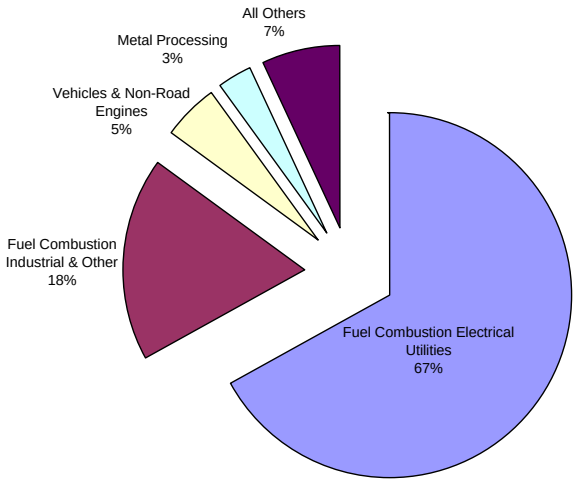
2006 Sulfur Dioxide Summary

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 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
SO_2 Emissions by Source Category



Source: USEPA website
http://www.epa.gov/air/urbanair/so2/what1.html
Last updated, Monday, July 23, 2007

Figure 2 (page 2) shows that 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. As shown in Figure 3 (page 2) SO_2 levels tend to peak in mid to late 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 that fall to the earth in rain and snow. Better known as acid rain, this acidic precipitation can damage forests and crops, can make lakes and streams too acidic for fish, and eventually 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 0.03 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.

