Missouri Department of Natural Resources

Background Concentrations

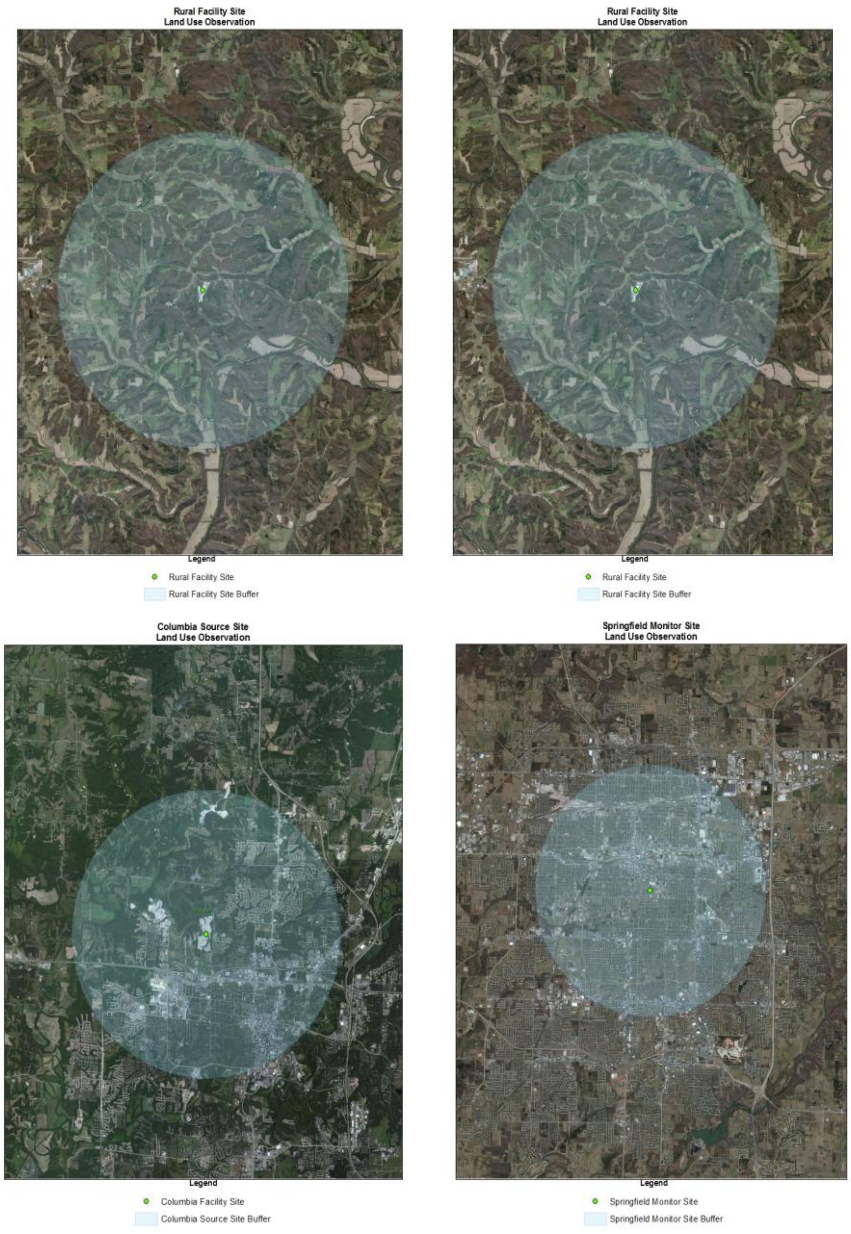
According to 40 CFR Part 51, Appendix W, background concentrations must be considered when determining compliance with the National Ambient Air Quality Standards (NAAQS). Background concentrations are defined as the impact due to natural sources, nearby sources (excluding the source under consideration) and unidentified sources.

Existing monitoring data should be incorporated into the model results to account for the impact from natural sources or unidentified sources. Nearby source impacts, on the other hand, should be based upon a review of existing inventory data to determine which sources are expected to have a significant concentration gradient in the vicinity of the source being permitted. The requirements for the creation of interactive source inventories vary and are described in detail on the Permit Modeling Guidance website at the following link: NAAQS Interactive Source Inventories. The focus of this document is limited and only addresses the assignment of monitored background values for inclusion into the air quality analysis.

The monitored background value for *de minimis* and minor source permit applications will be based upon data obtained from the closest air quality monitor provided it is not unduly influenced by a nearby facility. If a monitor is not located within the immediate vicinity, a representative, regional site will be used to determine background. Due to the limited number of air quality sites located within the State of Missouri, staff members will visually review the regional characteristics within five kilometers of each source to determine what monitoring station best represents the observed land use surrounding the facility site.

For example, a minor source that is located within Columbia would be best represented by data collected within a similarly sized urban area, such as Springfield. Likewise, a site located in a rural area would be best represented by data collected at Mark Twain State Park, a rural background site, refer to Figure #1, entitled “Representative Monitor Site Selection Example.”

