Missouri Department of Natural Resources

***Sulfur Dioxide Significant Impact Determination***

Sulfur dioxide ($SO_2$) forms in the atmosphere as a result of the release of emissions from the combustion of fossil fuels, other combustion processes, ore extraction and diesel engines. $SO_2$ also contributes to the secondary formation of fine particulate matter in the form of sulfates.

If a construction project triggers the need for an ambient air quality impact analysis, the applicant must perform an initial assessment, or preliminary impact analysis, to determine if a full impact analysis is necessary. The preliminary impact analysis should only consider the potential emissions due to the proposed construction or the net emissions increase due to a modification. The results obtained from the preliminary impact analysis will be used to determine if the applicant can avoid a detailed, cumulative air quality analysis that requires an assessment of compliance with the National Ambient Air Quality Standards (NAAQS) and the Prevention of Significant Deterioration (PSD) increment standards. Initially, the preliminary impact analysis will be used to answer the following questions:

1. Does the ambient concentration due to the proposed project exceed the significant impact levels?
2. Does the ambient concentration due to the proposed project exceed the significant monitoring thresholds (applies to PSD permit applications only)?
3. If a significant impact is predicted to occur, what is the furthest extent of the significant impact area?

A significant impact occurs when the overall maximum 3-hour, 24-hour or annual concentration exceeds the thresholds contained within Table 1. In addition, a significant 1-hour significant impact will occur if the five year average of the maximum concentrations exceed the threshold contained within Table 1.

**Table 1**
**$SO_2$ Significant Impact Thresholds**

| Pollutant | Averaging Time | Significant Impact Level | Comment |
|---|---|---|---|
| | | ***($\mu g/m^3$)*** | |
| $SO_2$ | 1-Hour | 7.83 (3 parts per billion)* | The Multiyear Average of the Highest 1-Hour Value at Each Receptor |
| $SO_2$ | 3-Hour | 25.0 | Maximum 3-Hour Impact |
| $SO_2$ | 24-Hour | 5.0 | Maximum 24-Hour Impact |
| $SO_2$ | Annual | 1.0 | Maximum Annual Impact |

**Interim Significant Impact Level per EPA guidance document entitled "Guidance Concerning the Implementation of the 1-hour $SO_2$ NAAQS for the Prevention of Significant Deterioration Program" assuming 25 degrees Celsius and 760 millimeters of mercury (1 ppb = 2.61 $\mu g/m^3$).*

It is important to note that the 1-hour significant impact level for $SO_2$ is based upon a multiyear average of the highest 1-hour values at each receptor rather than the maximum, first high impact at each receptor. The determination to allow the use of the multiyear average is based upon the August 23, 2010 guidance document from the Environmental Protection Agency entitled "Guidance Concerning the Implementation of the 1-hour $SO_2$ NAAQS for the Prevention of Significant Deterioration Program." This document states that the determination of significant impact should be based upon an average of the annual distribution of daily maximum 1-hour values to reflect the form of the NAAQS standard. The 3-hour, 24-hour and annual significant impact levels continue to be based upon the overall, maximum impact on a receptor by receptor basis. Unlike the 1-hour averaging period, the concentrations for the 3-hour, 24-hour and annual averaging period should not be averaged over the five year period.

For example, Table 2 contains a sample summary of 1-hour $SO_2$ concentrations obtained over a five-year period. The first four columns contain a description of the receptor data that denotes the location of the receptor followed by the predicted concentration due to the construction of a fictitious $SO_2$ source. The last column contains the multiyear average for the five-year period. The multiyear average determines if a significant ambient impact occurred at each receptor within the domain for the 1-hour averaging period.

