2005 Nitrogen Dioxide Summary

New Jersey Department of Environmental Protection

Nature and Sources

Nitrogen Dioxide (NO_2) is a reddish-brown, highly reactive gas that is formed in the air through the oxidation of Nitric Oxide (NO). When NO_2 reacts with other chemicals, it can form ozone, particulate matter, and other compounds which can contribute to regional haze and acid rain. Nitrogen Oxides (NO_x) is a mixture of gases which is mostly comprised of NO and NO_2. These gases are emitted from the exhaust of motor vehicles, the burning of coal, oil or natural gas, and during industrial processes such as welding, electroplating, and dynamite blasting. Although most NO_x is emitted as NO, it is readily converted to NO_2 in the atmosphere. In the home, gas stoves and heaters produce substantial amounts of nitrogen dioxide. A pie chart summarizing the major sources of NO_x is shown below (Figure 1). As much of the NO_x in the air is emitted by motor vehicles, concentrations tend to peak during the morning and afternoon rush hours. This is shown in the graph in Figure 2 (page 2), which also indicates that concentrations tend to be higher in the winter than the summer. This is due in part to poorer local dispersion conditions caused by light winds and other weather conditions that are more prevalent in the colder months of the year.

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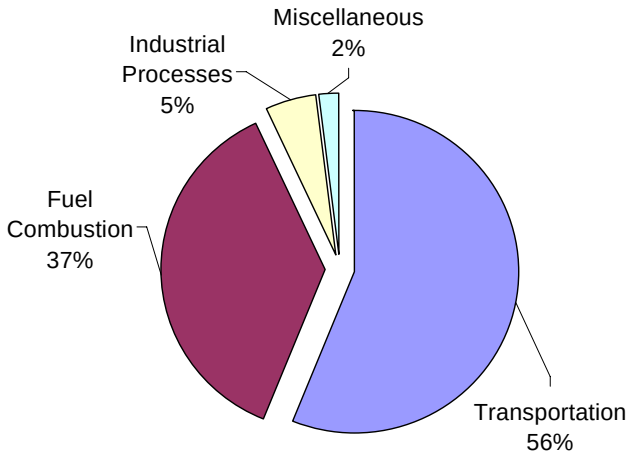
Figure 1
National Summary of 2002
NO_x Emissions by Source Category



Source: USEPA National Air Quality Emissions Trends Report, 2003 Special Studies, September 2003

Health and Environmental Effects

Short-term exposures (less than 3 hours) to low levels of nitrogen dioxide may aggravate pre-existing respiratory illnesses, and can cause respiratory illnesses, particularly in children ages 5-12. Symptoms of low level exposure to NO and NO_2 include irritation to eyes, nose, throat and lungs, coughing, shortness of breath, tiredness and nausea. Long-term exposures to NO_2 may increase susceptibility to respiratory infection and may cause permanent damage to the lung. NO and NO_2 are found in tobacco smoke, so people who smoke or breathe in second-hand smoke may be exposed to NO_x. The U.S. Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the U.S. Environmental Protection Agency (EPA) have determined that, with the available information, no conclusion can be made as to the carcinogenicity of NO or NO_2 to human beings.

Nitrogen Oxides contribute to a wide range of environmental problems. These include potential changes in the composition of some plants in wetland and terrestrial ecosystems, acidification of freshwater bodies, eutrophication of estuarine and coastal waters, increases in levels of toxins harmful to fish and other aquatic life, and visibility impairment.

