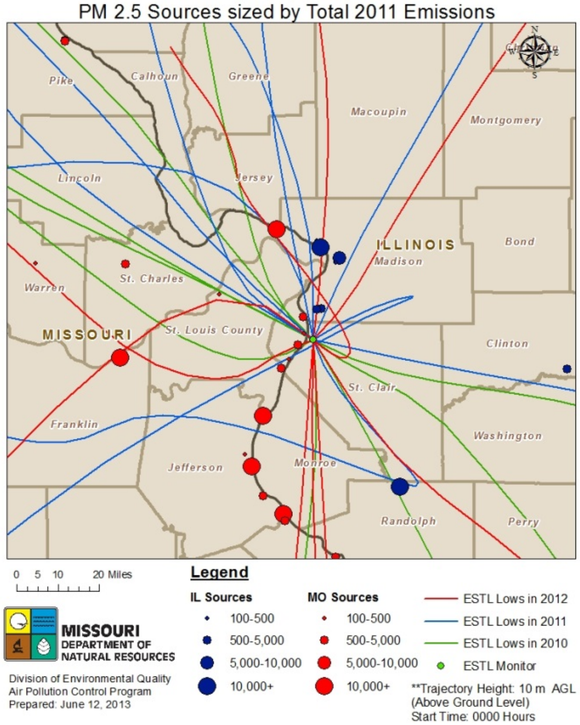


Figure 9 HYSPLIT Wind Trajectories for Low $PM_{2.5}$ Concentration Days at East St. Louis in 2010 – 2012 (12:00 a.m., 12:00 p.m., and 11:00 p.m.)

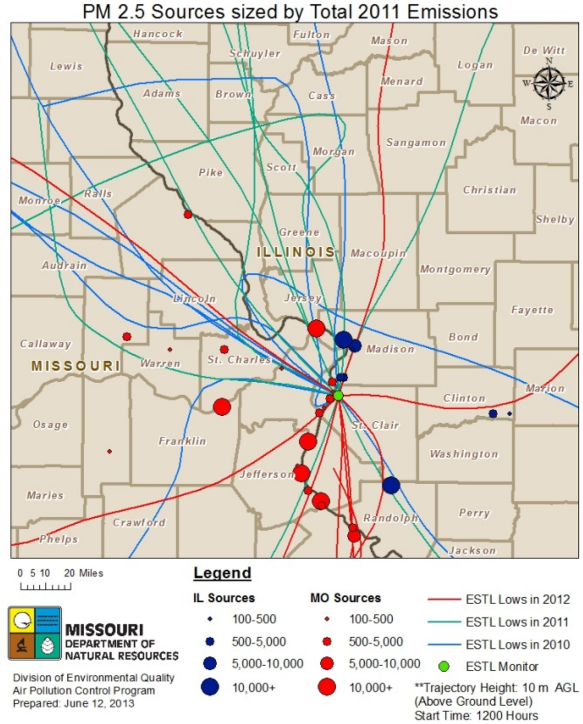
12:00 a.m. (Morning)

PM2.5: 24 Hr Back Trajectories** for East St. Louis
Monitored Lows in 2010, 2011, 2012, with Direct/Precursor
PM 2.5 Sources sized by Total 2011 Emissions



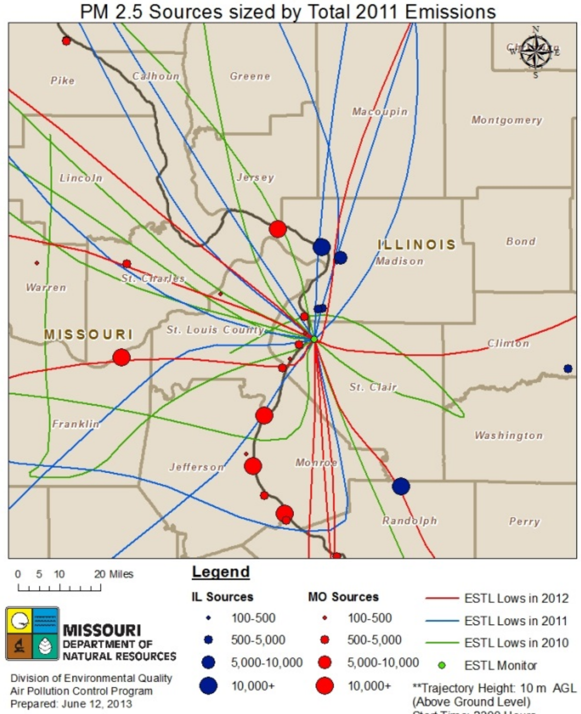
12:00 p.m. (Noon)