Figure 1
Representative Monitor Site Selection Example



Background Concentrations

If an urban monitor site is selected for background purposes, staff will determine which meteorological corridors are not influenced by explicitly modeled sources. The meteorological corridors will be defined according to ten degree wind direction sectors. Staff will review the hourly profile for each meteorological corridor in order to determine a representative background value. Statistical measures may be employed in the determination of the background concentration. Any statistical analyses that are employed will be presented to the Environmental Protection Agency Region VII for approval prior to finalization.

For Prevention of Significant Deterioration (PSD) reviews, the applicant may be required to collect ambient air quality monitoring data for a period of one year. If preconstruction data is collected, the monitored background concentrations for use in the air quality analysis should be based upon results obtained from the preconstruction data collection effort. Additional information on preconstruction monitoring requirements can be found at the following link: Preconstruction Monitoring Requirements.

Ultimately, the form of the NAAQS dictates the procedures that will be followed when determining monitored background concentrations. Each step is summarized below on a pollutant by pollutant basis.

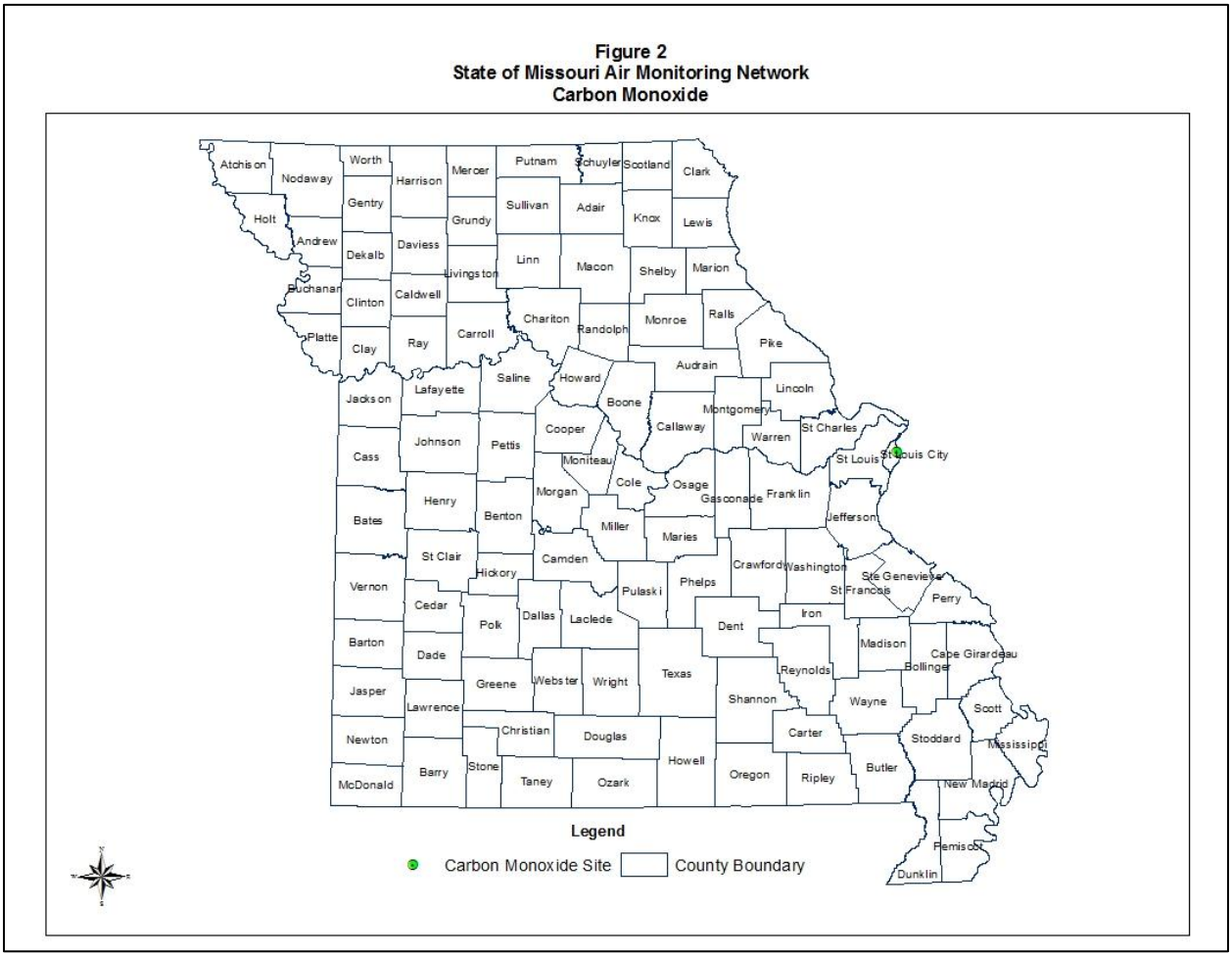
Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless gas that is primarily the result of combustion. Approximately 90 percent of the CO emitted within the State of Missouri is due to mobile source emissions with an additional seven percent contribution from fossil fuels and other industrial processes.