Standards

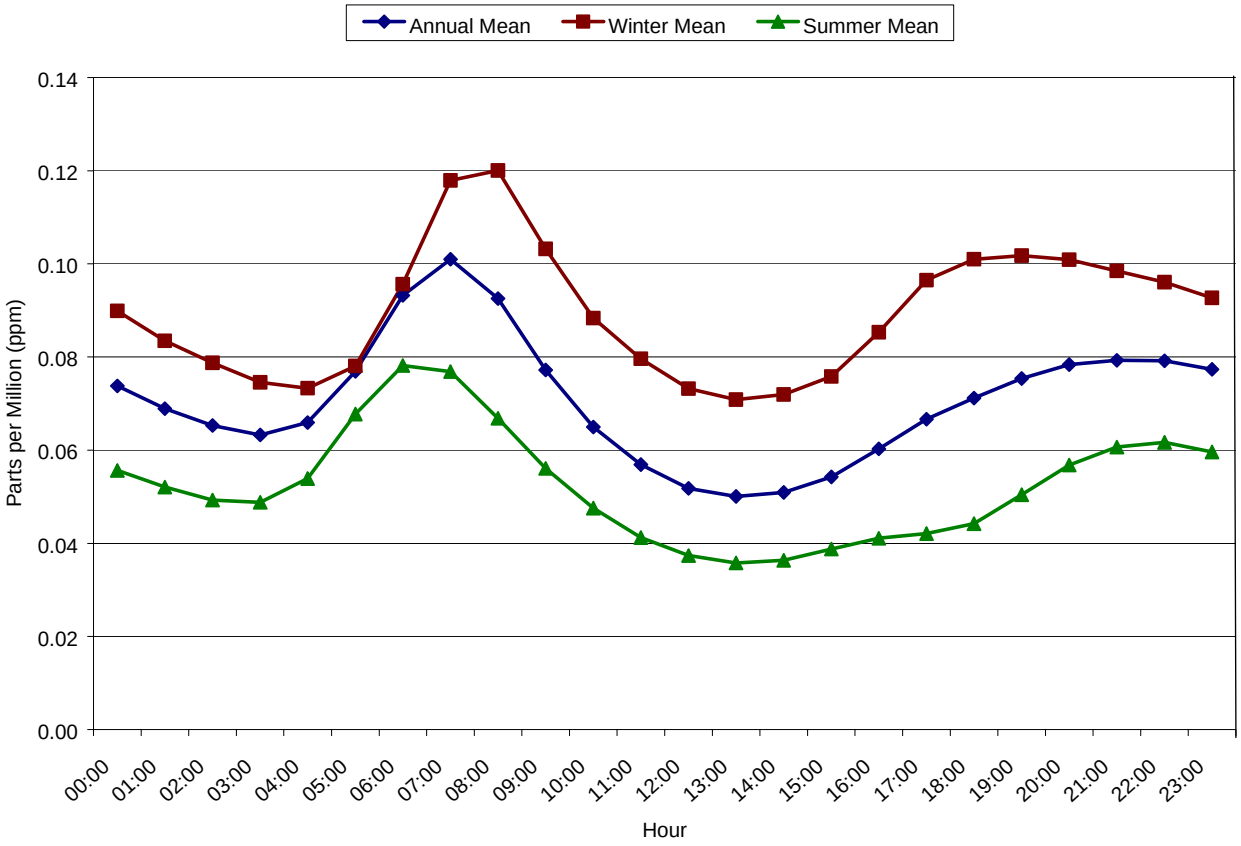
The primary (health based) and secondary (welfare based) National Ambient Air Quality Standards (NAAQS) for NO_2 are the same. They are set at a calendar year average concentration of 0.053 parts per million (ppm). The New Jersey Ambient Air Quality Standards (NJAAQS) are identical to the NAAQS except micrograms per cubic meter ($\mu g/m^3$) are the standard units and the state standard applies to any 12-month period, not just the calendar year. The state of California has a one-hour average standard of 470 $\mu g/m^3$ that New Jersey uses as a guideline in assessing short-term impacts from specific sources. Table 1 provides a summary of the NO_2 standards.

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

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

Averaging Period	Type	New Jersey	National	California
12-month average	Primary	100 µg/m^3 (0.05 ppm)		
Annual average	Primary		0.053 ppm (100 µg/m^3)	
12-month average	Secondary	100 µg/m^3 (0.05 ppm)		
Annual average	Secondary		0.053 ppm (100 µg/m^3)	
1-hour average	Primary			470 µg/m^3 (0.25 ppm)

Figure 2
Nitrogen Dioxide & Nitric Oxide Concentrations – New Jersey
1967-1999
Seasonal and Hourly Variation



Monitoring Locations

The state monitored NO_2 levels at 9 locations in 2005. These sites are shown in the map to the right.