PM2.5: 24 Hr Back Trajectories** for East St. Louis
Monitored Lows 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 East St. Louis
Monitored Lows in 2010, 2011, 2012, with Direct/Precursor
PM 2.5 Sources sized by Total 2011 Emissions



5. Comparison of $PM_{2.5}$ Concentrations at Blair Street and East St. Louis

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

Table 11 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 East St. Louis monitor are 3.7 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 East St. Louis, which indicates that local emissions sources could be causing the elevated $PM_{2.5}$ concentrations in the area on some of the high $PM_{2.5}$ episode days.

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 East St. Louis site. The Air Program retrieved the 24-hour $PM_{2.5}$ concentrations at the Blair Street and East St. Louis monitors for the top 20 percent episode days listed in Table 1 and compared these values, which are listed below in Tables 12, 13, and 14 for the years 2010, 2011, and 2012, respectively. As can be seen, the 24-hour values at the highest 20 percent episode days at the East St. Louis are roughly 10% – 15% higher on average than the 24-hour values recorded at the Blair Street site on those same days. However, when looking at the individual days listed in Tables 12 – 14, on most days the values recorded at East St. Louis and Blair Street are very comparable, and Blair Street records higher 24-hour $PM_{2.5}$ on some of the episode days evaluated. The reason the total average 24-hour $PM_{2.5}$ concentration on high $PM_{2.5}$ episode days at East St. Louis is higher than the total average concentration recorded at Blair Street on those same days is because there are several outlier days where the East St. Louis site is recording 24-hour concentrations that are 25% - +100% higher than the concentrations recorded at Blair Street. These outlier days have been highlighted in Tables 12 – 14 and drive the design value at East St. Louis higher than it is across the St. Louis urban core. 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 East St. Louis monitor's design value higher than the monitors located in the St. Louis urban core. Figures 10 and 11 display the wind rose and HYSPLIT results, respectively, for these outlier days at East St. Louis.

As noted in Section 4, the HYSPLIT and wind rose data evaluated indicates that calm and low wind speed events often result in high $PM_{2.5}$ episode days at the East St. Louis monitor; however wind direction and air trajectory paths do not offer specific trends that tend to result in the high $PM_{2.5}$ days recorded at East Louis. The meteorology data analyzed for the outlier days provides similar evidence. Calm wind events comprise 45% of the hours associated with the outlier days, and low wind speeds comprise nearly all of the remaining hours during outlier episodes, but wind directions and trajectory paths do not provide any conclusive trends that can be used to determine the sources that are causing/contributing to the elevated $PM_{2.5}$ concentrations as there is no predominant direction or path that air masses travel from on the outlier days at East St. Louis. The calm and low wind events associated with high and outlier $PM_{2.5}$ days indicate that local emissions could be getting trapped in the area causing elevated levels that are not experienced even 3.7 miles away at Blair Street. Additionally, the wind direction and trajectory paths that travel across Missouri's portion of the MSA on some of the outlier days, supports the same conclusion that local nearby sources in Illinois could be increasing $PM_{2.5}$ concentrations after the air masses pass through Missouri. The evaluation of the outlier data supports a conclusion that local, nearby sources could be causing the violation at the East St. Louis monitor, but the evaluation does not provide conclusive evidence about the specific sources that are causing/contributing to the violation.