Figure 2
Sulfur Dioxide – New Jersey
2006 Monthly Variation

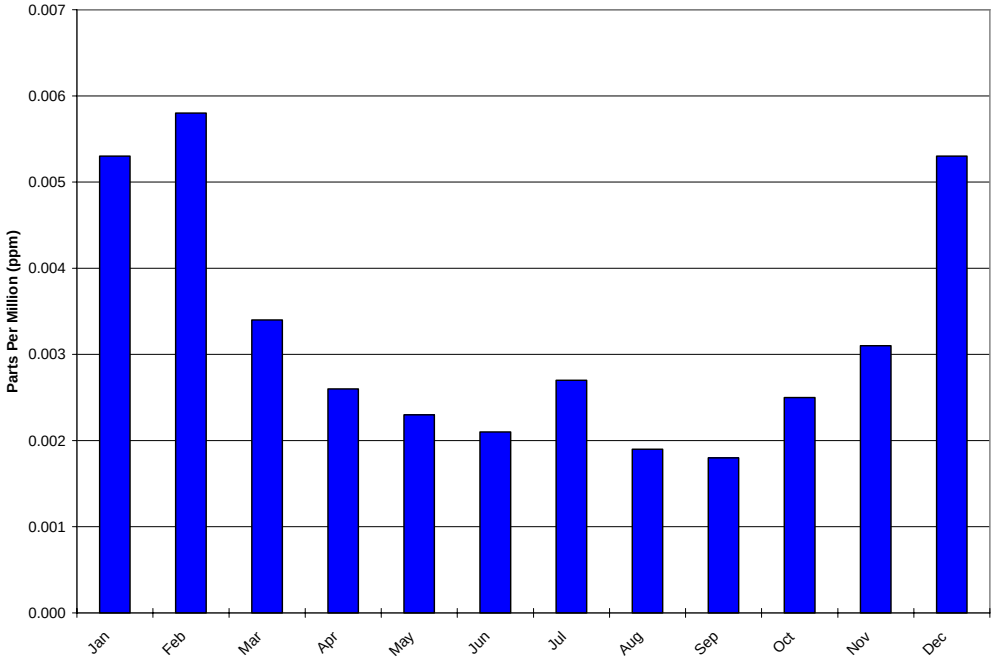


Figure 3
Sulfur Dioxide – New Jersey
2006 Hourly Variation

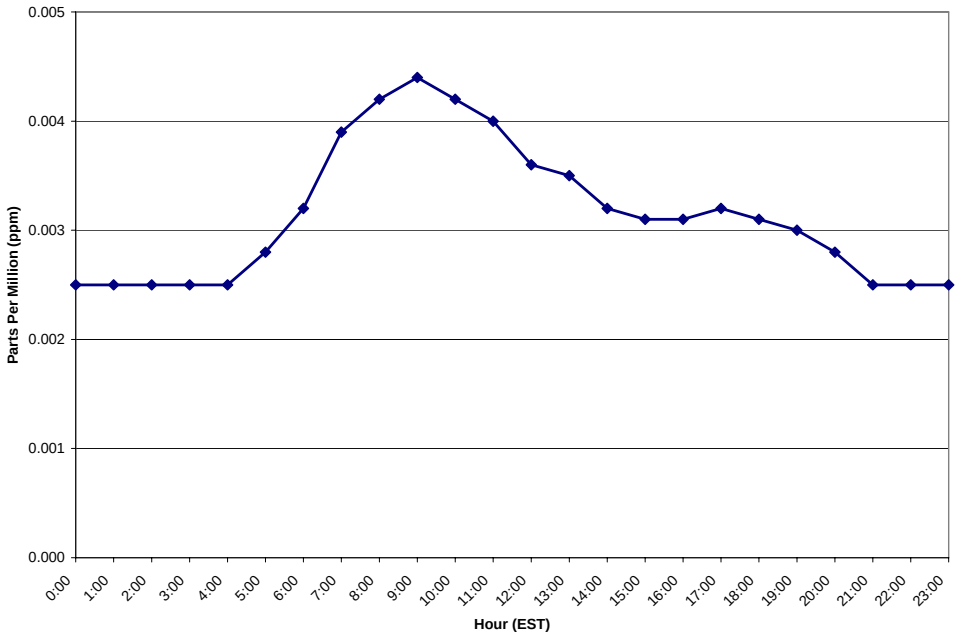


Table 1
National and New Jersey Ambient Air Quality Standards for Sulfur Dioxide

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)	0.03 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

MONITORING LOCATIONS

The state monitored SO_2 levels at 13 locations in 2006. These sites are shown in the map in Figure 4.

SO_2 LEVELS IN 2006

None of the monitoring sites recorded exceedances of the primary or secondary SO_2 standards during 2006. The maximum 12-month average concentration recorded was 0.008 ppm in Bayonne. The maximum 24-hour average level recorded was 0.029 ppm which was recorded at Camden Lab. The highest 3-hour average recorded was 0.052 ppm at Camden Lab and Elizabeth Lab. Summaries of the 2006 data are provided in Tables 2 and 3 (page 4), and Figures 5 and 6 (page 5).

Figure 4
2006 Sulfur Dioxide Monitoring Network

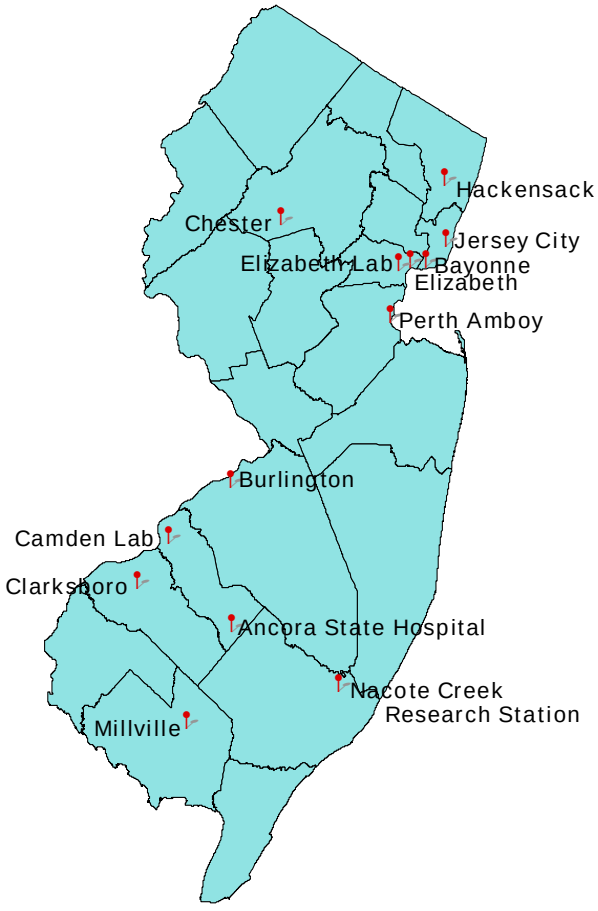


Table 2
Sulfur Dioxide Data – 2006
3-Hour and Annual Averages

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	0.032	0.031	0.003	0.002
Bayonne	0.047	0.042	0.008	0.005
Burlington	0.026	0.025	0.003	0.003
Camden Lab	0.052	0.037	0.005	0.003
Chester	0.044	0.036	0.003	0.003
Clarksboro	0.035	0.033	0.004	0.003
Elizabeth	0.040	0.026	0.005	0.004
Elizabeth Lab	0.052	0.047	0.007	0.005
Hackensack	0.031	0.024	0.004	0.003
Jersey City	0.040	0.040	0.007	0.005
Millville	0.039	0.030	0.003	0.002
Nacote Creek Research Center	0.016	0.015	0.002	0.001
Perth Amboy	0.031	0.025	0.004	0.003

