2011 Nitrogen Dioxide Summary

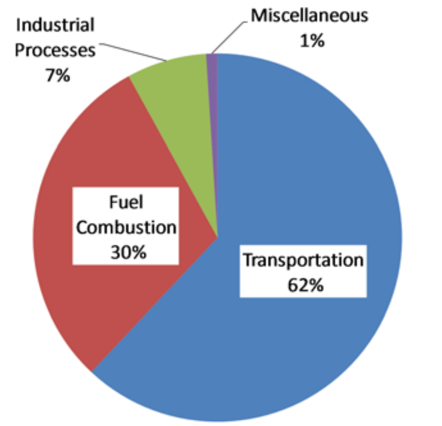
New Jersey Department of Environmental Protection

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. Oxides of Nitrogen (NOx) 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 NOx 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 NOx is shown in Figure 1. As much of the NOx 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 Figures 2-4 (pages 2-3).

Figure 1
National Summary of 2008 Oxides of Nitrogen (NOx) Emissions by Source Category



Source: USEPA National Summary of Nitrogen Oxides Emissions, 2008

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 NOx.

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.

Figure 2
Nitric Oxide – New Jersey
2011 Hourly Variation
Parts Per Million (ppm)

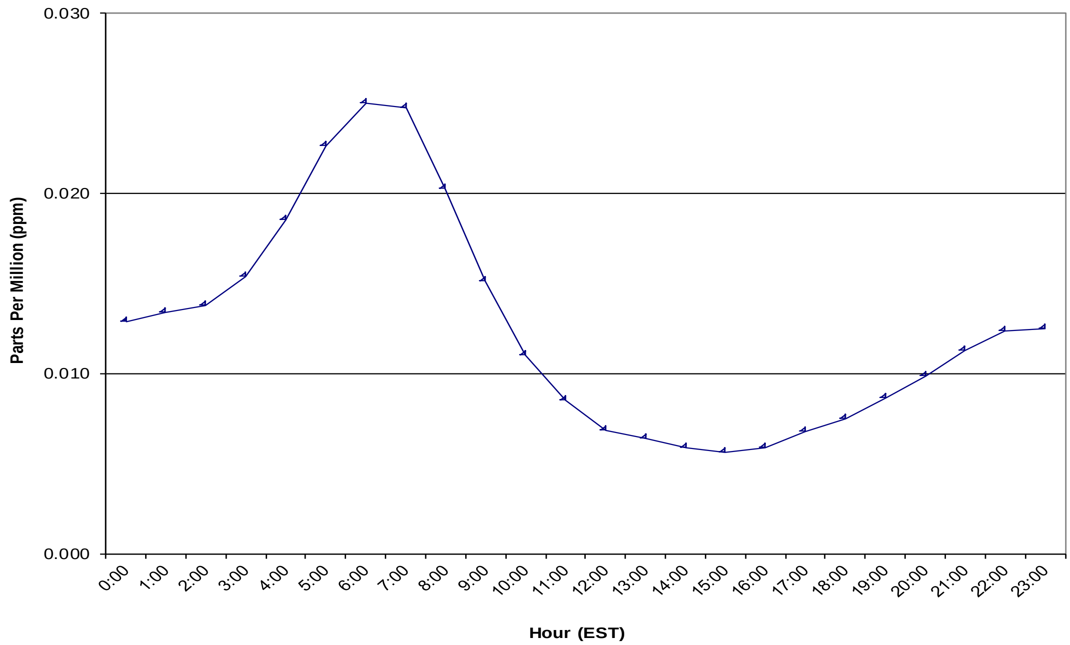


Figure 3
Nitrogen Dioxide – New Jersey
2011 Hourly Variation
Parts Per Million (ppm)