On Jan. 8, 2011, the Environmental Protection Agency decided to retain the primary CO NAAQS at nine parts per million for the 8-hour averaging period and 35 parts per million for the 1-hour averaging period. CO is a deterministically based standard where one exceedance per year is allowed before an area is determined to be in violation of the NAAQS. Because the NAAQS is not a statistically based standard, the background concentration becomes the highest recorded CO value from the most recent three year period for each averaging period under consideration. The proximity of the monitoring station to the facility site and spatial characteristics such as land use and terrain dictate which monitoring site will be selected for use. Figure 2, entitled “State of Missouri Air Monitoring Network, Carbon Monoxide,” displays the location of the CO monitoring sites located within the State of Missouri.

Currently, one site within the state continuously measures CO concentrations: Blair Street, St. Louis, Missouri. This site was established as a mobile source monitor designed to determine the impact within an urban area that experiences high traffic counts. It is likely that the values obtained from this site will over-estimate ambient background concentrations within most areas of state. However, since it is the only site available, the use of the data should be conservative and will ensure that the contribution due to natural and/or unidentified sources is accounted for in the air quality analysis.

Background Concentrations



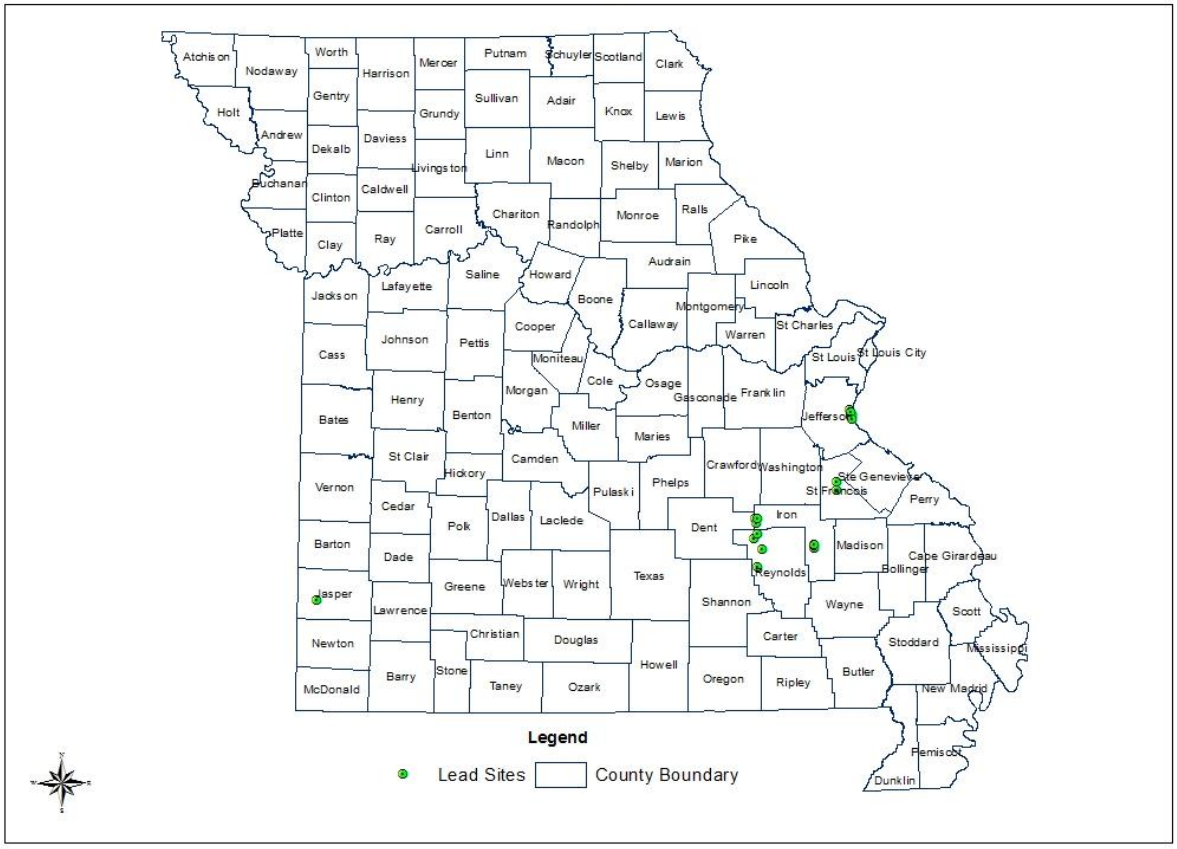
Lead

Lead (Pb) is a naturally occurring metal that can be found in various manufactured products produced at industrial sites across the United States and abroad. The removal of lead from gasoline in the 1980's resulted in a drastic decline in ambient concentrations. Today, lead emissions primarily result from industrial processes that occur at lead smelters, recycling facilities and mining operations.

On Nov. 12, 2008, the Environmental Protection Agency substantially strengthened the lead NAAQS by reducing the primary standard from 1.5 micrograms per cubic meter, $\mu g/m^3$, to 0.15 $\mu g/m^3$ (measured as total suspended particles). The Environmental Protection Agency also revised the secondary (welfare-based) standard to be identical to the primary standard.

The form of the standard is based on the highest rolling three-month average over a period of three years. The standard is met at a monitoring site when the three-month average is less than or equal to 0.15 $\mu g/m^3$. Figure 3, entitled "State of Missouri Air Monitoring Network, Lead," displays the location of the lead monitoring sites located within the State of Missouri.

