



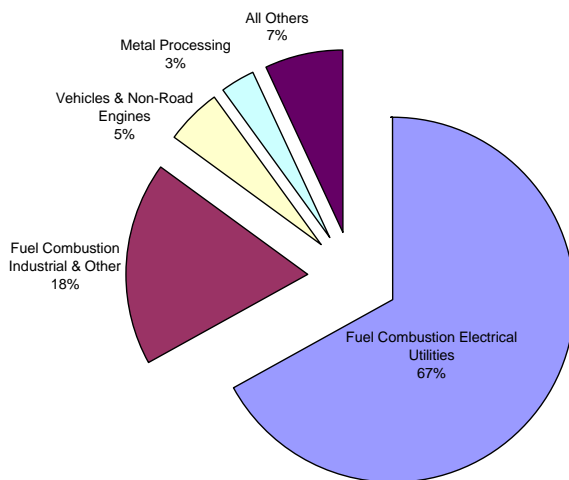
# 2007 Sulfur Dioxide Summary

New Jersey Department of Environmental Protection

## NATURE AND SOURCES

Sulfur dioxide (SO<sub>2</sub>) is a heavy, colorless gas with a suffocating odor that easily dissolves in water to form sulfuric acid. SO<sub>2</sub> 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<sub>2</sub>. A pie chart summarizing the major sources of SO<sub>2</sub> is shown in Figure 1.

**Figure 1**  
**National Summary**  
**SO<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> dissolves at the surface of the membranes. Groups that are especially susceptible to the harmful health effects of SO<sub>2</sub> include children, the elderly, and people with heart or lung disorders such as asthma. When SO<sub>2</sub> 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<sub>2</sub> and based on available information, determined that no conclusion can be made as to the carcinogenicity of SO<sub>2</sub> 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<sub>2</sub> 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

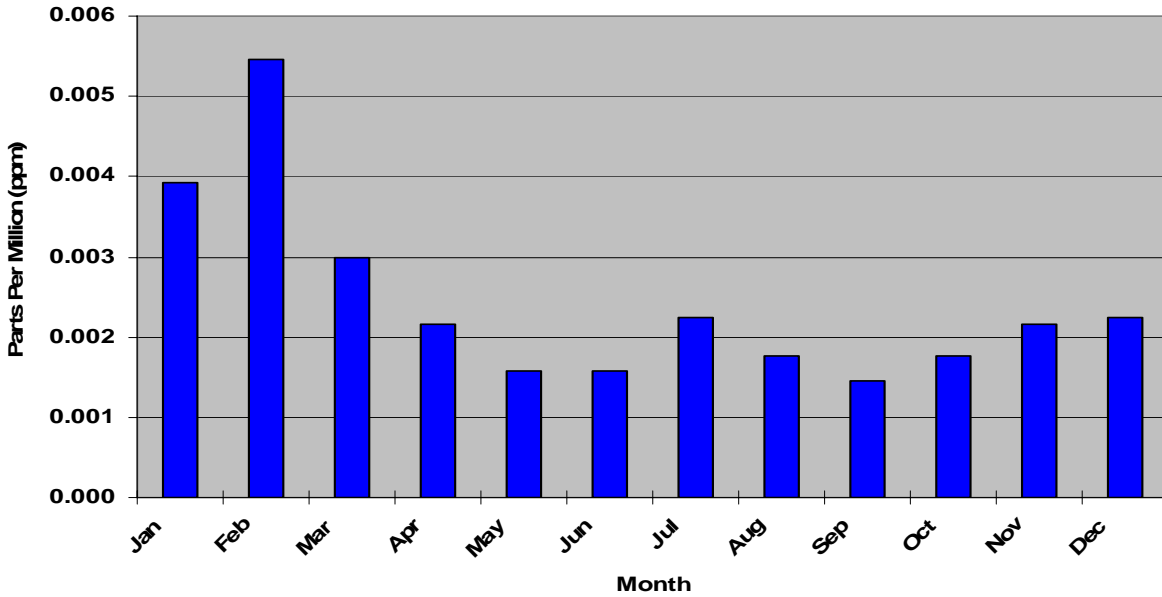
There are three National Ambient Air Quality Standards (NAAQS) for SO<sub>2</sub>. There is an annual average health standard of 0.03 parts per million (ppm). This is based on a calendar year average of continuously monitored levels. There is also a 24-hour average health based standard of 0.14 ppm which 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 be exceeded more than once per year.