Table 3
Sulfur Dioxide Data – 2006
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	0.011	0.013	0.011
Bayonne	0.020	0.019	0.018	0.017
Burlington	0.020	0.017	0.019	0.015
Camden Lab	0.029	0.025	0.024	0.024
Chester	0.024	0.020	0.020	0.019
Clarksboro	0.017	0.015	0.015	0.014
Elizabeth	0.017	0.015	0.017	0.014
Elizabeth Lab	0.025	0.024	0.022	0.022
Hackensack	0.015	0.014	0.015	0.013
Jersey City	0.028	0.027	0.025	0.023
Millville	0.012	0.010	0.011	0.009
Nacote Creek Research Station	0.008	0.006	0.006	0.006
Perth Amboy	0.015	0.015	0.014	0.013

Figure 5
Highest and 2nd Highest 24-Hour Averages
of Sulfur Dioxide in New Jersey - 2006

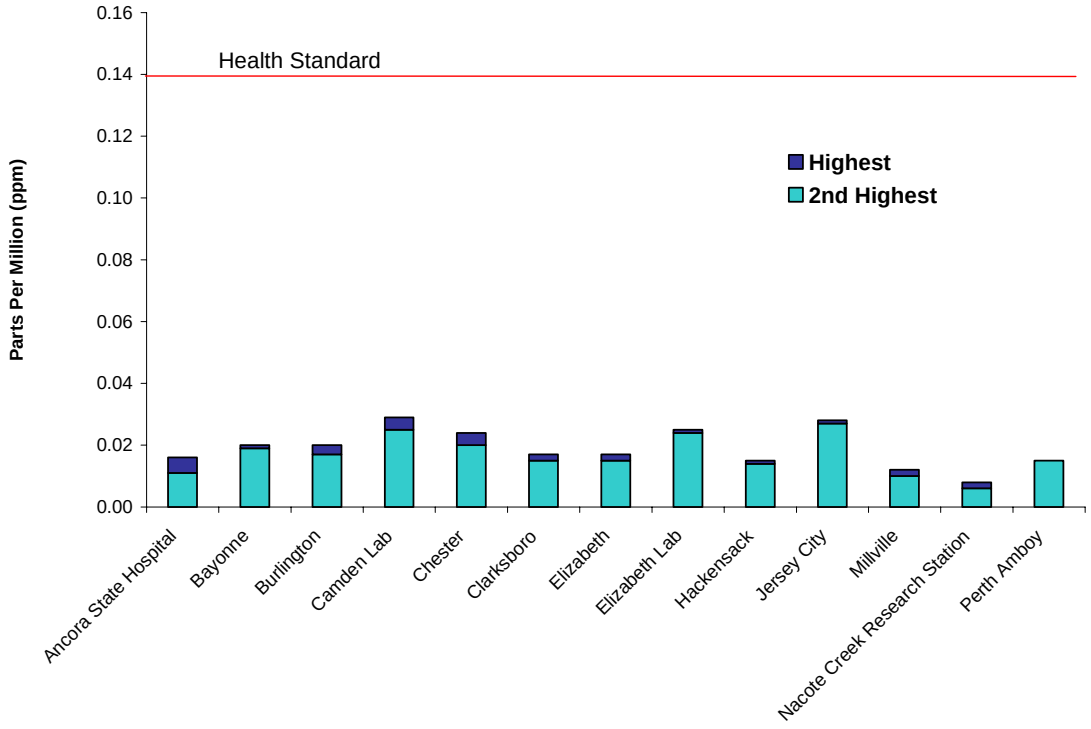
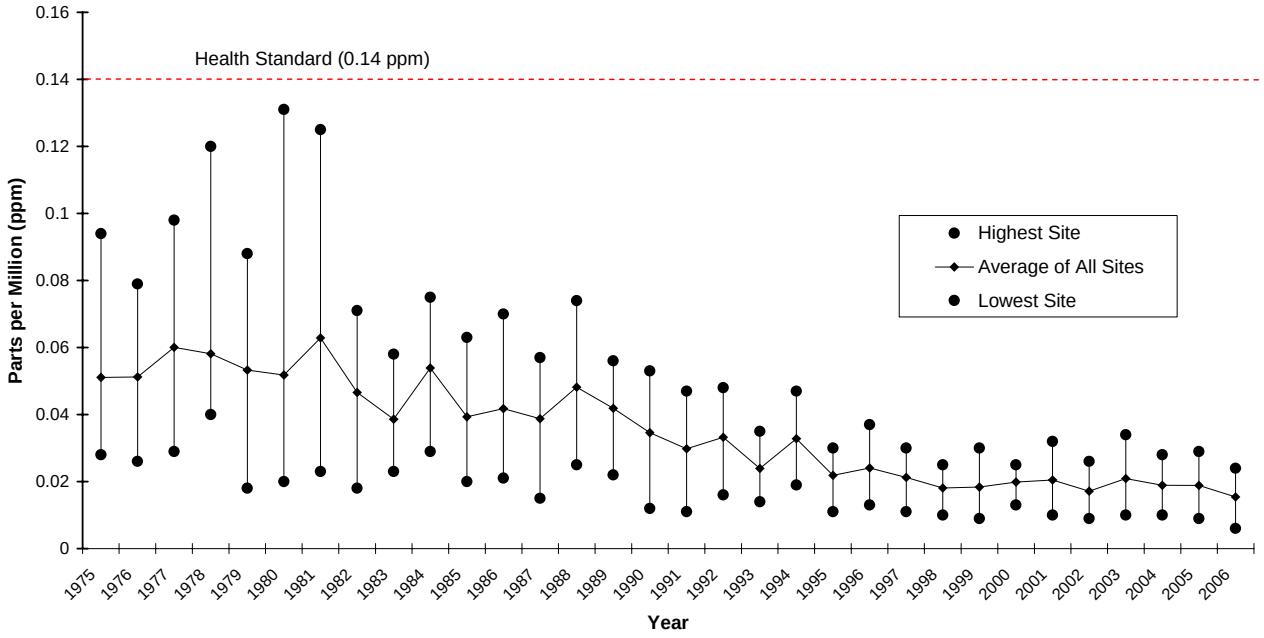