Table 11 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 12 Top 20% Days for E. St. Louis vs. Same Day Value for Blair Street (2010)

Date	E St. Louis 24-Hour value	Blair 24-Hour Value
12/10/2010	23.3	23
12/28/2010	22	22
3/9/2010	21.6	24.1
8/24/2010	20.4	13.7
10/11/2010	19.9	16.5
2/1/2010	19.7	20.2
12/4/2010	19.4	20.3
2/23/2010	19.1	13.7
4/14/2010	18.9	17.3
8/12/2010	18.7	19.1
11/16/2010	17.8	17.4
Average Value for top 20% at ESTL	**20.1**	**18.8**

* Note: All values have been rounded to the nearest 0.1 $\mu g/m^3$

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

Table 13 Top 20% Days for E. St. Louis vs. Same Day Value for Blair Street (2011)		
Date	E St. Louis 24-Hour value	Blair 24-Hour Value
1/3/2011	37.4	7.1
6/8/2011	25.3	24.9
1/27/2011	24.8	24.5
7/2/2011	22.3	20.2
5/27/2011	21.2	7.6
1/15/2011	20.6	20.4
12/5/2011	20.1	13.2
8/1/2011	19.6	20.7
9/12/2011	18.9	13.2
3/10/2011	18.1	20.8
5/9/2011	18	18.1
Average Value for top 20% at ESTL	**22.4**	**17.3**

* Note: All values have been rounded to the nearest 0.1 $\mu g/m^3$

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

Table 14 Top 20% Days for E. St. Louis vs. Same Day Value for Blair Street (2012)		
Date	E St. Louis 24-Hour value	Blair 24-Hour Value
11/17/2012	32	31.5
1/10/2012	28	22
9/6/2012	20.3	10.1
6/8/2012	16.3	14.9
7/8/2012	16.3	16.6
12/29/2012	16	18.2
1/22/2012	15.9	15.6
3/28/2012	15.7	13.2
8/7/2012	15.2	13
12/17/2012	14.6	16.1
12/23/2012	14.2	14.6
Average Value for top 20% at ESTL	**18.6**	**16.9**

* Note: All values have been rounded to the nearest 0.1 $\mu g/m^3$

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

Figure 10 Wind Directions and Speeds for All Hours of the Day on Outlier $PM_{2.5}$ Concentration Days at East St. Louis in 2010 – 2012