Figure 3
State of Missouri Air Monitoring Network
Lead



All of the lead sites located within the state were established to monitor specific sources of emissions and should not be considered background sites. In order to determine an appropriate background value, staff from the Construction Permit Modeling Unit, will be required to review the data collected at each site and exclude any value that is measured when the source is impacting the site based upon local meteorological data.

Nitrogen Dioxide

Nitrogen dioxide (NO_2) is one component of a group of highly reactive gases known as oxides of Nitrogen, NO_x. NO_2 rapidly forms in the atmosphere due to the release of emissions from vehicles, combustion processes and off-road equipment. NO_2 is an ozone precursor and also contributes to the secondary formation of fine particulate matter.

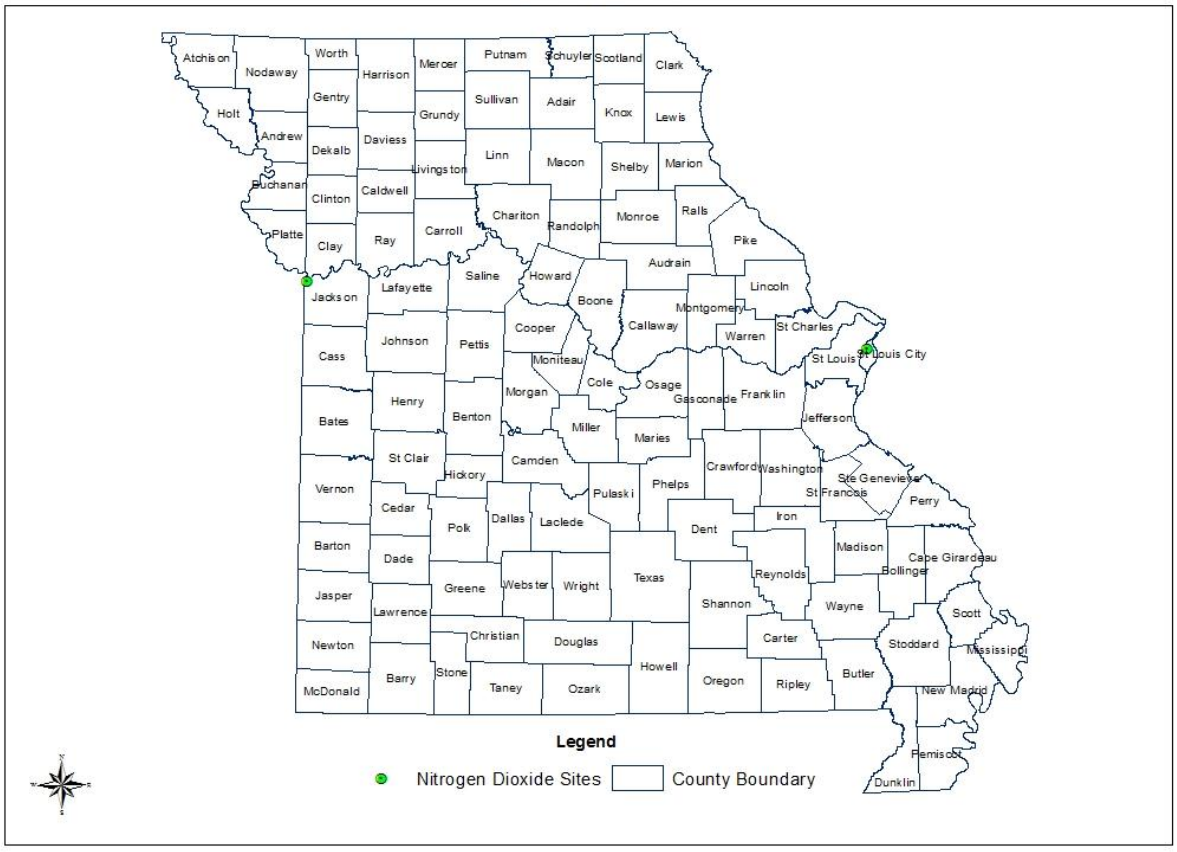
On Jan. 22, 2010, the Environmental Protection Agency substantially strengthened the NO_2 NAAQS through the establishment of a new 1-hour standard of 100 parts per billion. This

standard is in addition to the existing, annual NO_2 standard of 53 parts per billion. Unlike the annual NAAQS, the new 1-hour standard is a statistical standard that is based upon the three-year average of the 98th percentile of the annual distribution of daily maximum 1-hour average concentrations. As such, the assignment of background concentrations, for the new 1-hour averaging period, will be based upon guidance provided by the Environmental Protection Agency in the March 1, 2011 clarification memo entitled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NOx National Ambient Air Quality Standard." The department's Air Pollution Control Program will assign a single background concentration equal to the design value from a representative, existing air quality monitoring site. The design value is the 98th percentile of the daily maximum 1-hour values averaged across the most recent three-year period, regardless of the meteorological period being modeled. Temporally varying background concentrations will only be considered in instances where diurnal patterns could significantly impact the overall outcome of the predicted impacts.