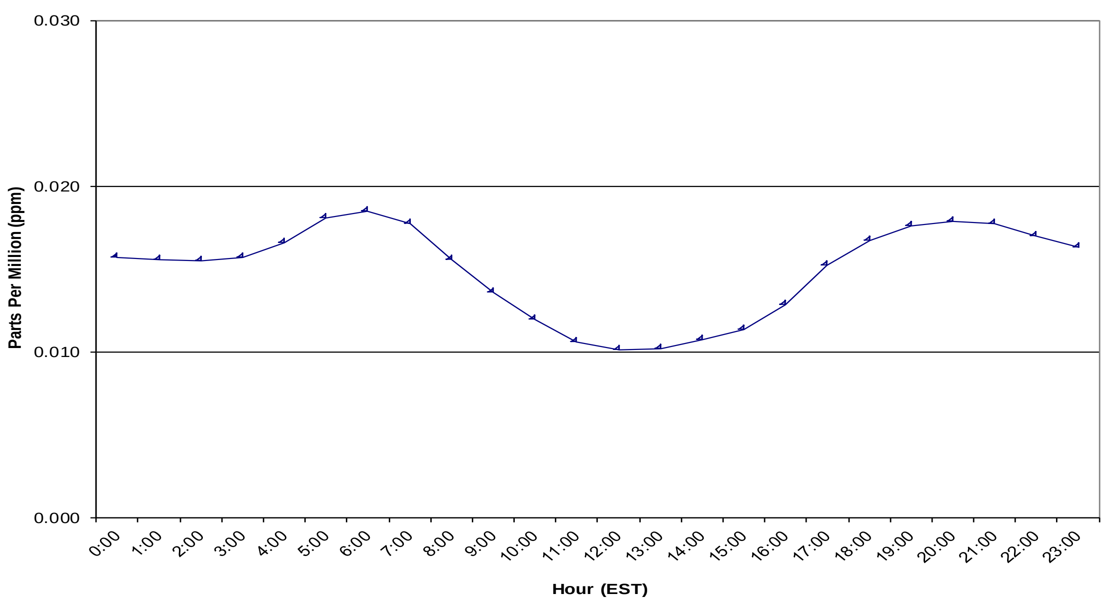
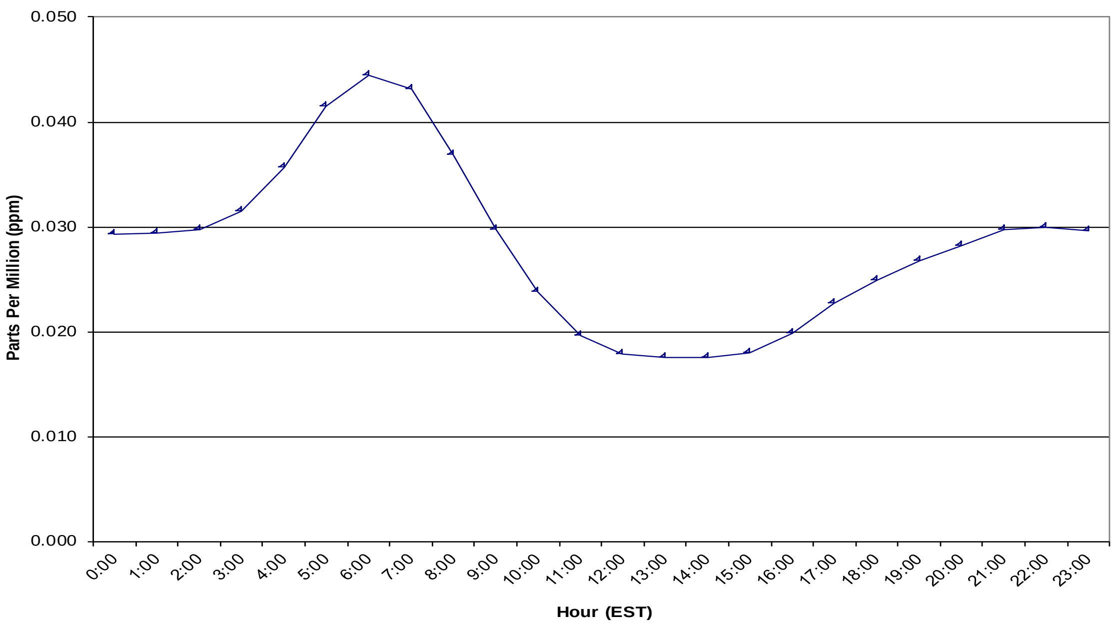


Figure 4
Total Oxides of Nitrogen – New Jersey
2011 Hourly Variation
Parts Per Million (ppm)



STANDARDS

The primary (health based) and secondary (welfare based) National Ambient Air Quality Standards (NAAQS) annual average 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. In 2010, the EPA strengthened the primary NAAQS by adding a 1-hour NO_2 standard of 0.100 ppm along with the current annual average NO_2 standard of 0.053 ppm. Table 1 provides a summary of the NO_2 standards.

Table 1
National and New Jersey Ambient Air Quality Standards for Nitrogen Dioxide (NO_2)
Parts Per Million (ppm) and Micrograms Per Cubic Meter ($\mu g/m^3$)

Averaging Period	Type	New Jersey	National
12-month average	Primary	100 $\mu g/m^3$ (0.053 ppm)	
Annual average	Primary		0.053 ppm (100 $\mu g/m^3$)
12-month average	Secondary	100 $\mu g/m^3$ (0.053 ppm)	
Annual average	Secondary		0.053 ppm (100 $\mu g/m^3$)
1-hour average	Primary		0.100 ppm (190 $\mu g/m^3$)