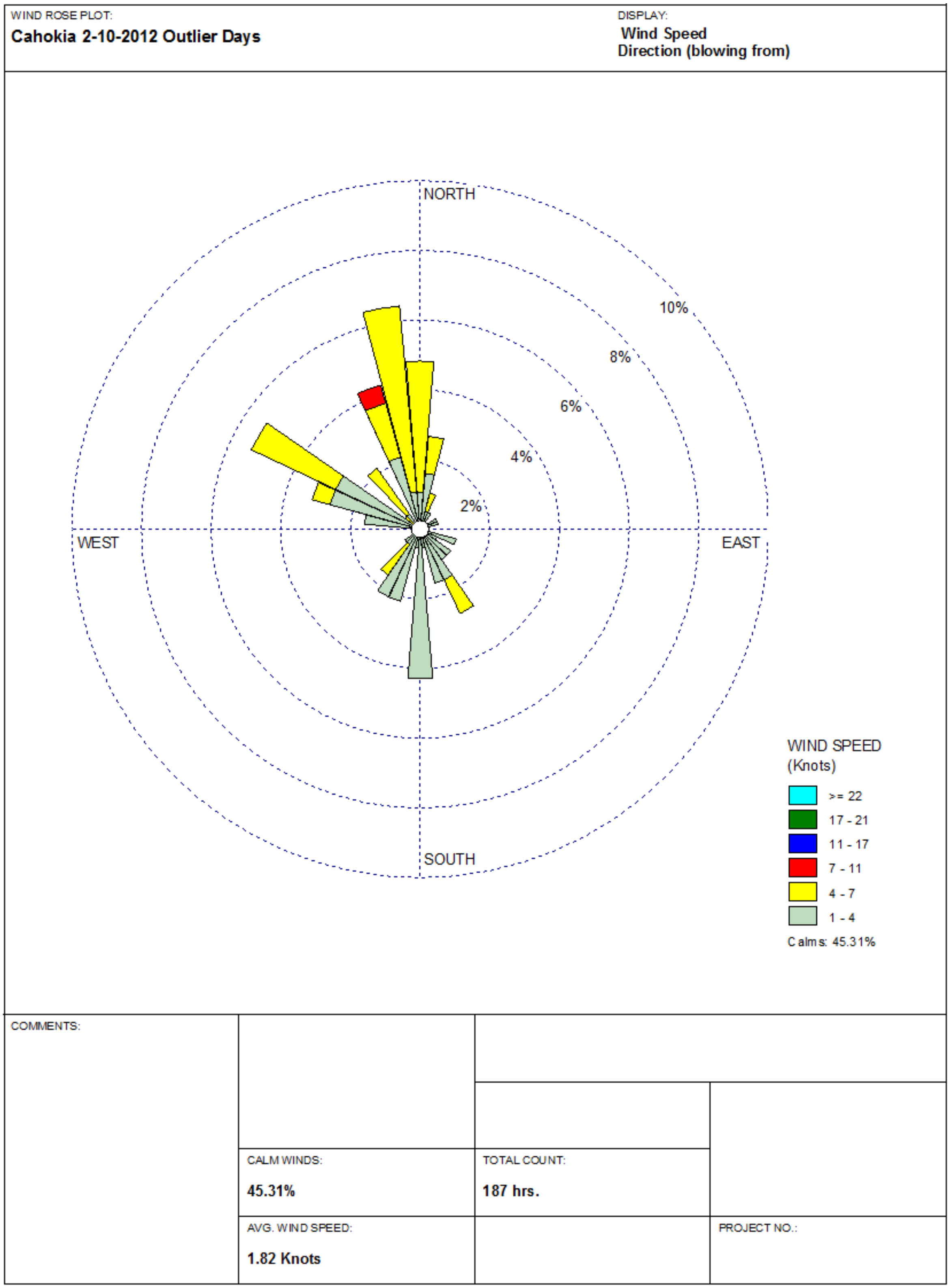
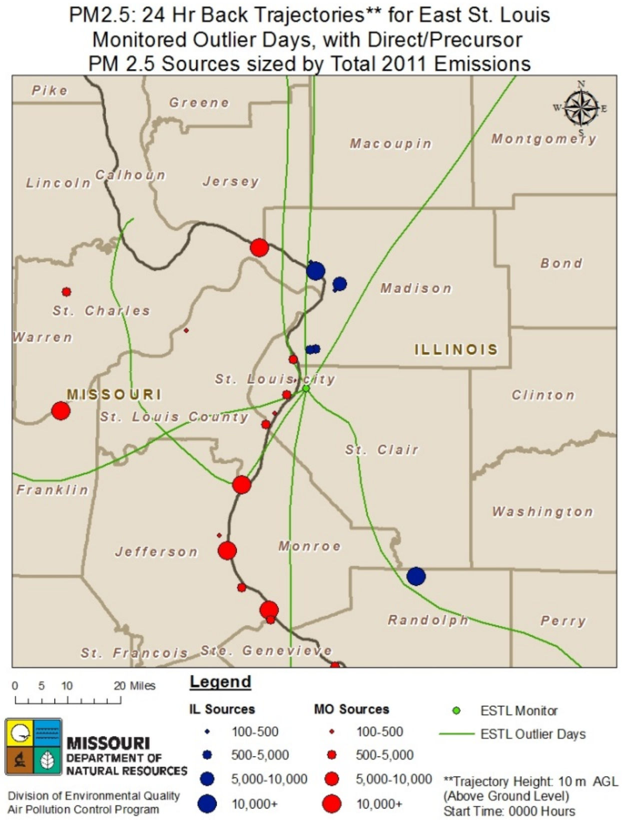
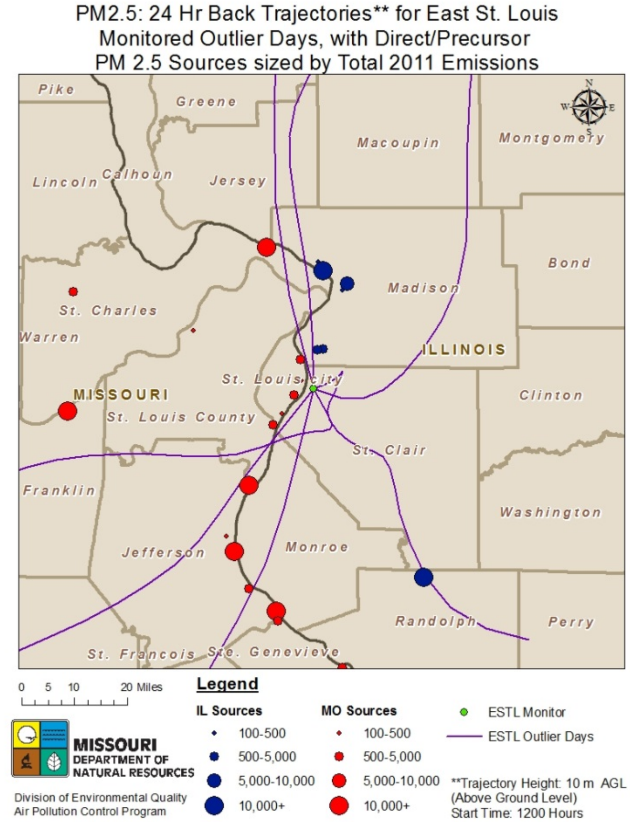