For the annual NO_2 standard, the maximum reported concentration from the most recent three-year period is used to assign the monitored background concentration. The proximity of the monitoring station to the facility site and spatial characteristics such as land use and terrain dictate which monitoring site will be selected for use. Figure 4, entitled "State of Missouri Air Monitoring Network, Nitrogen Dioxide," displays the location of the NO_2 monitoring sites located within the State of Missouri.

Background Concentrations

Figure 4
State of Missouri Air Monitoring Network
Nitrogen Dioxide



Currently, two sites within the state continuously measure NO_2 concentrations: Margaretta Street in St. Louis City and Troost Avenue in Kansas City. These sites were established as urban area NO_2 sensors designed to determine the diurnal NO_2 patterns compared to ozone concentrations. It is likely that the values obtained from these two sites will over-estimate ambient background concentrations within most areas of state.

Ozone

Ground level ozone is not directly emitted into the atmosphere but is formed when NO_2 and volatile organic compounds react in the presence of sunlight. Due to the complex nature of ozone formation, construction permit applicants are not required to conduct dispersion modeling analyses for this pollutant; and, as such, typically do not need to gather background ozone data. However, if an applicant determines that they are going to conduct a Tier 3 NO to NO_2 conversion analysis, background ozone values are a required input into the AERMOD dispersion model and can be provided by staff from the Construction Permit Modeling Unit.

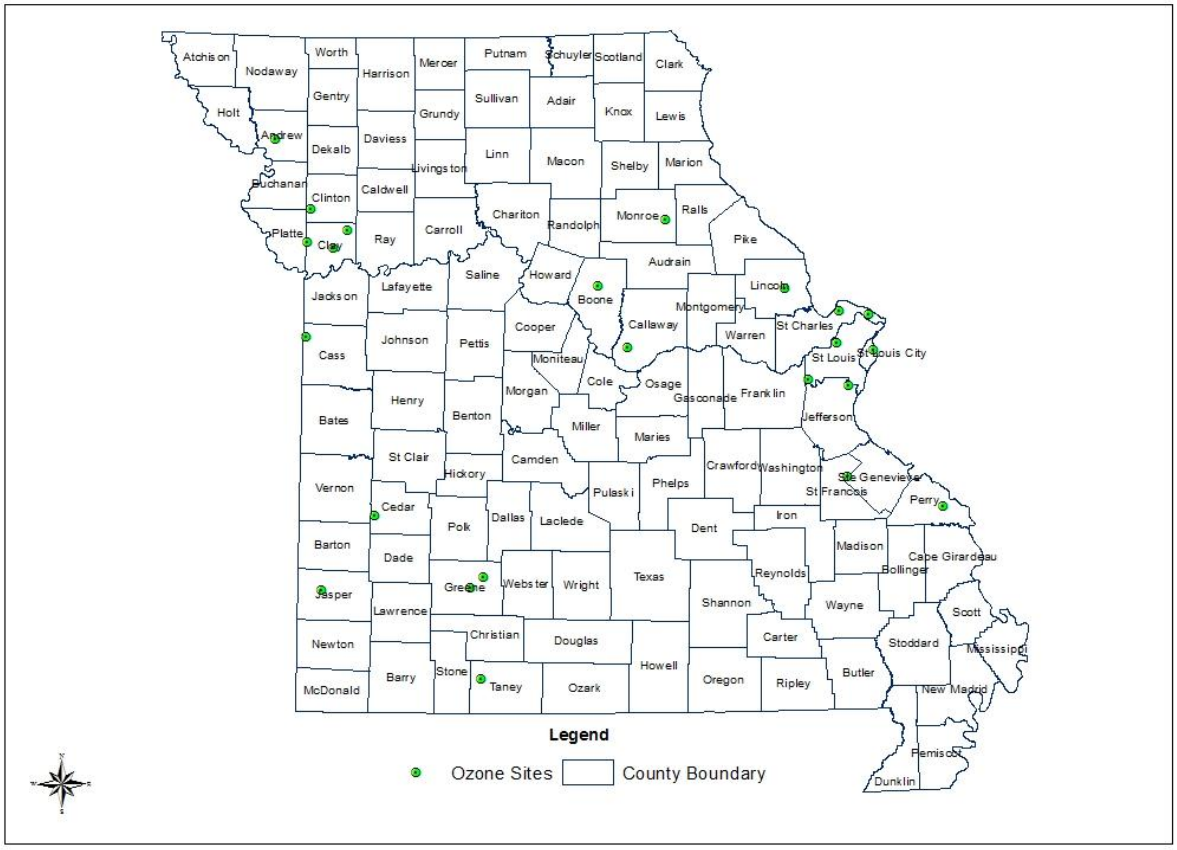
Currently, AERMOD will accept a single ozone value, temporally varying values or hourly ozone values in units of parts per billion. Within the State of Missouri, four distinct seasons can be

noted and impact the chemical reactions that occur within the atmosphere. Given the differing seasonal patterns, applicants should request temporally varying ozone values or hourly ozone values for input into the Tier 3 NO_2 compliance demonstration.

The assignment of background concentrations for the new 1-hour NO_x standard is based upon guidance provided by the Environmental Protection Agency in the March 1, 2011 clarification memo entitled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NOx National Ambient Air Quality Standard." Figure 5, entitled "State of Missouri Air Monitoring Network, Ozone," displays the location of the ozone monitoring sites located within the State of Missouri.