New Jersey has also set state air quality standards for SO<sub>2</sub>. They are similar to the federal standards but are

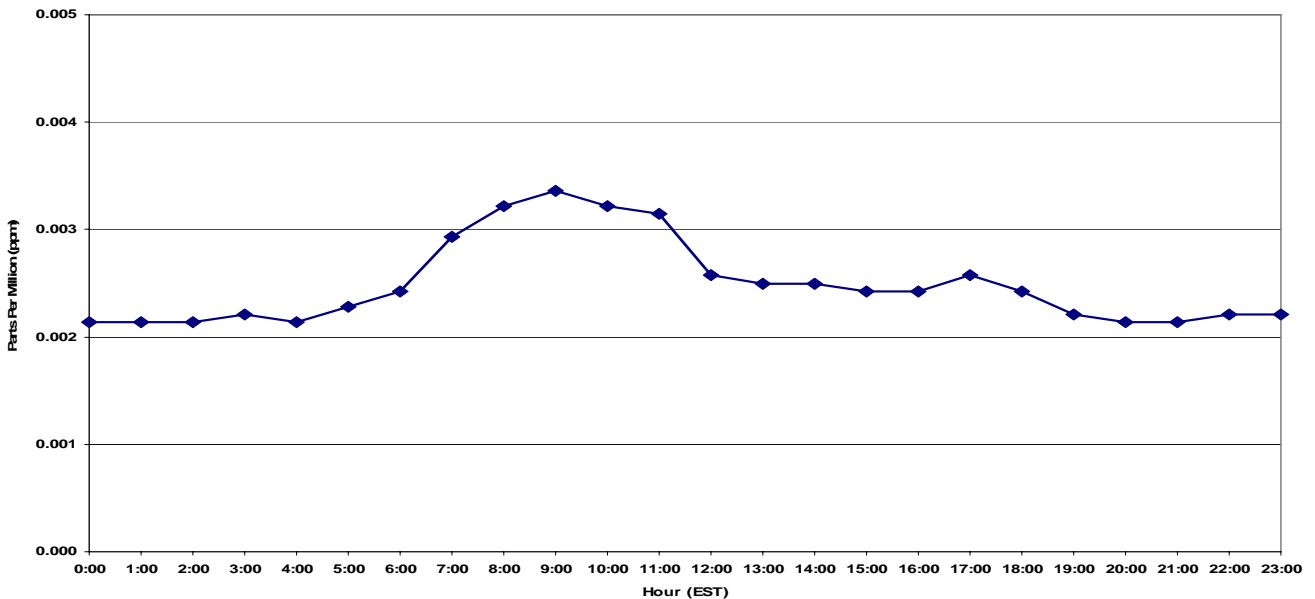
expressed in micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) instead of ppm. They are also based on rolling averages rather than block averages. So, for example, the state's primary 12-month standard is based on any twelve-month average recorded during the year, while the federal standard is 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  $\text{SO}_2$ .

**Figure 2**  
**Sulfur Dioxide – New Jersey**  
**2007 Monthly Variation**  
**Parts Per Million (ppm)**



**Figure 3**  
**Sulfur Dioxide – New Jersey**  
**2007 Hourly Variation**  
**Parts Per Million (ppm)**



**Table 1**  
**National and New Jersey Ambient Air Quality Standards for Sulfur Dioxide**  
**Parts Per Million (ppm)**  
**Micrograms Per Cubic Meter ( $\mu\text{g}/\text{m}^3$ )**

