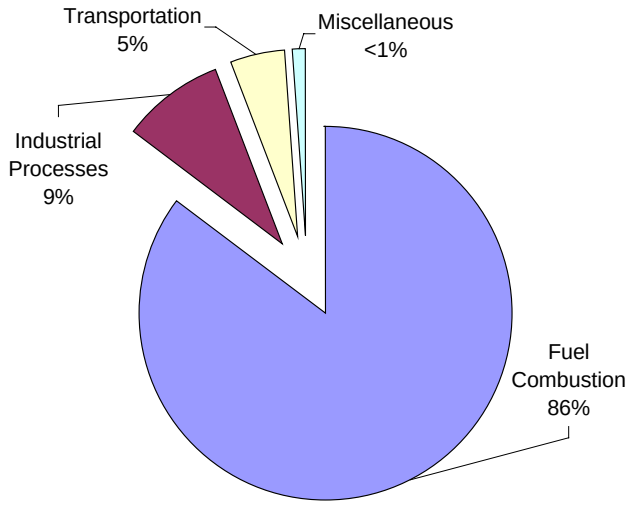
2004 Sulfur Dioxide Summary

New Jersey Department of Environmental Protection

Nature and Sources

Sulfur dioxide (SO_2) is a heavy, colorless gas with a suffocating odor that easily dissolves in water to form sulfuric acid. SO_2 gases can be formed when fuels containing sulfur are burned, or when gasoline is extracted from oil. Most of the sulfur dioxide released into the air comes from electric utilities, especially those that burn coal with a high sulfur content. Sulfur is found in raw materials such as crude oil, coal, and ores that contain metals such as aluminum, copper, zinc, lead and iron. Industrial facilities that derive their products from these materials may also release SO_2. A pie chart summarizing the major sources of SO_2 is shown in Figure 1.

Figure 1
National Summary of 2002
SO_2 Emissions by Source Category[a]



[a] - sums do not equal 100 due to rounding
Source: USEPA National Air Quality Emissions Trends Report, 2003 Special Studies, September 2003

SO_2 concentrations in New Jersey are generally higher in the winter than in the summer due to higher emissions from space heating and other sources. This is shown in the chart depicted in Figure 2 (page 2). The chart also shows that SO_2 levels tend to peak in the morning as emissions accumulate prior to being more effectively dispersed when wind speeds increase and atmospheric mixing increases later in the day.

Health and Environmental Effects

Sulfur dioxide causes irritation of the mucous membranes. This is probably the result of the action of sulfurous acid that is formed when the highly soluble SO_2 dissolves at the surface of the membranes. Groups that are especially susceptible to the harmful health effects of SO_2 include children, the elderly, and people with heart or lung disorders such as asthma. When SO_2 concentrations in the air become elevated, people belonging to these sensitive groups and those who are active outdoors may have trouble breathing. The International Agency for Research on Cancer (IARC) evaluated SO_2 and based on available information, determined that no conclusion can be made as to the carcinogenicity of SO_2 to human beings.

Sulfur dioxide reacts with other gases and particles in the air to form sulfates that can be harmful to people and the environment. Sulfate particles are the major cause of reduced visibility in the eastern United States. SO_2 can also react with other substances in the air to form acids, which fall to the earth in rain and snow. Acid rain damages forests and crops, can make lakes and streams too acidic for fish, and speeds up the decay of building materials and paints.

Standards

There are three National Ambient Air Quality Standards (NAAQS) for SO_2. There is an annual average health standard of 0.030 parts per million (ppm). This is based on a calendar year average of continuously monitored levels. There is also a 24-hour average health based standard of 0.14 ppm which is not to be exceeded more than once a year, and a secondary (welfare based) standard of 0.5 ppm, 3-hour average concentration that is also not to exceeded more than once per year.

New Jersey has also set state air quality standards for SO_2. They are similar to the federal standards but are expressed in micrograms per cubic meter ($\mu g/m^3$) instead

of ppm. They are also based on rolling averages rather than block averages. So, for example, the state's primary 12-month standard is based on any twelve-month average recorded during the year, while the federal standard is based solely on the calendar year average. The state also has secondary 12-month, 24-hour, and 3-hour average standards. Table 1 summarizes the NAAQS and the New Jersey Ambient Air Quality Standards (NJAAQS) for SO_2.