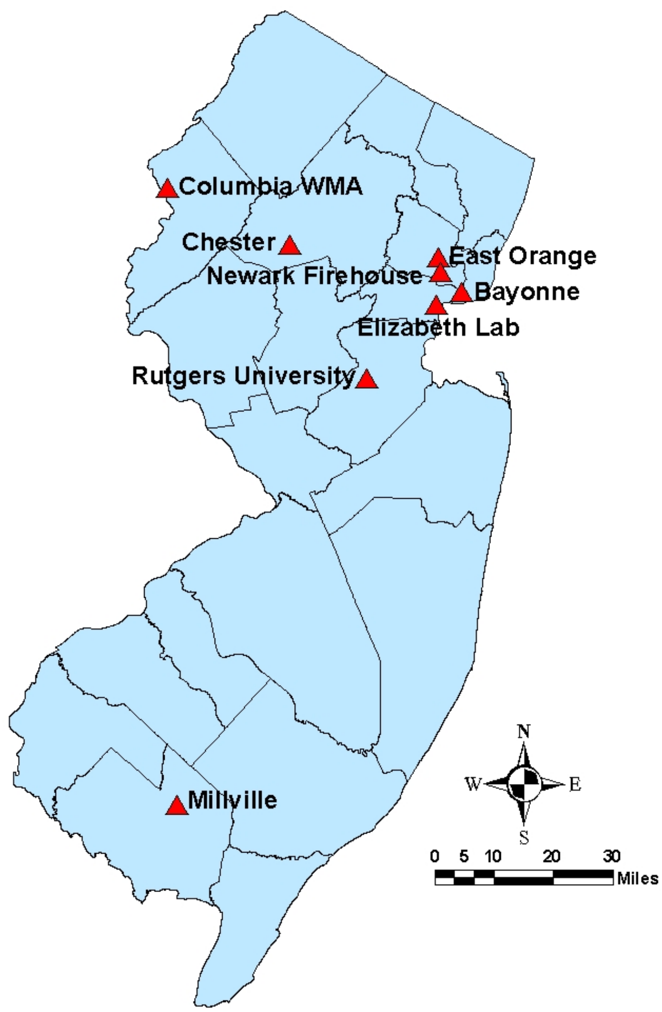
An area meets the new 1-hour NO_2 standard when the 3-year average of the 98th percentile of the daily maximum 1-hour NO_2 concentrations measured in this area is less than 0.100 ppm. This statistic, also known as the design value, is determined by first obtaining the maximum 1-hour average NO_2 concentrations for each day. Then, determine the 98th percentile of the daily maximum NO_2 concentrations for the current year, and for each of the previous two years. Finally, the average of these three 98th percentile values is the design value.

In addition to adding a 1-hour NO_2 standard of 0.100 ppm in 2010, the EPA requires a NO_2 near-roadway monitoring station to be operational by January 1, 2013. A near-roadway station must be located no more than 50 meters (164 feet) from the nearest traffic lane of a major roadway. NJDEP plans to establish one near-roadway NO_2 station in the New York-Northern New Jersey-Long Island Metropolitan area that meets the EPA criteria.

MONITORING LOCATIONS

The state monitored NO_2 levels at 8 locations in 2011. NO_2 monitors were established in the Columbia WMA and Newark Firehouse stations in January 2011. These sites are shown in Figure 5.

Figure 5
2011 Nitrogen Dioxide Monitoring Network



NO_2 LEVELS IN 2011

None of the monitoring sites recorded exceedances of either the National or New Jersey Air Quality Standards for NO_2 during 2011. The highest 12-month (calendar year) average concentration of NO_2 recorded was 0.024 ppm at the Elizabeth Lab site located at Exit 13 of the New Jersey Turnpike (Table 2, below and Figure 6, page 6). The maximum annual average concentration of NO recorded in 2011 was 0.027 ppm, at the Columbia WMA site (Table 2, below and Figure 7, page 6).

There were no exceedances of the 1-hour average NO_2 NAAQS of 0.100 ppm, although the Elizabeth Lab and Newark Firehouse sites each measured a 1-hour average NO_2 concentration that equaled 0.100 ppm as a maximum for 2011. The site that measured the highest 98th percentile of the daily maximum 1-hour NO_2 concentrations in 2011 was Elizabeth Lab with 0.071 ppm (Table 2, below and Figure 8, page 7). The site that measured the highest 1-hour NO_2 design value for the 3-year period from 2009 to 2011 was also Elizabeth Lab with 0.071 ppm (Table 2, below and Figure 9, page 7). All sites in New Jersey met the new 1-hour NO_2 standard. 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.