<b>Averaging Period</b>	<b>Type</b>	<b>New Jersey</b>	<b>National<sup>a</sup></b>
12-month average	Primary	80 $\mu\text{g}/\text{m}^3$ (0.03 ppm)	0.03 ppm
12-month average	Secondary	60 $\mu\text{g}/\text{m}^3$ (0.02 ppm)	---
24-hour average	Primary	365 $\mu\text{g}/\text{m}^3$ (0.14 ppm)	0.14 ppm
24-hour average	Secondary	260 $\mu\text{g}/\text{m}^3$ (0.10 ppm)	---
3-hour average	Secondary	1300 $\mu\text{g}/\text{m}^3$ (0.5 ppm)	0.5 ppm

<sup>a</sup> – National standards are block averages rather than moving averages.

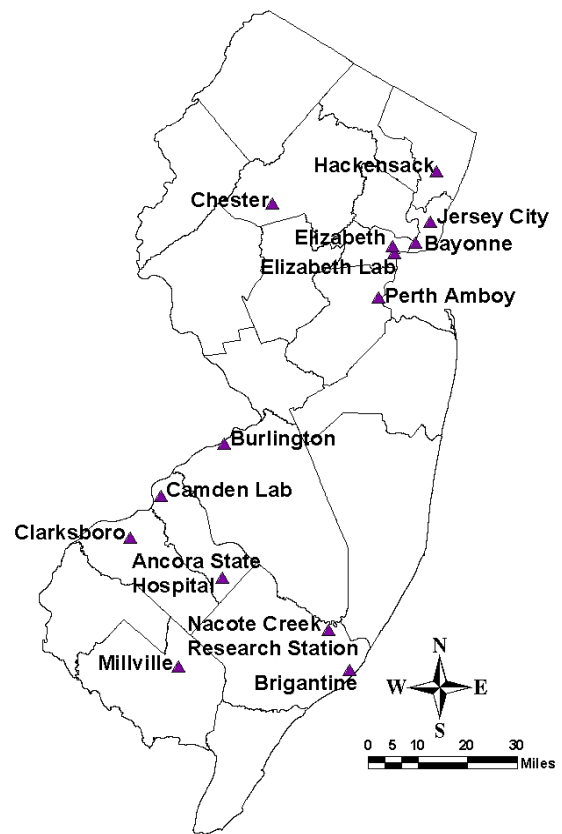
## MONITORING LOCATIONS

The state monitored SO<sub>2</sub> levels at 14 locations in 2007. These sites are shown in the map in Figure 4. Monitoring location changes for 2007 include a temporary shut down of Elizabeth after March 7<sup>th</sup>, the start up of a new site in Brigantine during August, and the permanent shut-down of Nacote Creek Research Station in mid-December.

## SO<sub>2</sub> LEVELS IN 2007

None of the monitoring sites recorded exceedances of the primary or secondary SO<sub>2</sub> standards during 2007. The maximum 12-month average concentration recorded was 0.007 ppm in Jersey City and at Elizabeth Lab. The maximum 24-hour average level recorded was 0.018 ppm which was recorded at both Camden Lab and Jersey City. The highest 3-hour average recorded was 0.044 ppm at Elizabeth Lab. Summaries of the 2007 data are provided in Tables 2 and 3 (page 4), and Figures 5 and 6 (page 5). The data from Bayonne after October 2007 through the end of the year was flagged as invalid.