**Table 2**
**Example 1-Hour $SO_2$ Significant Impact Determination**

| Receptor Data | | | | | Maximum 1-Hour Concentration | | | | | Multiyear Average |
|---|---|---|---|---|---|---|---|---|---|---|
| Receptor # | Easting | Northing | Elevation | Hill Hgt | 2005 | 2006 | 2007 | 2008 | 2009 | 5-Year Average |
| | *(Meters)* | *(Meters)* | *(Meters)* | *(Meters)* | *($\mu g/m^3$)* | *($\mu g/m^3$)* | *($\mu g/m^3$)* | *($\mu g/m^3$)* | *($\mu g/m^3$)* | *($\mu g/m^3$)* |
| 1 | 738926.5 | 4218288 | 263.1 | 263.1 | 31.25918 | 31.20577 | 32.89036 | 33.23922 | 31.59046 | 32.037 |
| 2 | 742500 | 4216900 | 217.62 | 245.69 | 6.323641 | 7.582946 | 6.044968 | 6.250525 | 6.411163 | 6.522649 |
| 3 | 742800 | 4217500 | 214.49 | 219.61 | 4.710182 | 7.010377 | 5.094992 | 6.948161 | 5.553701 | 5.863483 |
| 4 | 743000 | 4216400 | 215.26 | 245.49 | 5.229619 | 5.818229 | 3.119879 | 5.189997 | 5.646945 | 5.000934 |
| 5 | 740900 | 4215500 | 216.74 | 262.78 | 4.779679 | 5.88134 | 4.156865 | 5.553537 | 4.580657 | 4.990416 |

Based upon the 5-year average, Receptor # 1 exceeds the 1-hour significant impact threshold of 7.83 $\mu g/m^3$ and would trigger the need for an evaluation of compliance with the NAAQS and increment standards.

Likewise, Table 3 provides an example of the significant impact determination for the remaining averaging periods. As noted previously, the 3-hour, 24-hour and annual significant impact determination is based upon the maximum concentration that was predicted over the five year period, not the average of the values over the five year period.

**Table 3**
**Example 3-Hour, 24-Hour and Annual $SO_2$ Significant Impact Determination**

| Receptor Data | | | | | Maximum Annual Concentration | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Receptor # | Easting | Northing | Elevation | Hill Hgt | 2005 | 2006 | 2007 | 2008 | 2009 | Maximum |
| | *(Meters)* | *(Meters)* | *(Meters)* | *(Meters)* | *($\mu g/m^3$)* | *($\mu g/m^3$)* | *($\mu g/m^3$)* | *($\mu g/m^3$)* | *($\mu g/m^3$)* | *($\mu g/m^3$)* |
| ***3-Hour Averaging Period*** | | | | | | | | | | |
| 1 | 744250 | 4214250 | 220.48 | 233.99 | 19.83798 | 20.92122 | 13.87417 | 17.65676 | 28.2222 | 28.2222 |
| 2 | 742400 | 4216400 | 211.67 | 252.04 | 11.63767 | 12.24781 | 15.02326 | 13.07479 | 28.15561 | 28.15561 |
| 3 | 739544.8 | 4222739 | 163.04 | 239.25 | 12.41118 | 14.48129 | 11.80714 | 13.85818 | 26.40593 | 26.40593 |
| 4 | 742400 | 4216000 | 217.05 | 252.07 | 13.65832 | 17.08445 | 18.48455 | 26.23744 | 20.84193 | 26.23744 |
| 5 | 744750 | 4215250 | 220.15 | 233.21 | 17.59219 | 18.1181 | 17.45665 | 24.6706 | 18.75847 | 24.6706 |
| ***24-Hour Averaging Period*** | | | | | | | | | | |
| 1 | 738500 | 4218200 | 227.46 | 263.81 | 8.29497 | 6.80112 | 6.86948 | 9.2217 | 7.56834 | 9.2217 |
| 2 | 740300 | 4216700 | 212.46 | 226.25 | 6.89514 | 3.61538 | 2.90806 | 3.48304 | 3.77328 | 6.89514 |
| 3 | 744250 | 4214250 | 220.48 | 233.99 | 2.79847 | 3.52156 | 3.3902 | 2.96513 | 6.8818 | 6.8818 |
| 4 | 739917.6 | 4217866 | 170.79 | 282.43 | 2.81624 | 3.28336 | 4.38121 | 3.29057 | 5.16687 | 5.16687 |
| 5 | 741100 | 4223400 | 113.62 | 113.62 | 4.55584 | 3.2121 | 4.1606 | 4.41057 | 4.93076 | 4.93076 |
| ***Annual Averaging Period*** | | | | | | | | | | |
| 1 | 739252.3 | 4222850 | 239.11 | 239.11 | 1.04036 | 2.13137 | 2.00079 | 1.61191 | 1.7752 | 2.13137 |
| 2 | 738927.2 | 4218238 | 255.03 | 263.51 | 0.65034 | 0.87531 | 1.12709 | 0.92081 | 0.81387 | 1.12709 |
| 3 | 740493.2 | 4218439 | 241.94 | 241.94 | 1.0265 | 1.06768 | 1.05573 | 0.87661 | 1.05656 | 1.06768 |
| 4 | 738600 | 4218300 | 250.55 | 250.55 | 0.67589 | 0.62289 | 0.90456 | 0.71596 | 0.7906 | 0.90456 |
| 5 | 738900 | 4218200 | 243.93 | 263.86 | 0.5732 | 0.7578 | 0.88859 | 0.80622 | 0.6982 | 0.88859 |