Table 2
Nitrogen Dioxide (NO_2) and Nitric Oxide (NO) Data - 2011
1-Hour and 12-Month Averages

Parts Per Million (ppm)
National 1-Hour Standard = 0.100 ppm
National 12-Month Standard = 0.053 ppm

	Nitrogen Dioxide 1-Hour Average (ppm)				Nitrogen Dioxide 12-Month Average (ppm)		Nitric Oxide 12-Month Average (ppm)
Monitoring Sites	**Maximum**	**2nd Highest**	**2011 98th%-ile**	**2009-2011 98^{th} %-ile (3-year)**	**Maximum (Running 12-month)**	**Calendar year**	**Calendar Year**
Bayonne	0.076	0.074	0.064	0.065	0.019	0.018	0.010
Chester	0.059	0.053	0.041	0.037	0.005	0.005	0.000
Columbia WMA	0.065	0.057	0.050	---*	0.022	0.014	0.027
East Orange	0.085	0.075	0.062	0.064	0.021	0.021	0.015
Elizabeth Lab	0.100	0.097	0.071	0.071	0.024	0.024	0.026
Millville	0.039	0.038	0.036	0.039	0.008	0.007	0.006
Newark Firehouse	0.100	0.088	0.068	---*	0.027	0.021	0.013
Rutgers University	0.060	0.050	0.047	0.048	0.010	0.010	0.003

* Columbia WMA and Newark Firehouse do not have enough data to calculate a 3-year average.

Figure 6
Annual Average Nitrogen Dioxide Concentrations
In New Jersey – 2011
Parts Per Million (ppm)

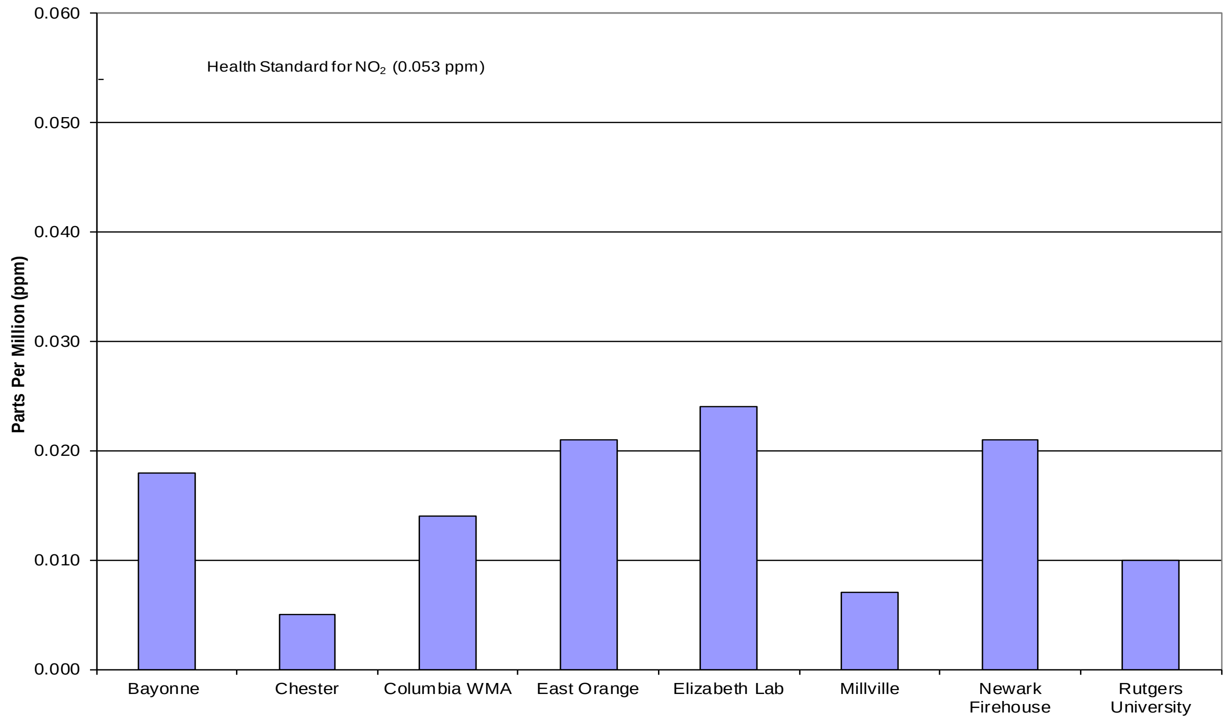


Figure 7
Annual Average Nitric Oxide Concentrations
In New Jersey – 2011
Parts Per Million (ppm)