**Figure 4**  
**2007 Sulfur Dioxide**  
**Monitoring Network**



**Table 2**  
**2007 Sulfur Dioxide Data**  
**3-Hour and Annual Averages**  
**Parts Per Million (ppm)**

<b>Monitoring Sites</b>	<b>3-Hour Average Maximum</b>	<b>3-Hour Average 2<sup>nd</sup> Highest<sup>b</sup></b>	<b>12-Month Average Maximum</b>	<b>Calendar Year Average</b>
Ancora State Hospital	0.030	0.027	0.002	0.002
Bayonne (c)	0.028	0.027	0.005	-----
Brigantine (d)	0.018	0.015	-----	-----
Burlington	0.023	0.022	0.003	0.002
Camden Lab	0.030	0.030	0.005	0.003
Chester	0.032	0.031	0.003	0.002
Clarksboro	0.026	0.025	0.004	0.003
Elizabeth (e)	0.019	0.017	0.005	-----
Elizabeth Lab	0.044	0.036	0.007	0.004
Hackensack	0.024	0.021	0.004	0.002
Jersey City	0.028	0.027	0.007	0.004
Millville	0.018	0.016	0.003	0.002
Nacote Creek Research Center (f)	0.016	0.014	0.002	0.001
Perth Amboy	0.020	0.019	0.004	0.002

<sup>b</sup> – Based on non-overlapping 3 – hour moving averages.

<sup>c</sup> – Data after October 2007 flagged as Invalid.

<sup>d</sup> – Site start up during August 2007.

<sup>e</sup> – Temporary shut down of site after March 7, 2007.

<sup>f</sup> – Permanent shut down of site after December 18, 2007.

**Table 3**  
**2007 Sulfur Dioxide Data**  
**24-Hour and Daily Averages**  
**Parts Per Million (ppm)**

<b>Monitoring Sites</b>	<b>24-Hour Average Maximum</b>	<b>24-Hour Average 2<sup>nd</sup> Highest<sup>b</sup></b>	<b>Daily Average Maximum</b>	<b>Daily Average 2<sup>nd</sup> Highest</b>
Ancora State Hospital	0.014	0.011	0.012	0.009
Bayonne (c)	0.015	0.014	0.014	0.013
Brigantine (d)	0.007	0.006	0.007	0.005
Burlington	0.015	0.012	0.014	0.010
Camden Lab	0.018	0.016	0.015	0.014
Chester	0.016	0.015	0.014	0.012
Clarksboro	0.013	0.012	0.012	0.011
Elizabeth (e)	0.014	0.011	0.013	0.011
Elizabeth Lab	0.015	0.014	0.014	0.013
Hackensack	0.013	0.013	0.013	0.012
Jersey City	0.018	0.016	0.017	0.016
Millville	0.011	0.010	0.009	0.008
Nacote Creek Research Station (f)	0.008	0.006	0.006	0.005
Perth Amboy	0.011	0.010	0.010	0.009

<sup>b</sup> – Based on non-overlapping 24 – hour moving averages.

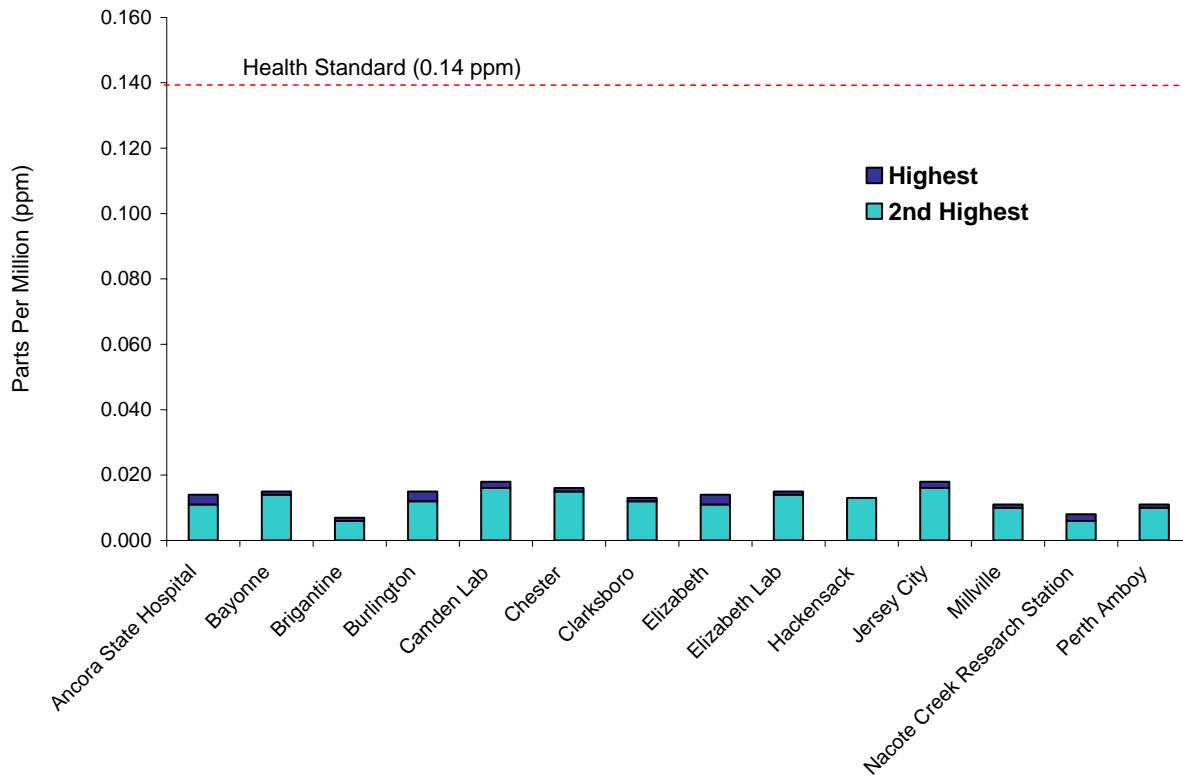
<sup>c</sup> – Data after October 2007 flagged as Invalid.