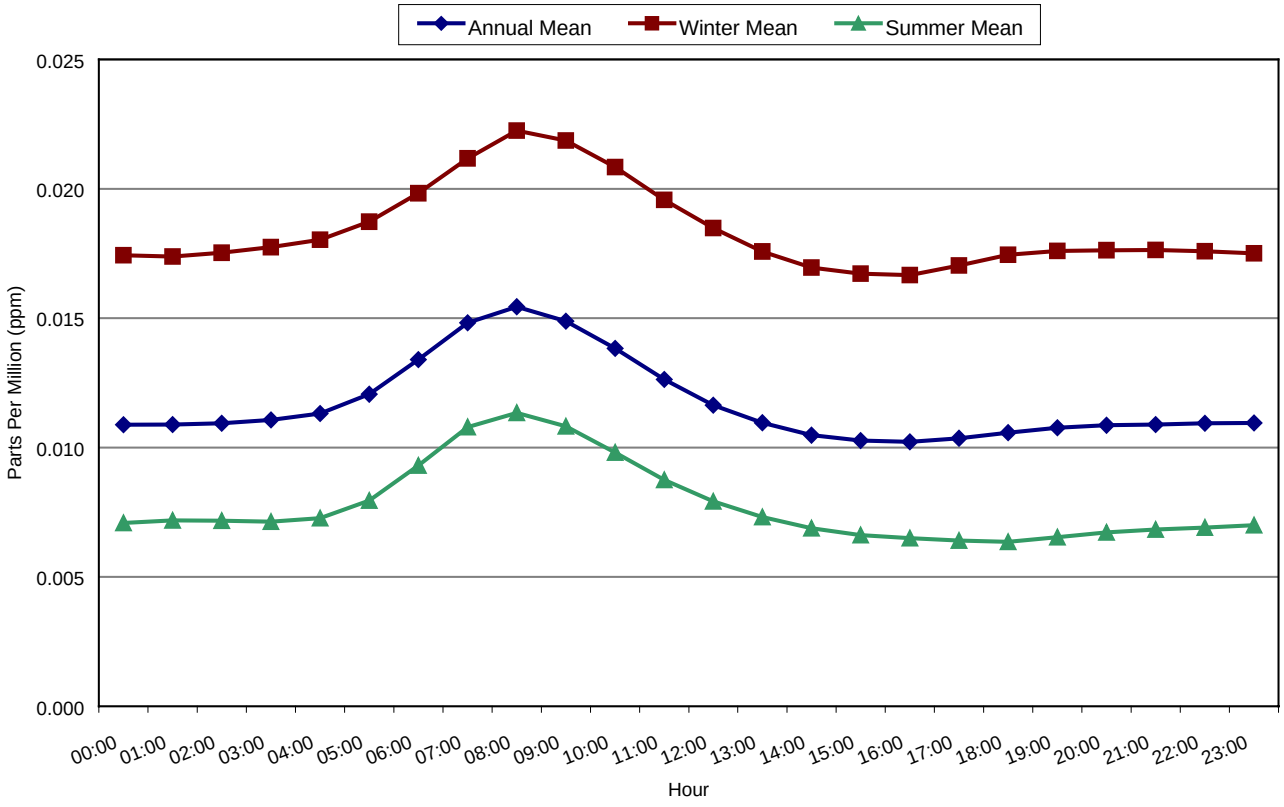
Table 1
National and New Jersey Ambient Air Quality Standards for Sulfur Dioxide

Parts Per Million (ppm)
Micrograms Per Cubic Meter (µg/m^3)

Averaging Period	Type	New Jersey	National[a]
12-month average	Primary	80 µg/m^3 (0.03 ppm)	0.030 ppm
12-month average	Secondary	60 µg/m^3 (0.02 ppm)	---
24-hour average	Primary	365 µg/m^3 (0.14 ppm)	0.14 ppm
24-hour average	Secondary	260 µg/m^3 (0.10 ppm)	---
3-hour average	Secondary	1300 µg/m^3 (0.5 ppm)	0.5 ppm

[a] – National standards are block averages rather than moving averages

Figure 2
Sulfur Dioxide Concentration - New Jersey
1967-1999
Seasonal and Hourly Variation



Monitoring Locations

The state monitored SO_2 levels at 13 locations in 2004. These sites are shown in the map in Figure 3. The Camden Lab monitoring station was temporarily discontinued on September 22, 2003, and resumed operation on January 8, 2004

SO_2 Levels in 2004

None of the monitoring sites recorded exceedances of the primary or secondary SO_2 standards during 2004. The maximum 12-month average concentration recorded was 0.009 ppm in Jersey City. The maximum 24-hour average level recorded was 0.033 ppm which was recorded in Jersey City. The highest 3-hour average recorded was 0.069 ppm at Elizabeth Lab. Summaries of the 2004 data are provided in Table 2, Table 3 (page 4) and Figure 4 (page 4).