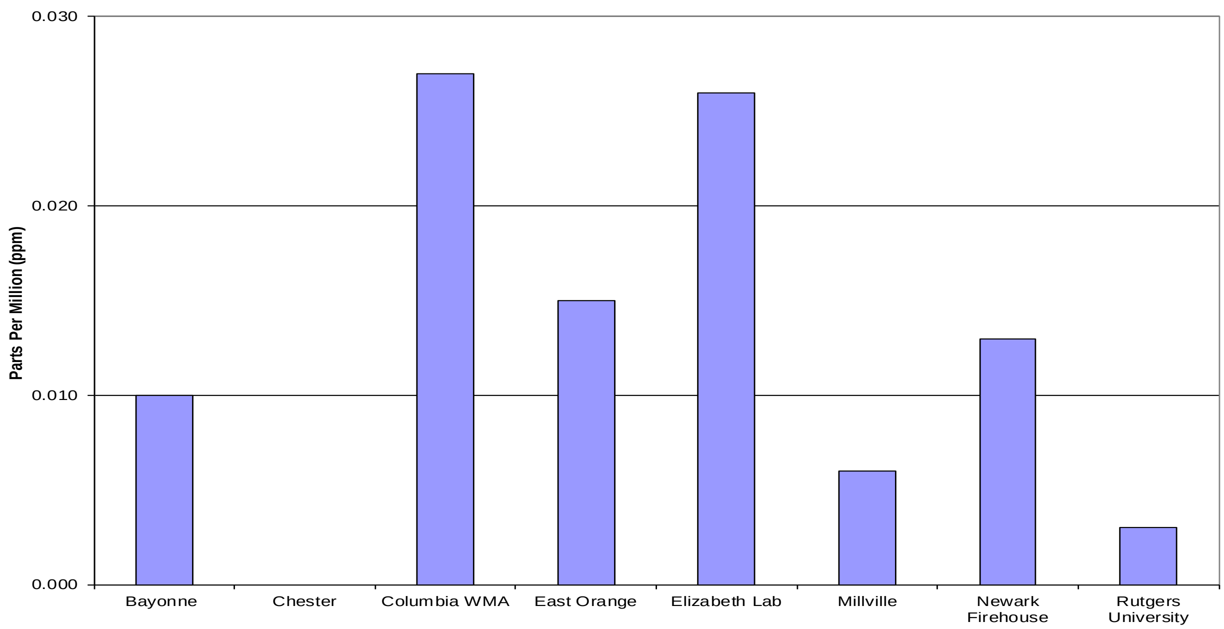


Figure 8
2011 98th Percentile Daily Maximum 1-Hour
Nitrogen Dioxide Concentration in New Jersey
Parts Per Million (ppm)