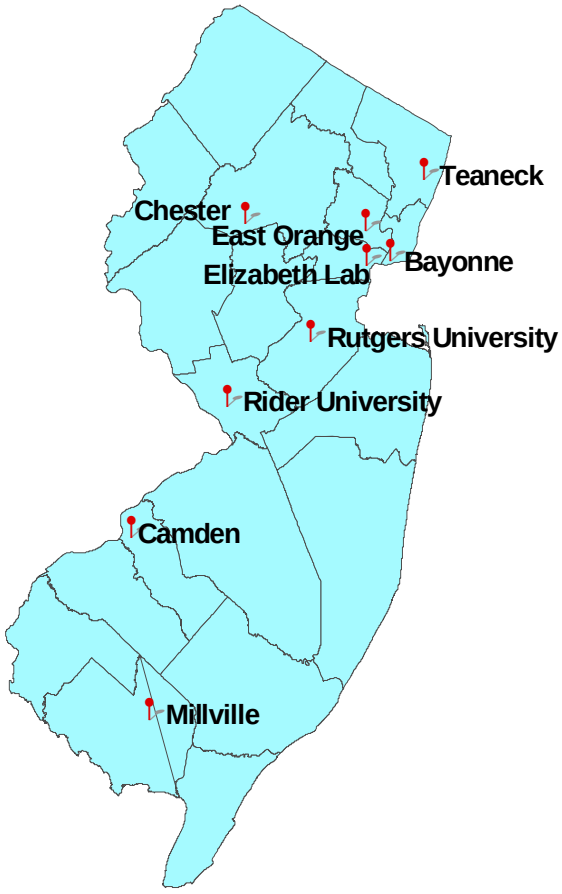
NO_2 Levels in 2005

None of the monitoring sites recorded exceedances of either the National or New Jersey Air Quality Standards for NO_2 during 2005. The maximum annual average concentration recorded was 0.032 ppm at the Elizabeth Lab site located at Exit 13 of the New Jersey Turnpike. While national health and welfare standards have not been established for Nitric Oxide (NO), it is considered to be an important pollutant that contributes to the formation of ozone, fine particles and acid rain. The maximum annual average concentration of NO recorded in 2005 was 0.042 ppm, also at the Elizabeth Lab site (see Table 2 and Figure 4, page 4).

Trends

Routine monitoring for NO_2 began in 1966, and 1974 was the last year that concentrations exceeded the NAAQS in New Jersey. A graph of NO_2 levels provided in Figure 5 shows the statewide average annual mean concentrations recorded from 1975 to 2005 in the form of a trendline. The graph also includes the levels of the

Figure 3
2005 Oxides of Nitrogen Monitoring Network



Tabe 2
Nitrogen Dioxide and Nitric Oxide Data-2005
1-Hour and 12-Month Averages

Parts Per Million (ppm)
California 1-Hour Standard = 0.25 ppm
National 12-Month Standard = 0.053 ppm

Monitoring Sites	Nitrogen Dioxide 1-Hour Average (ppm) Maximum	2nd Highest	Nitrogen Dioxide 12-Month Average (ppm) Maximum	Calendar year	Nitric Oxides Annual Average(ppm)
Bayonne	0.107	0.094	0.023	0.023	0.018
Camden Lab	0.089	0.083	0.022	0.021	0.012
Chester	0.056	0.056	0.011	0.011	0.004
East Orange	0.115	0.115	0.026	0.026	0.023
Elizabeth Lab	0.102	0.100	0.032	0.032	0.042
Millville	0.058	0.057	0.013	0.013	0.011
Rider University	0.064	0.063	0.016	0.016	0.011
Rutgers University	0.079	0.078	0.019	0.018	0.011
Teaneck	0.114	0.112	0.022	0.022	0.020