Several ozone sites are located around the state that could be used to determine appropriate background concentrations for use in a NO_2 compliance demonstration. Currently, two sites within the state of Missouri continuously collect ozone data throughout the year, the Blair Street monitor located in St. Louis and the Mark Twain State Park monitor located in Monroe County. The remaining sites operate from April 1 to October 31.

Figure 5
State of Missouri Air Monitoring Network
Ozone



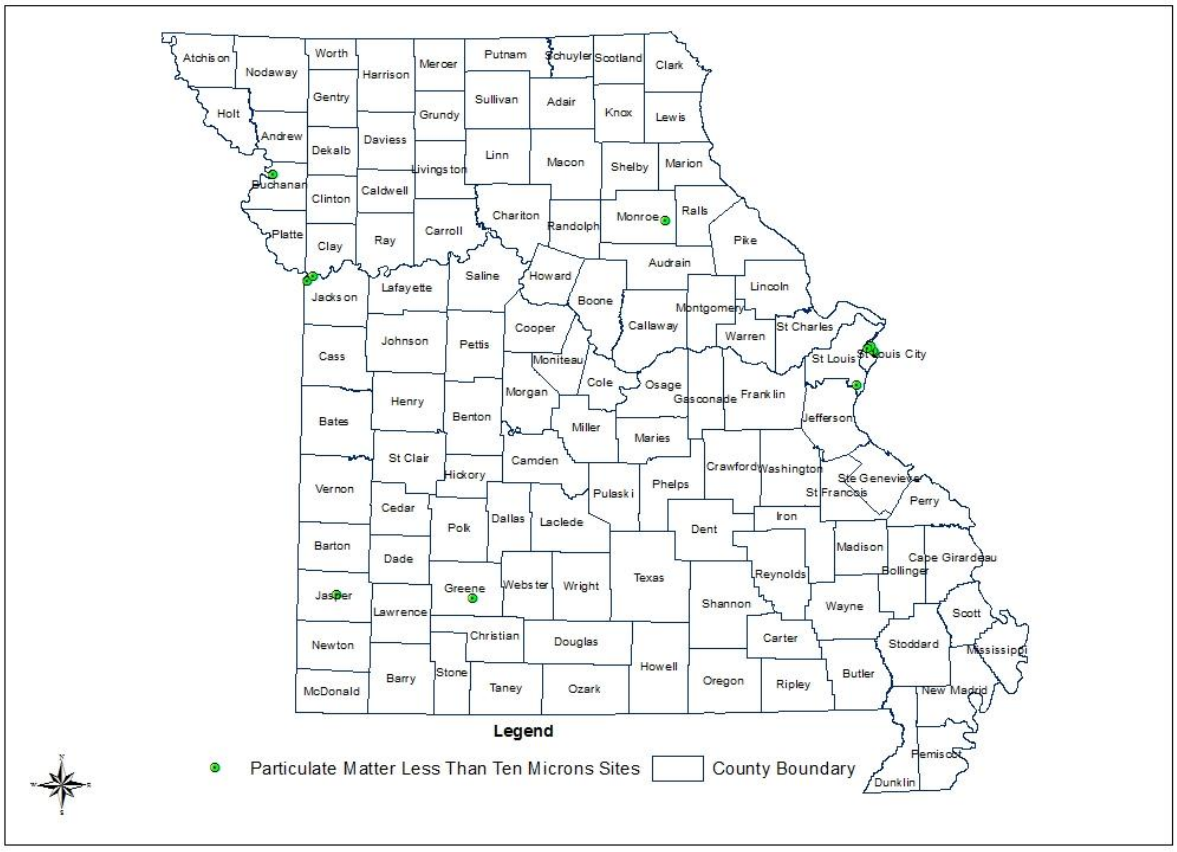
Particulate Matter less than Ten Microns

Particulate matter less than ten microns (PM_{10}) is defined as inhalable coarse particles less than ten microns in diameter. PM_{10} that is generated at industrial sites or along roadways can be comprised of various materials including soil, dust, metals, acids (nitrates and sulfates) or organic chemicals.

On June 14, 2012, the Environmental Protection Agency decided to retain the existing primary PM_{10} NAAQS of 150 $\mu g/m^3$ for the 24-hour averaging period. The annual PM_{10} standard was revoked in actions taken on July 18, 1997 and is no longer considered for NAAQS compliance purposes. The 24-hour PM_{10} standard can be exceeded once per year, averaged over a three-year period. The 24-hour background concentration for PM_{10} is the highest recorded value from the most recent three year period under consideration. The proximity of the monitoring station to the facility site and spatial characteristics such as land use and terrain dictate which monitoring site will be selected for use. Figure 6, entitled "State of Missouri Air Monitoring Network, Particulate Matter Less Than Ten Microns," displays the location of the PM_{10} monitoring sites located within the State of Missouri.