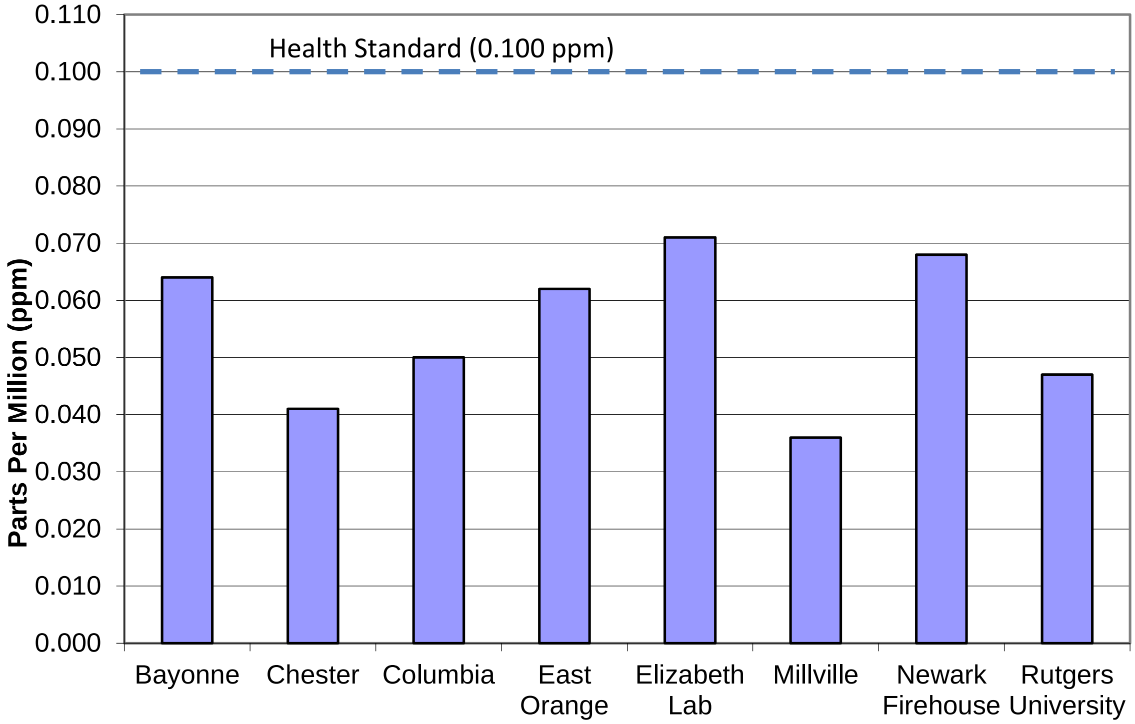
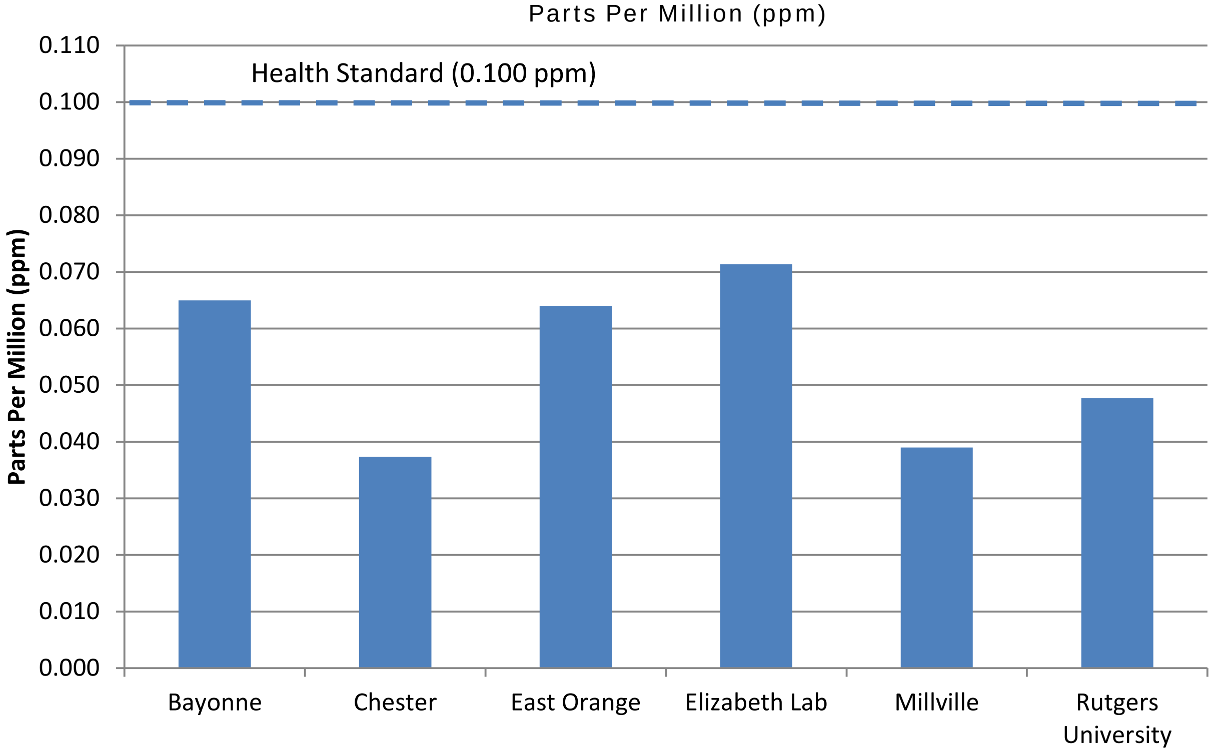


Figure 9
3-Year Average of the 98th Percentile Daily Maximum 1-Hour Average
Nitrogen Dioxide Concentration in New Jersey (2009-2011)
Parts Per Million (ppm)



TRENDS

Figures 10-12 (pages 8-9) indicate that concentrations tend to be higher in the winter than the summer. This is due in part to space heating and poorer local dispersion conditions caused by light winds and other weather conditions that are more prevalent in the colder months of the year.

Routine monitoring for NO_2 began in 1966, and 1974 was the last year that concentrations exceeded the annual average NAAQS for NO_2 in New Jersey. A graph of NO_2 levels provided in Figure 13 (page 10) shows the statewide average annual mean concentrations recorded from 1975 to 2011 in the form of a trendline. The graph also includes the levels of the 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.

Figure 10
Nitric Oxide – New Jersey
2011 Monthly Variation
Parts Per Million (ppm)