***Sulfur Dioxide Significant Impact Determination***

Based upon the maximum impact, Receptor #'s 1-4 for the 3-hour averaging period, Receptor #'s 1-4 for the 24-hour averaging period and Receptor #'s 1-3 for the annual averaging period exceed the significant impact thresholds.

If it is determined that a significant impact will take place, the applicant must determine the radius of impact due to the construction of the proposed project or modification. This information will be used to determine the extent of the model domain for the cumulative impact assessment and will aid in interactive source inventory development.

The radius of impact, commonly referred to as the significant impact area, is the circular area whose radius extends from the center of the facility to the most distant receptor where a significant impact is predicted to occur, or 50-kilometers, whichever is less. In order to determine the furthest extent of the impact area, each averaging period must be reviewed. For example, the model output for a new construction project indicates that the significant impact for the 1-hour averaging period occurs out to a distance of 15.6-kilometers from the source. The 3-hour, 24-hour and annual impact areas extend out to distances of 15.0, 15.3 and 3.5-kilometers from the same source. The $SO_2$ radius of impact for the project becomes 15.6-kilometers because this is the largest area of impact that is predicted to occur; refer to Figure's 1-5.

Figure 1
$SO_2$ Significant Impact Determination
Radius of Impact-15.6-Kilometers
1-Hour Averaging Period

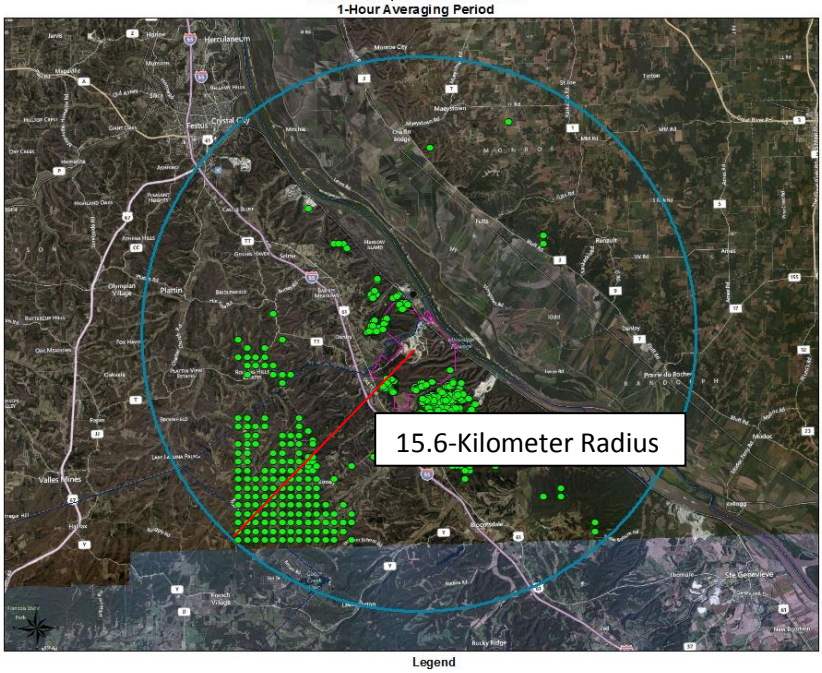


**Figure 2**
**$SO_2$ Significant Impact Determination**
**Radius of Impact-15.0-Kilometers**
**3-Hour Averaging Period**