Figure 3
2004 Sulfur Dioxide Monitoring Network

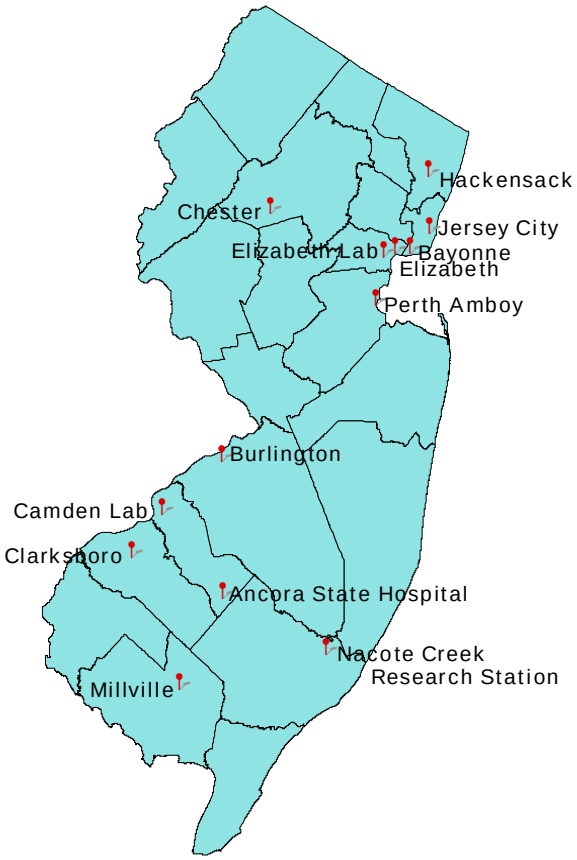


Table 2
Sulfur Dioxide Data – 2004
3-Hour and Annual Averages

Parts Per Million (ppm)

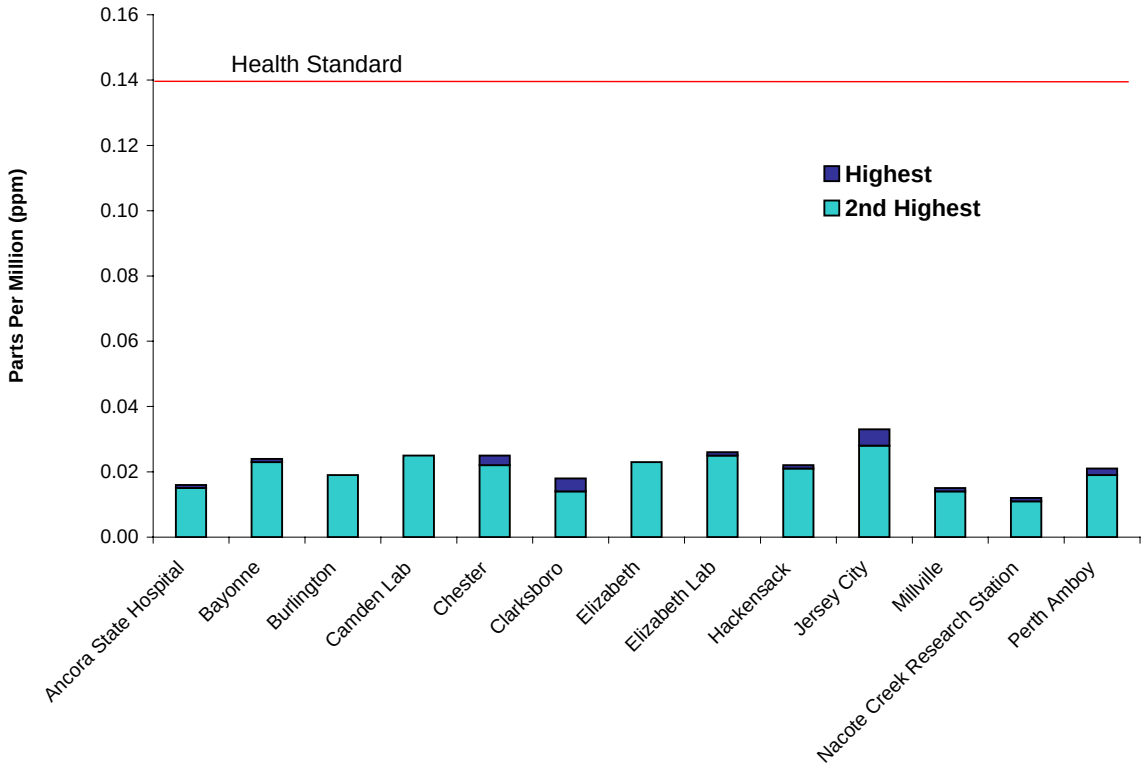
Monitoring Sites	3-Hour Average Maximum	3-Hour Average 2nd Highest	12-Month Average Maximum	Average Calendar Year
Ancora State Hospital	0.027	0.024	0.004	0.004
Bayonne	0.051	0.047	0.007	0.007
Burlington	0.032	0.031	0.004	0.004
Camden Lab	0.050	0.044	0.006	0.006
Chester	0.049	0.038	0.004	0.004
Clarksboro	0.031	0.029	0.004	0.004
Elizabeth	0.036	0.036	0.006	0.005
Elizabeth Lab	0.069	0.062	0.008	0.008
Hackensack	0.045	0.039	0.004	0.004
Jersey City	0.057	0.049	0.009	0.008
Millville	0.035	0.025	0.004	0.004
Nacote Creek Research Center	0.023	0.017	0.003	0.002
Perth Amboy	0.035	0.034	0.005	0.005