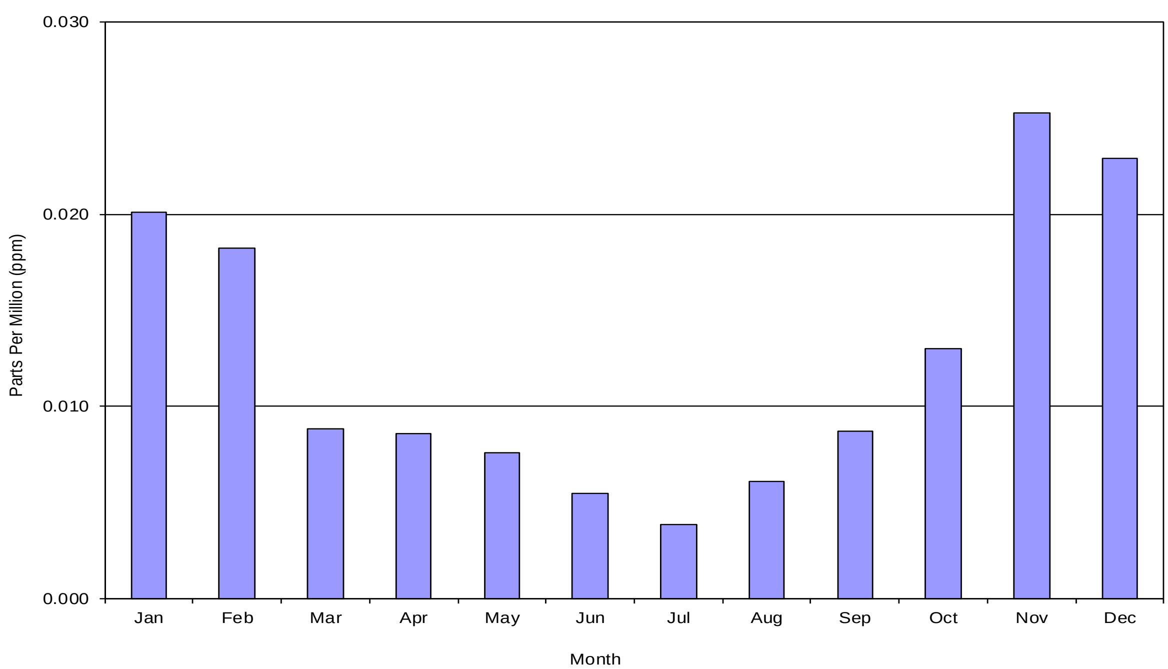


Figure 11
Nitrogen Dioxide – New Jersey
2011 Monthly Variation
Parts Per Million (ppm)

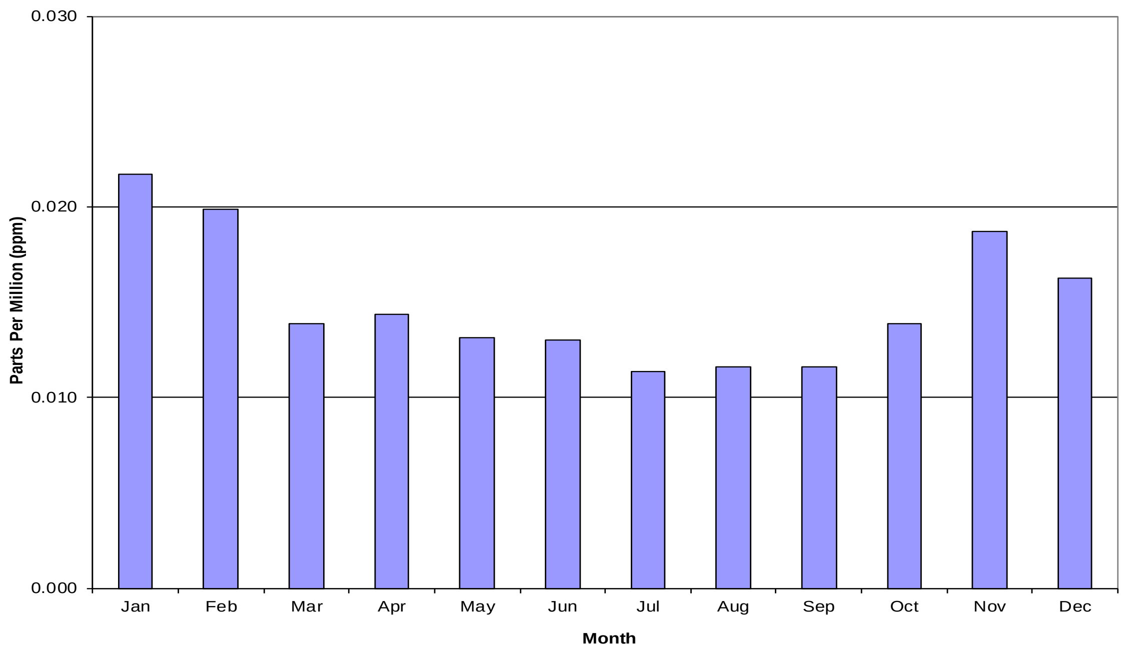


Figure 12
Total Oxides of Nitrogen – New Jersey
2011 Monthly Variation
Parts Per Million (ppm)