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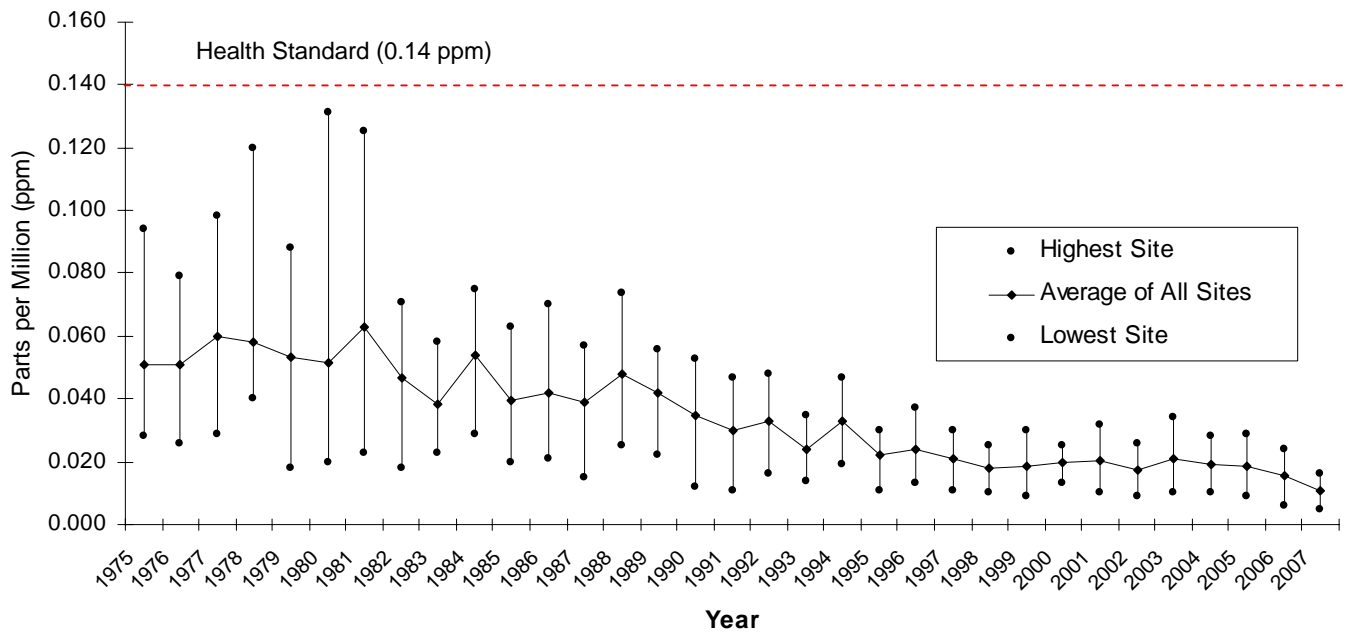
<sup>e</sup> – Temporary shut down of site after March 7, 2007.