Background Concentrations

Figure 6
State of Missouri Air Monitoring Network
Particulate Matter Less Than Ten Microns



<u>Particulate Matter less than Two and One-Half Microns</u>

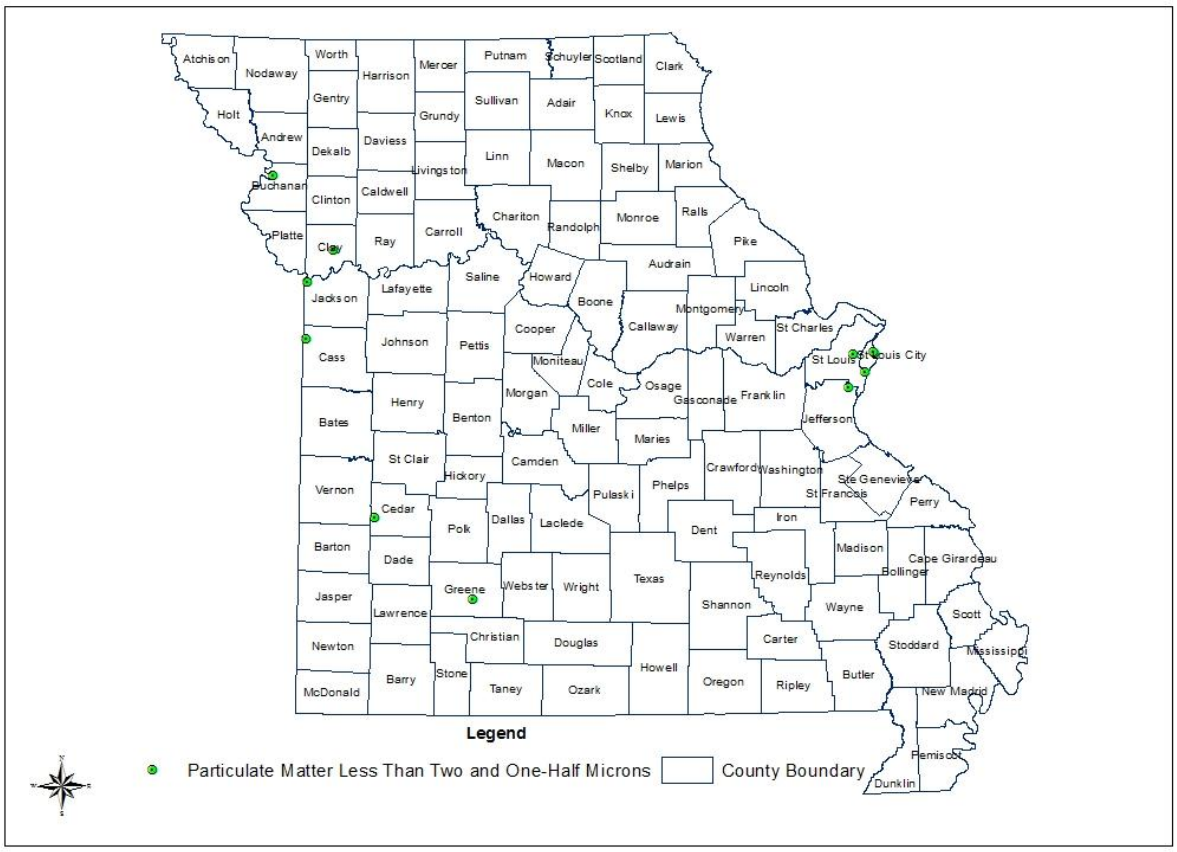
Particulate matter less than two and one-half microns, or $PM_{2.5}$, consists of particles that are less than two and one half microns in diameter. $PM_{2.5}$ is generated from various sources including the combustion of fuel, fires, industrial processes and vehicles.

On Dec. 14, 2012, the Environmental Protection Agency strengthened the existing $PM_{2.5}$ NAAQS through the establishment of a lower annual standard of 12μg/m^3 (existing standard is 15 μg/m^3). The 24-hour NAAQS will be retained at 35 μg/m^3; a value that was established on Sept. 21, 2006. Unlike the annual NAAQS, the 24-hour standard is a statistical standard that is based upon the three-year average of the 98th percentile of the 24-hour average concentrations. As such, the assignment of background concentrations, for the 24-hour averaging period, will be based upon guidance provided by the Environmental Protection Agency. The department's Air Pollution Control Program will assign a single background concentration equal to the design value from a representative, exiting air quality monitoring site. The design value is the 98th percentile of the 24-hour values averaged across the most recent three-year period, regardless

of the meteorological period being modeled. The background site will be chosen such that the contribution from secondary impacts is considered.

For the annual $PM_{2.5}$ standard, the maximum reported concentration from the most recent three-year period is used to assign the monitored background concentration. A representative site will be chosen based upon proximity of the monitoring station to the facility site and spatial characteristics such as land use and terrain. Figure 7, entitled "State of Missouri Air Monitoring Network, Particulate Matter Less Than Two and One-Half Microns," displays the location of the $PM_{2.5}$ monitoring sites located within the state of Missouri.

Figure 7
State of Missouri Air Monitoring Network
Particulate Matter Less Than Two and One-Half Microns



Sulfur Dioxide

Sulfur dioxide (SO_2) is one component of a group of highly reactive gases known as oxides of sulfur, or SO_x. SO_2 results from the release of emissions from fossil fuels, other combustion processes, ore extraction and non-road equipment. SO_2 also contributes to the secondary formation of fine particulate matter in the form of sulfates.