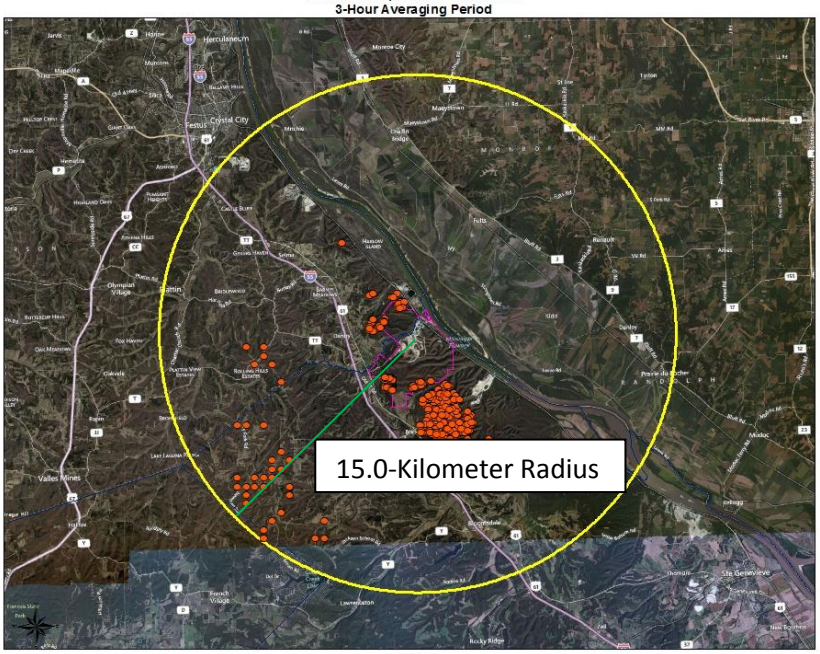



**Figure 3**
**$SO_2$ Significant Impact Determination**
**Radius of Impact-15.3-Kilometers**
**24-Hour Averaging Period**