<sup>f</sup> – Permanent shut down of site after December 18, 2007.

**Figure 5**  
**2007 Sulfur Dioxide Concentrations**  
**Highest and 2nd Highest 24-Hour Averages**  
**Parts Per Million (ppm)**



**Figure 6**  
**1975 - 2007 Sulfur Dioxide Concentrations**  
**Second Highest Daily Average**  
**Parts Per Million (ppm)**

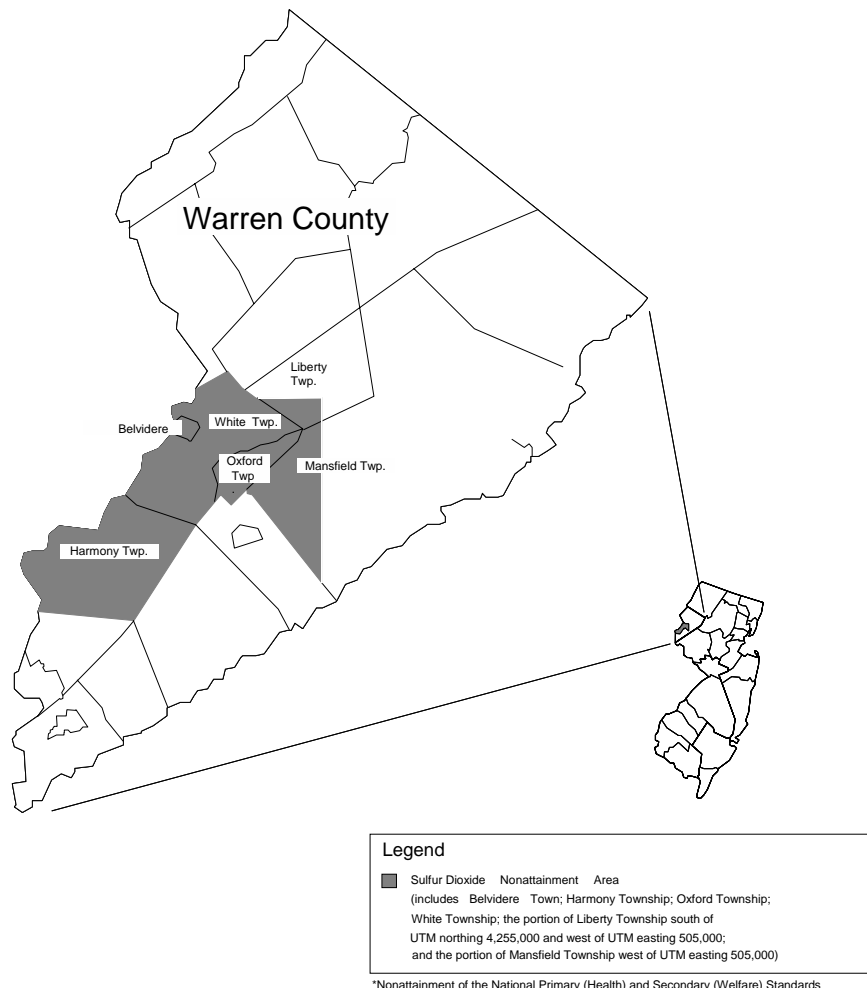


## TRENDS

Since the implementation of regulations requiring the use of low sulfur fuels in New Jersey, SO<sub>2</sub> concentrations have improved significantly. The last time an exceedance of any of the National SO<sub>2</sub> standards was recorded in the state was in 1980. A trend graph of SO<sub>2</sub> 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<sub>2</sub>. 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 the map in Figure 7.

Figure 7  
Sulfur Dioxide Non-attainment Areas in New Jersey



## REFERENCES

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