Figure 11 HYSPLIT Wind Trajectories for Outlier $PM_{2.5}$ Concentration Days at East St. Louis in 2010 – 2012 (12:00 a.m., 12:00 p.m., and 11:00 p.m.)

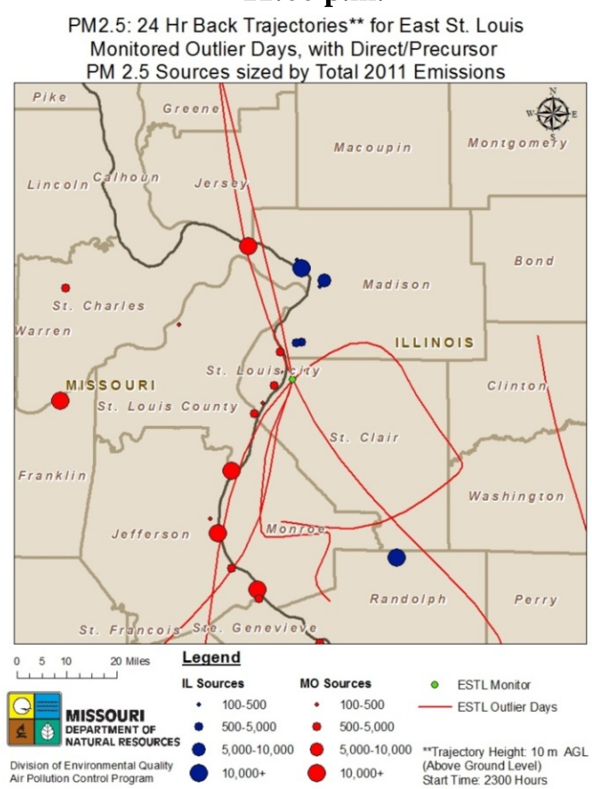
12:00 a.m. (Morning)



12:00 p.m. (Noon)



11:00 p.m.



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 15 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 15 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 15, 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 if the East St. Louis monitor's 2011 – 2013 design value violates the NAAQS.