Table 3
Sulfur Dioxide Data – 2004
24-Hour and Daily Averages

Parts Per Million (ppm)

Monitoring Sites	24-Hour Average Maximum	24-Hour Average 2nd Highest	Daily Average Maximum	Daily Average 2nd Highest
Ancora State Hospital	0.016	0.015	0.015	0.012
Bayonne	0.024	0.023	0.024	0.022
Burlington	0.019	0.019	0.019	0.019
Camden Lab	0.025	0.025	0.024	0.023
Chester	0.025	0.022	0.023	0.021
Clarksboro	0.018	0.014	0.017	0.013
Elizabeth	0.023	0.023	0.023	0.023
Elizabeth Lab	0.026	0.025	0.025	0.023
Hackensack	0.022	0.021	0.021	0.021
Jersey City	0.033	0.028	0.030	0.028
Millville	0.015	0.014	0.013	0.013
Nacote Creek Research Station	0.012	0.011	0.012	0.010
Perth Amboy	0.021	0.019	0.020	0.018

Figure 4
Highest and 2nd Highest Daily Averages
0f SO_2 in New Jersey - 2004



TRENDS

Since the implementation of regulations requiring the use of low sulfur fuels in New Jersey, SO_2 concentrations have improved significantly. The last time an exceedance of any of the National SO_2 standards was recorded in the state was in 1980. A trend graph of SO_2 levels showing the daily average concentrations recorded since 1975 from the highest, average, and lowest of all sites is shown in Figure 5 below. The graph uses the second highest daily value, as this is the value that determines if the national health standard is being met (one exceedance per site is allowed each year).

Although there has not been a measured exceedance of the NAAQS in over two decades, there is still a small area of New Jersey that is classified as a non-attainment area for SO_2. This is the result of air quality modeling studies that predicted non-attainment of the standard within a small area of Warren County. The area is shown in the map in Figure 6 (page 6).

Figure 5
Sulfur Dioxide Concentrations in New Jersey
1975-2004
Second Highest Daily Average