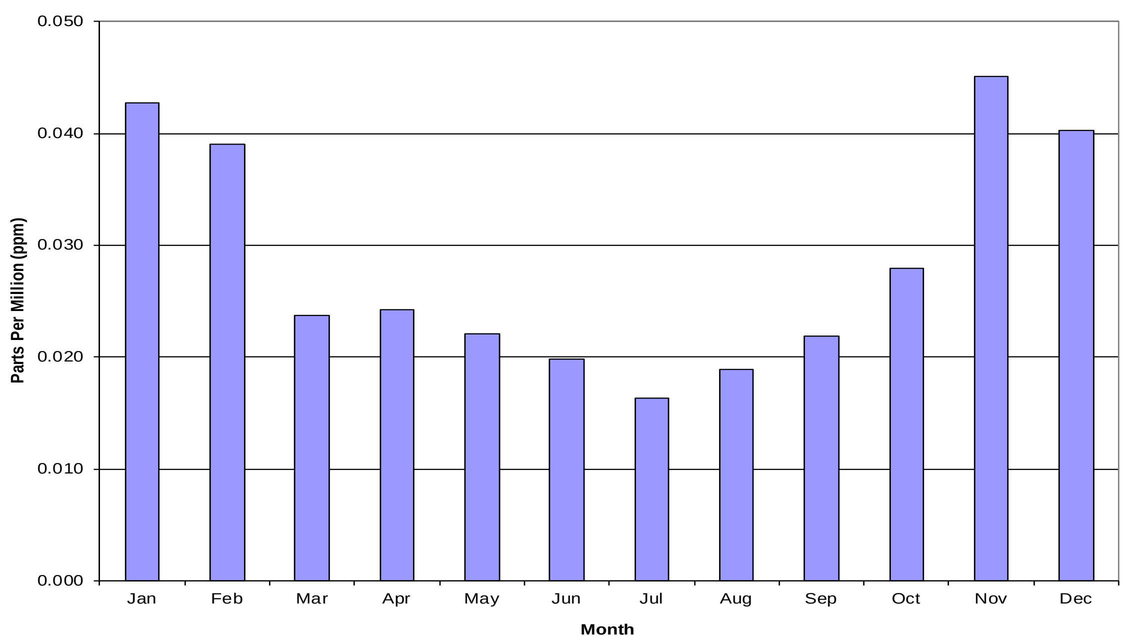
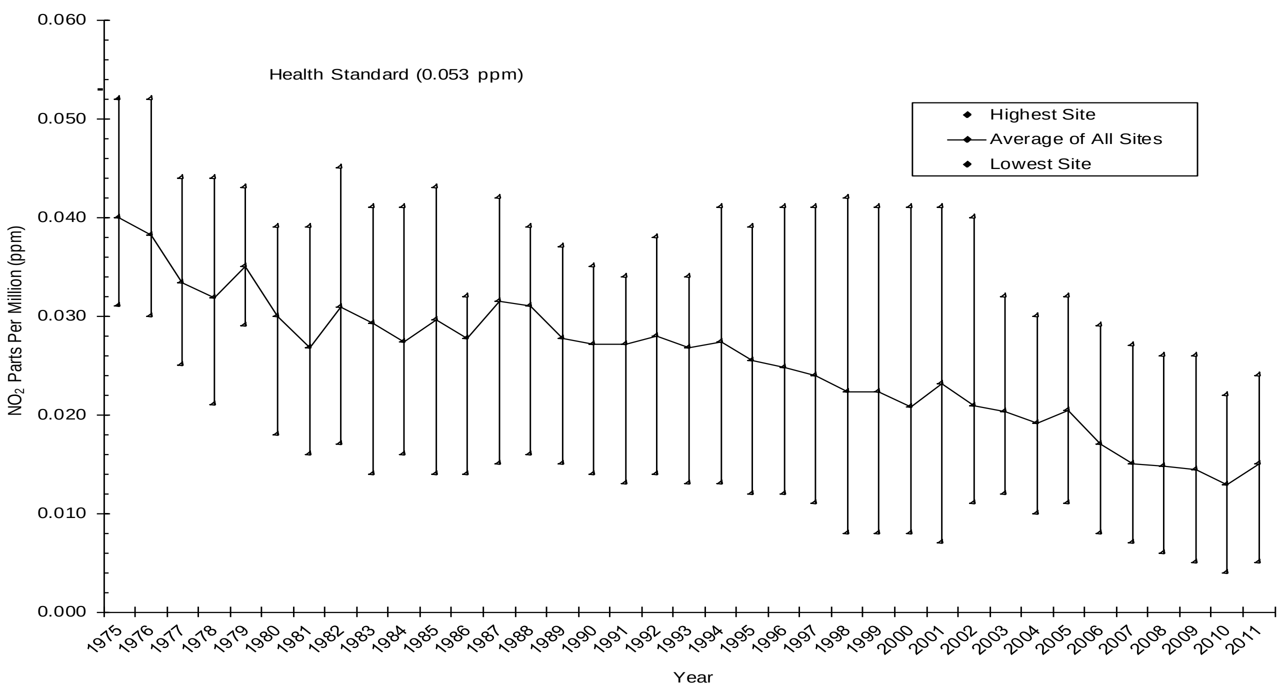


Figure 13
Nitrogen Dioxide Concentrations in New Jersey 1975-2011
12-Month (Calendar Year) Average
Parts Per Million (ppm)



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