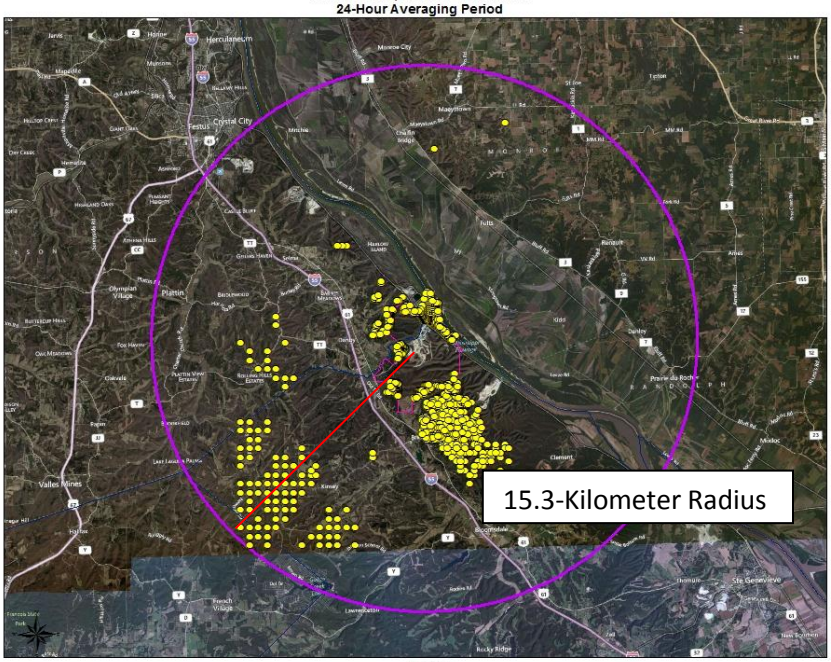


**Figure 4**
**$SO_2$ Significant Impact Determination**
**Radius of Impact-3.5-Kilometers**
**Annual Averaging Period**

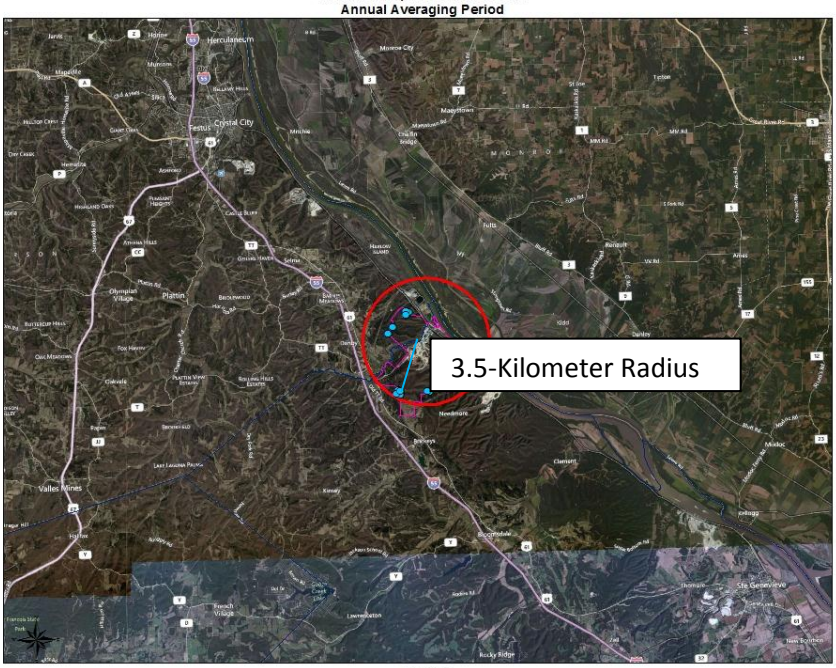
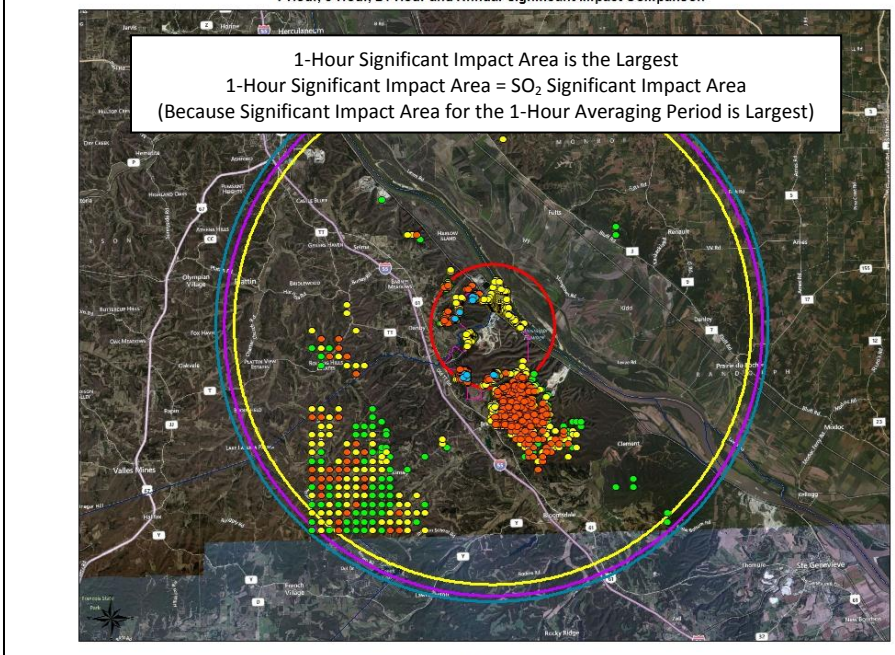



**Figure 5**
**$SO_2$ Significant Impact Determination**
**1-Hour, 3-Hour, 24-Hour and Annual Significant Impact Comparison**



It is important to note that the determination of ambient impact due to new source or modification must consider quantifiable point source releases and fugitive source releases.

**IMPORTANT!!!** If a significant impact is predicted to occur and a ***Section 8,*** major source permit is being sought, the applicant must determine if pre-construction monitoring will be required. Part D, of the 1977 Clean Air Act Amendments, requires PSD applicants to collect site-specific monitoring data for $SO_2$ if the significant monitoring threshold of 13 $\mu g/m^3$ is exceeded for the 24-hour averaging period. The primary objective of the data collection effort is to ensure that the existing air quality within the region is in compliance with the NAAQS.

The applicant must collect a minimum of one-year of data if it is determined that preconstruction monitoring is required. Additional information regarding preconstruction data collection efforts can be found at the following link: Preconstruction Monitoring Requirements.