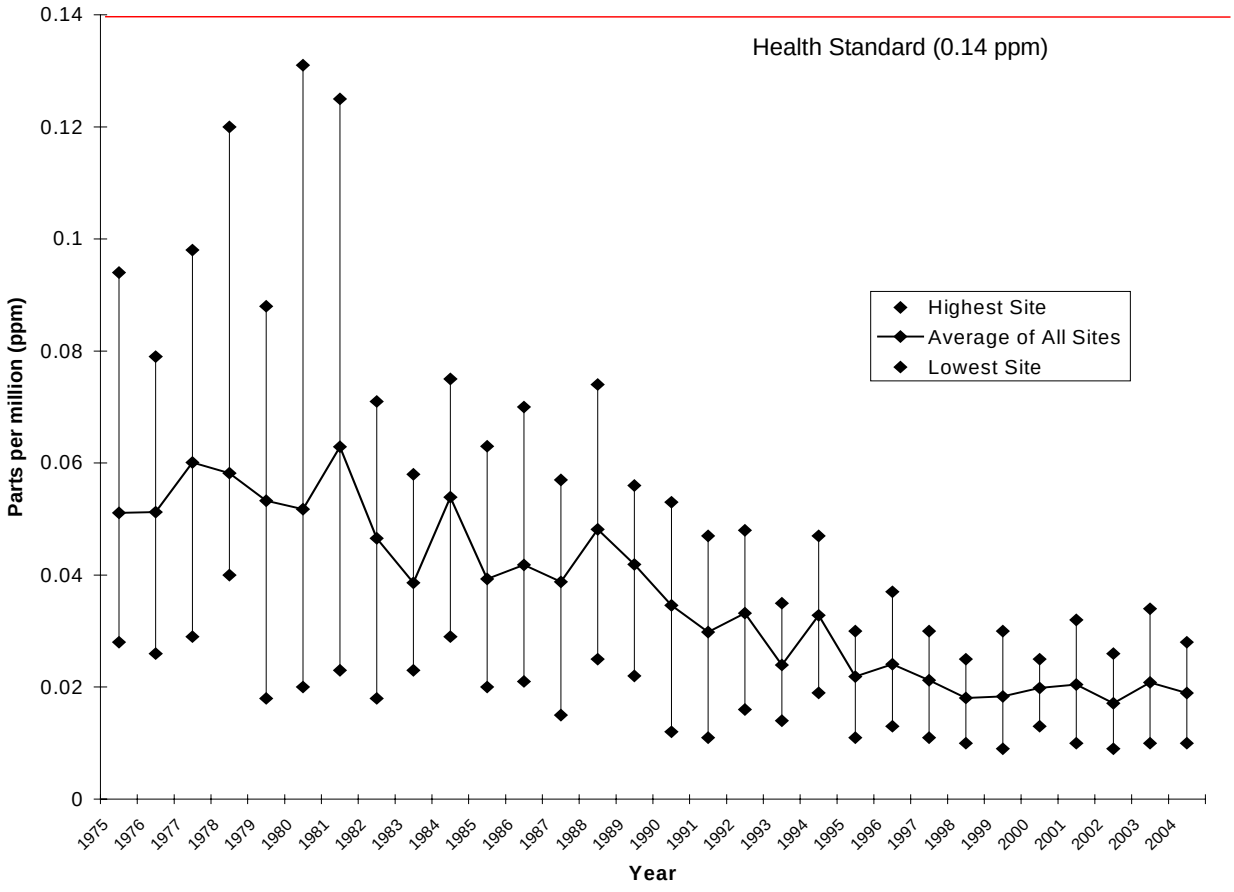
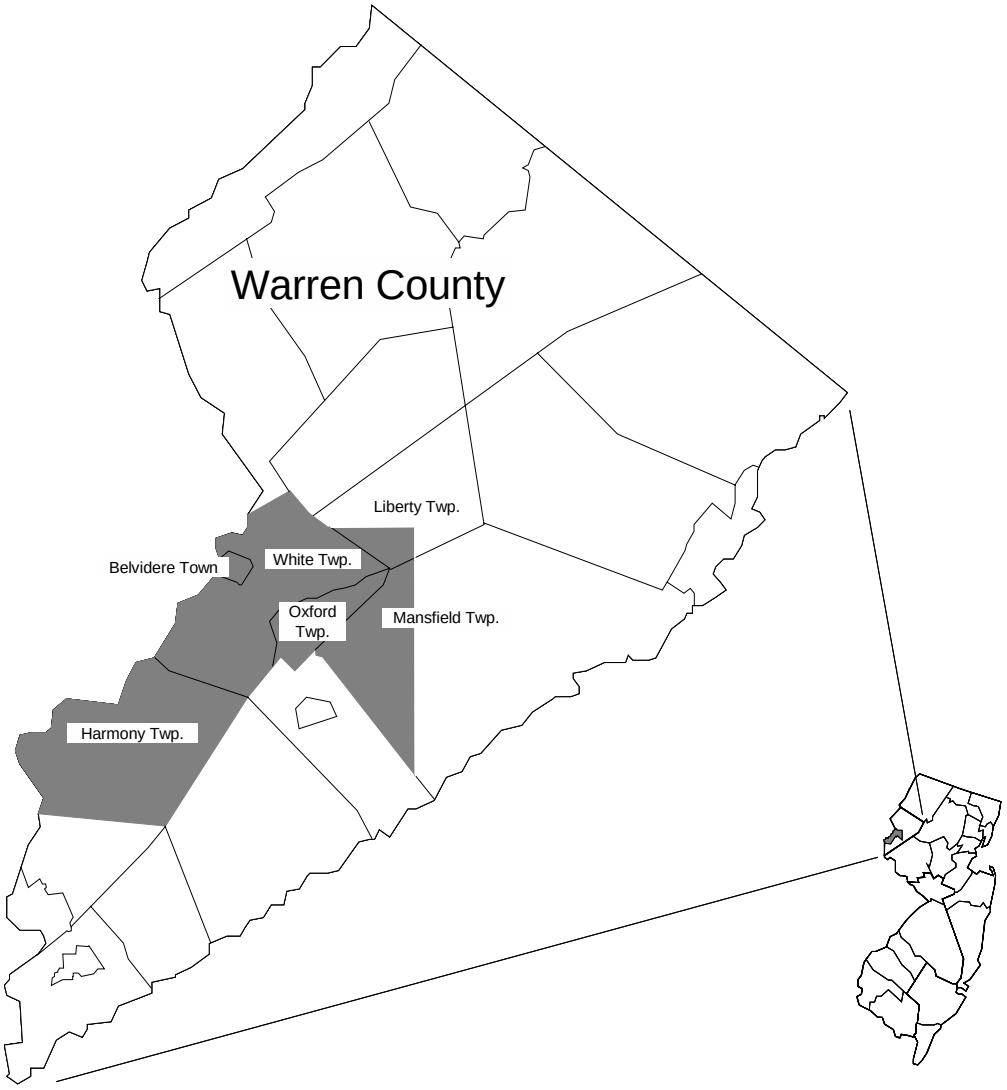