Figure 4
Annual Average NO and NO_2 Concentrations
in New Jersey - 2005

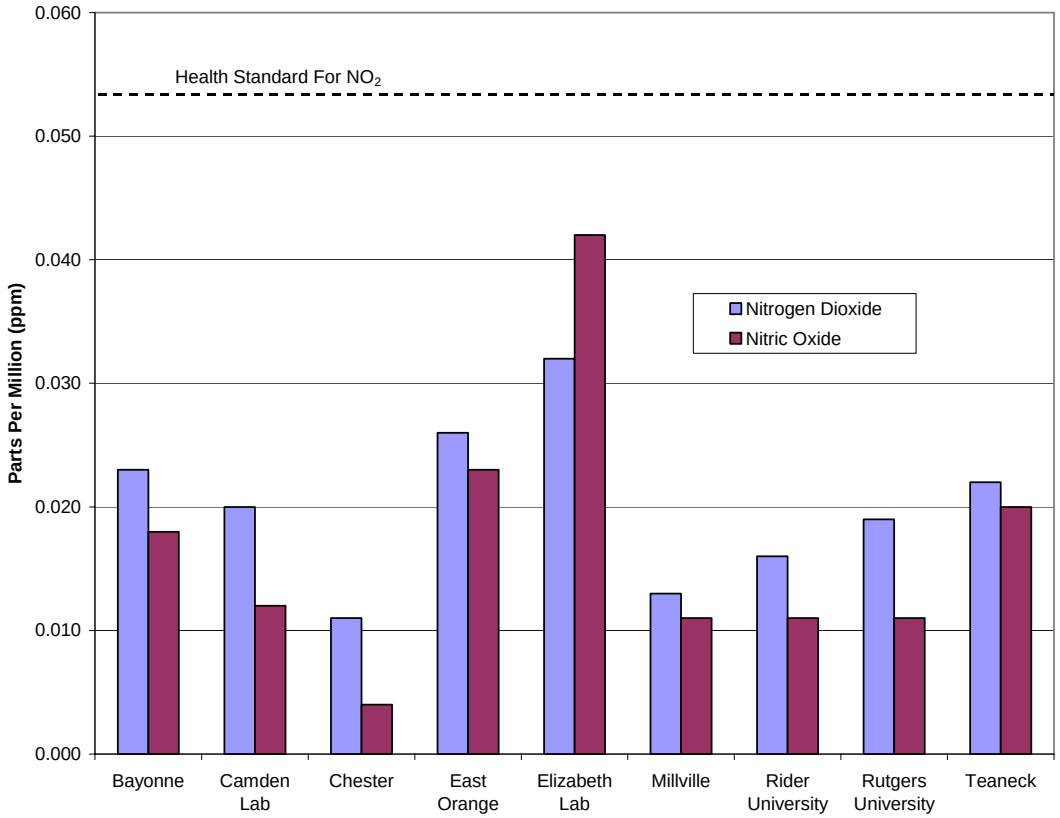
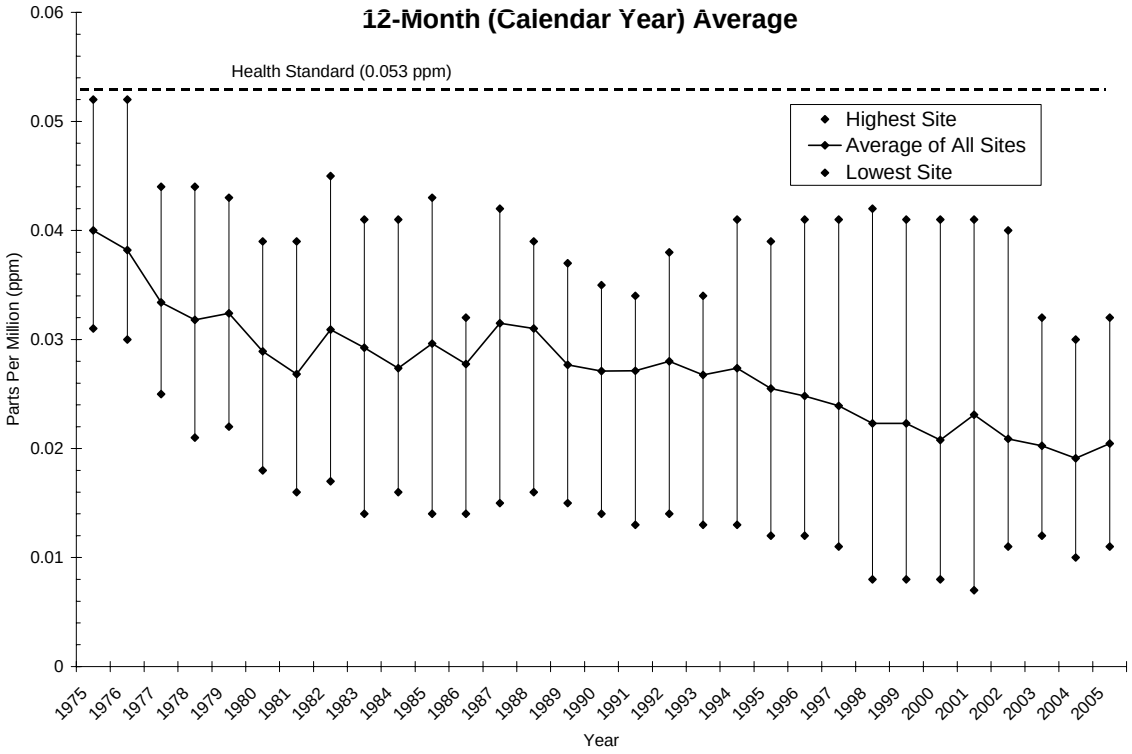