Figure 6
Sulfur Dioxide Concentrations in New Jersey
1975 - 2006
Second Highest Daily Average

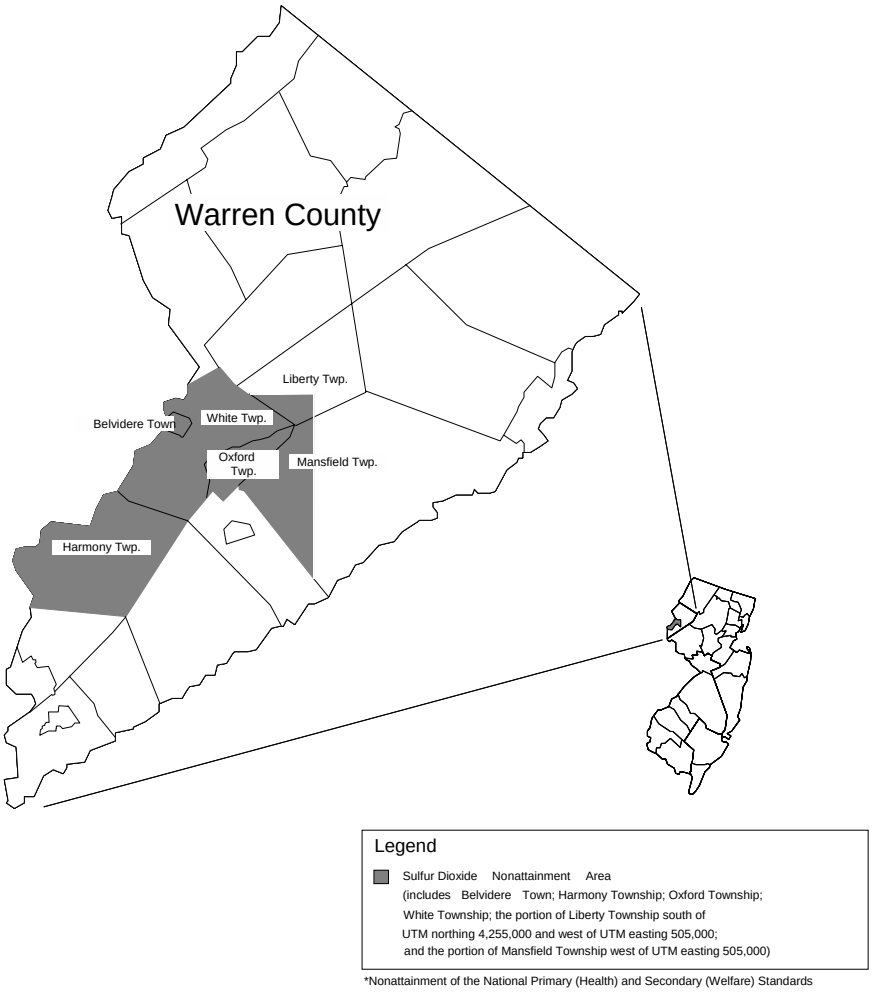


TRENDS

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 6 (page 5). The graph uses the second highest daily average, 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 below in Figure 7.

Figure 7
Sulfur Dioxide Non-Attainment Areas* in New Jersey



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

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