Figure 6
Sulfur Dioxide Non-Attainment Areas* in New Jersey



Legend

Sulfur Dioxide Nonattainment Area
(includes Belvidere Town; Harmony Township; Oxford Township; White Township; the portion of Liberty Township south of UTM northing 4,255,000 and west of UTM easting 505,000; and the portion of Mansfield Township west of UTM easting 505,000).

*Nonattainment of the National Primary (Health) and Secondary (Welfare) Standards

Five Minute Average SO_2 Monitoring

A 1992 court decision compelled the USEPA to review, and if appropriate, revise the NAAQS for SO_2. After soliciting comments from the public and evaluating several options, the USEPA determined that high short-term SO_2 concentrations are a local problem rather than a widespread national concern. The USEPA Administrator decided in May 1996 not to revise the NAAQS for SO_2, but concluded that in some local areas, 5-minute SO_2 concentrations greater than 0.6 ppm pose a health threat to sensitive persons. In January 1997, the USEPA published proposed revisions to the regulations that would establish "concern and intervention levels (IL)." This IL would have a lower range of 0.6 ppm and an upper range of 2.0 ppm of SO_2. These levels are based on a 5-minute SO_2 concentration that is the highest of the 5-minute averages from the 12 possible non-overlapping periods during a clock hour. Under the proposed regulations, the USEPA would leave the responsibility of assessing the health risk and implementing corrective measures to the States. Also, the USEPA recommended that States evaluate the need to monitor 5-minute SO_2 averages around sources based on citizen complaints, the actual emissions of a source, the population in the vicinity of the source, and environmental justice issues.

The USEPA published a draft "Guideline Document for Ambient Monitoring of 5-Minute SO_2 Concentrations" on July 20, 2000. This guidance is intended to assist State and local agencies in determining whether 5-minute SO_2 monitoring should be established in their jurisdictions, and how to redesign an existing SO_2 network to fulfill these additional needs.

In October 2002, an air monitoring project was established in Warren County, New Jersey to evaluate the feasibility of monitoring 5-minute SO_2 concentrations in the vicinity of local point source. This is the first time since the publication of USEPA's draft "Guideline Document for Ambient Monitoring of 5-Minute SO_2 Concentrations" that SO_2 concentrations anywhere in New Jersey are being directly compared to the 5-minute SO_2 guideline IL. Warren County was selected for this study as the Belvidere area of the county is the only SO_2 non-attainment area in the state (see Figure 6 – page 6). The study had broad community involvement in its design and implementation. It is primarily being supported by a local industrial facility as part of a Supplemental Environmental Project (SEP). SEPs are sometimes part of settlement agreements between the DEP and a regulated facility. They are projects deemed to have an environmental benefit for the community, and are supported by a facility in lieu of, or in addition to, direct monetary penalties. The results of the monitoring study are available on the World Wide Web at www.airqap.com

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