Figure 5
Nitrogen Dioxide Concentrations in New Jersey
1975-2005
12-Month (Calendar Year) Average



sites that measured the highest annual mean and lowest annual mean in each year as points above and below this trendline. Although NO_2 concentrations are well within the NAAQS, there is still a great deal of interest in oxides of nitrogen because of their role in the formation of other pollutants – most notably ozone and fine particles. Both these pollutants are of concern over much of the northeastern United States and efforts to reduce levels of ozone and fine particles are likely to require reductions in NO emissions.

Total Reactive Oxides of Nitrogen (NO_Y)

Although not specifically defined, there is a broad group of nitroxyl compounds in the ambient air that react in the troposphere and contribute to the formation of ozone. These compounds, called Total Reactive Oxides of Nitrogen (NO_y), include nitrogen oxides (NO_x), peroxyacyl nitrates ($RC(O)OONO_2$ or PAN), peroxynitric acid (HO_2NO_2), nitrous acid (HONO), nitric acid (HNO_3), dinitrogen pentoxide (N_2O_5) and nitrate radicals ($\bullet NO_3$). NO_y can also be described as the sum of the nitrogen oxides (NO_x) and the atmospheric NO_x oxidation products. Although measuring NO_y is not required by the federal regulations, it is strongly recommended by the EPA to supplement the data collected by Photochemical Assessment Monitoring Stations (PAMS) Network. NO_y measurements may provide valuable information for evaluating chemical mechanisms in ozone (O_3) prediction models, indicate NO and NO_2 emission trends, and assist in developing regional control strategies for O_3.

The identification and measurement of individual NO_y compounds is technically difficult and expensive, however, a few manufacturers have introduced analyzers that measure total NO_y concentrations. The NJDEP evaluated one of these commercially available NO_y analyzers at the Rider University station starting in March 2002. The Rider University station was selected as the testing location for the NO_y analyzer because it is also a PAMS station.

After a lengthy period of testing, it was determined that there are significant uncertainties in the NO_y concentrations due to technical problems with the analytical method. The NJDEP has decided to postpone further NO_y monitoring until more accurate measurement technologies are established and become available.

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