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 16. 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 16 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 monitor with the highest design value for the area, and was the most difficult monitor for which to demonstrate attainment of the 1997 Annual $PM_{2.5}$ NAAQS. As seen in Table 11, the Granite City monitor is only 6.48 miles from the East St. Louis monitor, and therefore, any reductions in Missouri that impact the Granite City monitor would likely have a similar impact on the East St. Louis monitor. The 10 mile radius around the Granite City monitor 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 17 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 17	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 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 on the Illinois side of the St. Louis MSA.

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 reduces 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 East St. Louis by 0.12 $\mu g/m^3$ in 2012, which supports the conclusion that emissions from Missouri sources do not have a significant impact on the $PM_{2.5}$ concentrations recorded at the East St. Louis 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 if the East St. Louis monitor violates the 2012 Annual NAAQS based on 2011 – 2013 monitoring data. Therefore, if areas in Missouri are ultimately included in a nonattainment area due to a violation at the East St. Louis 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 a violation in East St. Louis, it would only require Missouri to develop a resource intensive attainment demonstration for the area.

7. Conclusion

In conclusion, when considering monitoring data, emissions data, and meteorology of counties surrounding the violating monitor located in East St. Louis, IL it is unclear exactly what is causing the violation at this monitor. Some criteria evaluated through the weight of evidence analysis provide inconclusive evidence about the sources that are causing/contributing to the violation at this monitor, yet other criteria evaluated support the conclusion that nearby local sources in East St. Louis are causing the violation at this monitor. The 2010 – 2012 design values for all monitors that are suitable for comparison to the annual NAAQS on the Missouri side of the St. Louis MSA attain the NAAQS, where the East St. Louis monitor on the Illinois side of the St. Louis MSA is not attaining, which supports a conclusion that local nearby sources could be causing the violation.

Meteorology data supports this same conclusion. High $PM_{2.5}$ episode days are associated with a significant portion of calm wind events, and low days are associated with few calm wind events, supporting the conclusion that local sources are causing the peak episodes; however the trajectory data indicates that air masses traveling from all directions including some days over the path of Missouri sources and some days from other directions which could support a conclusion that the urban region or long range transport is causing/contributing to the violation.

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 pollutant being analyzed can come from hundreds of miles away before forming particulate at ground-level, or it could condense or form at ground-level in the immediate local area based on meteorological conditions. Therefore it is difficult to draw any conclusion based on emissions data alone.

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 ultimate designation for the area.

Through this weight of evidence analysis performed to analyze the $PM_{2.5}$ concentrations at the East St. Louis monitor, the evidence is inconclusive about whether Missouri sources are causing or contributing to the violation at this monitor. It is noted that the fact that the East St. Louis monitor only samples one in six days and there is no CSN speciation data to evaluate also adds to the difficulty in determining sources that are causing/contributing to the violation at this monitor.

Furthermore, as indicated in subsection 2.2 of this Appendix, it is possible that the East St. Louis monitor will come into compliance with the 2012 annual $PM_{2.5}$ NAAQS once 2013 is complete and the design value is based on the more recent 2011 – 2013 time period because of the downward trend in $PM_{2.5}$ concentrations across the entire St. Louis Region over the past decade.

Taking all of the available evidence into consideration, Missouri's recommendation is to designate all areas in Missouri as attainment/unclassifiable if a nonattainment area results because the 2011 – 2013 design value at the East St. Louis monitor violates the standard. This recommendation is based on all available evidence including ambient air quality data, emissions data, and meteorology data, which through this evaluation are inconclusive when attempting to determine the potential sources that are causing/contributing to the elevated $PM_{2.5}$ concentrations in East St. Louis. This recommendation is also based on the consideration of potential controls that might be required if Missouri areas were designated nonattainment, along with the downward trend in $PM_{2.5}$ concentrations across the entire St. Louis region over the past decade and in recent years. Finally, due to the federal control measures already in place this declining trend in $PM_{2.5}$ concentrations across St. Louis is only expected to continue, which will likely result in the East St. Louis monitor attaining the 2012 Annual NAAQS in the near future, regardless of whether areas in Missouri are ultimately designated attainment or nonattainment.