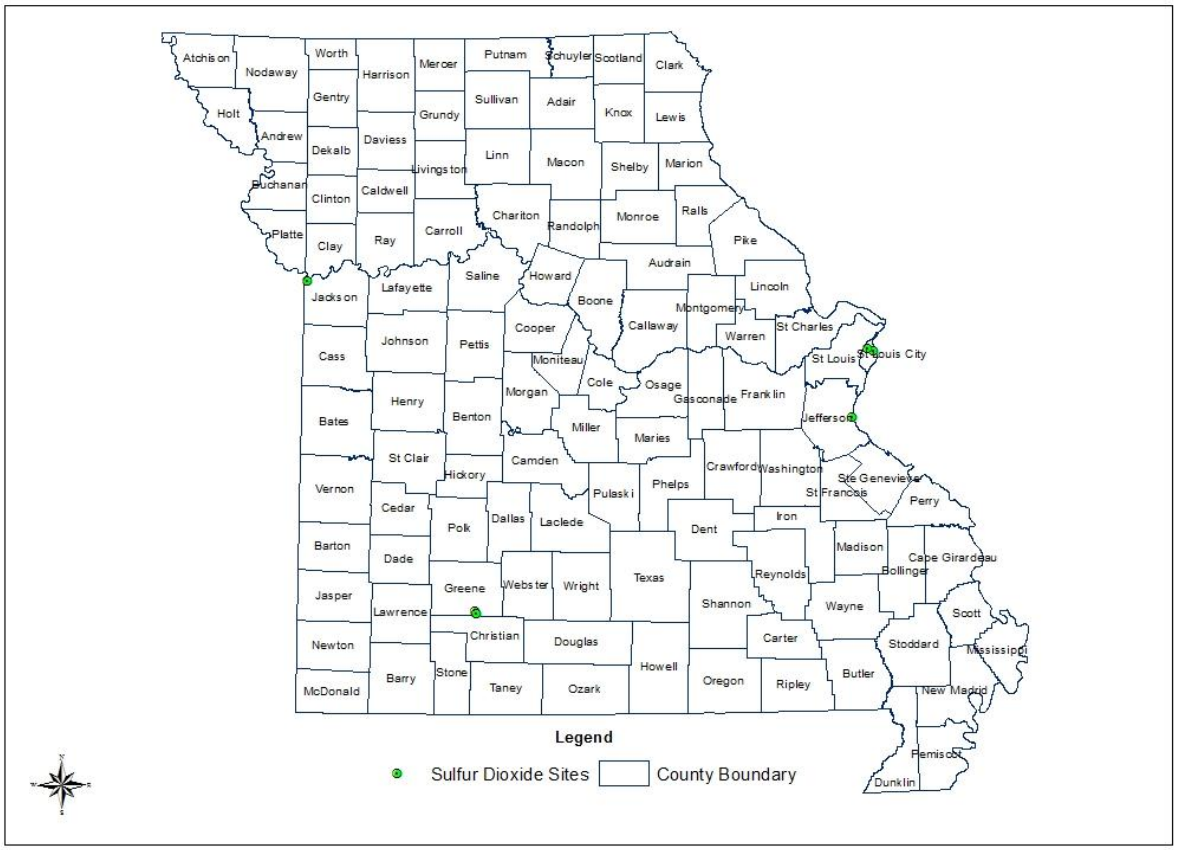
Background Concentrations

On June 2, 2010, the Environmental Protection Agency substantially strengthened the SO_2 NAAQS through the establishment of a new 1-hour standard of 75 parts per billion. This standard is in addition to the existing, 3-hour SO_2 standard that is being retained at of 0.5 parts per million. Unlike the 3-hour NAAQS, the new 1-hour standard is a statistical standard that is based upon the three-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average concentrations. As such, the assignment of background concentrations for the new 1-hour standard is based upon guidance provided by the Environmental Protection Agency in the March 24, 2011 memo entitled "Area Designations for the 2010 Revised Primary Sulfur Dioxide National Ambient Air Quality Standards." The department's Air Pollution Control Program will assign a single background concentration equal to the design value from a representative, exiting air quality monitoring site. The design value is the 99th percentile of the daily maximum 1-hour values averaged across the most recent three-year period, regardless of the meteorological period being modeled.

For the 3-hour SO_2 standard, the maximum reported concentration from the most recent three-year period is used to assign the monitored background concentration. A representative site will be chosen based upon proximity of the monitoring station to the facility site and spatial characteristics such as land use and terrain. Figure 8, entitled "State of Missouri Air Monitoring Network, Sulfur Dioxide," displays the location of the SO_2 monitoring sites located within the State of Missouri.

Background Concentrations

Figure 8
State of Missouri Air Monitoring Network
Sulfur Dioxide



It is important to note that the existing 24-hour and annual SO_2 standards must be considered when determining NAAQS compliance until one year following the effective date of the initial designations under Section 107(d)(1) for the new 1-hour SO_2 NAAQS. For the 24-hour and annual SO_2 standards, the maximum reported concentration from the most recent three-year period is used to assign the monitored background concentration. A representative site will be chosen based upon proximity of the monitoring station to the facility site and spatial characteristics such as land use and terrain.