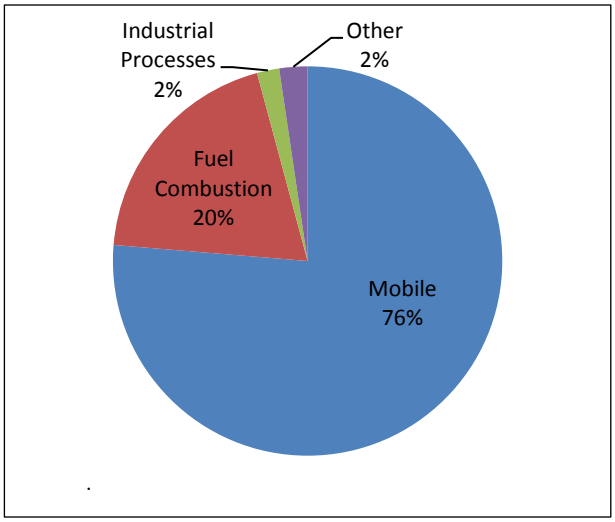
2015 Nitrogen Dioxide Summary

New Jersey Department of Environmental Protection

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). NO_2 is used by regulatory agencies as the indicator for the group of gases known as nitrogen oxides (NOx). These gases are emitted from motor vehicle exhaust, combustion of coal, oil or natural gas, and 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. When NO_2 reacts with other chemicals it can form ozone, particulate matter, and other pollutant compounds. A pie chart summarizing the major sources of NOx in New Jersey is shown in Figure 1. Because 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 Figure 2.

Figure 1
2011 New Jersey NOx Emissions
by Source Category



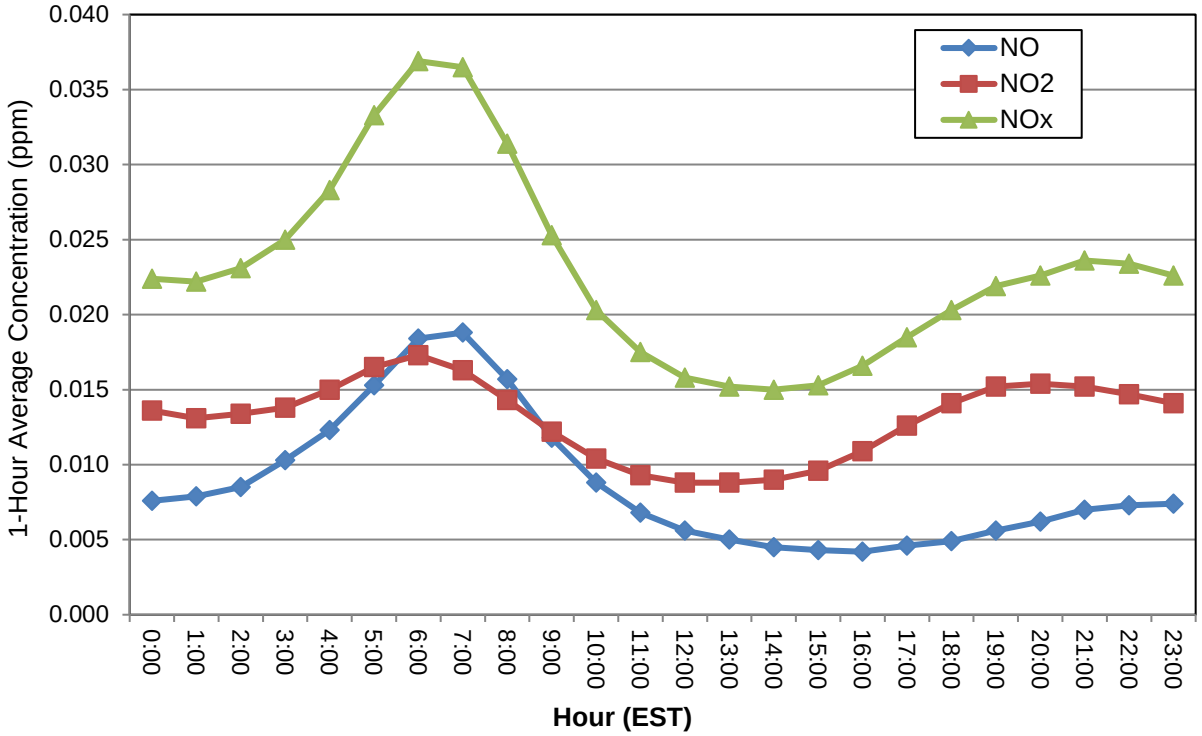
www3.epa.gov/air/emissions/index.htm

HEALTH AND ENVIRONMENTAL EFFECTS

Short-term exposures to low levels of nitrogen dioxide may aggravate pre-existing respiratory illnesses and cause respiratory illnesses in children, people with asthma, and the elderly. 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. Studies show a connection between breathing elevated short-term NO_2 concentrations and increases in hospital emergency department visits and hospital admissions for respiratory issues, especially asthma. Individuals who spend time on or near major roadways can experience high short-term NO_2 exposures.

Nitrogen oxides contribute to a wide range of environmental problems. Chemical reactions in the air form both ozone and particulate matter. Nitrate particles make the air hazy and impair visibility, and contribute to nutrient pollution in coastal waters, resulting in eutrophication. NO_2 also reacts with water and oxygen to form nitric acid, a component of acid rain, which causes acidification of freshwater bodies and harms sensitive ecosystems such as lakes and forests.

Figure 2
2015 Nitrogen Oxides Concentrations in New Jersey
Hourly Variation
Parts per Million (ppm)



Ambient Air Quality Standards

The primary (health-based) and secondary (welfare-based) annual average National Ambient Air Quality Standards (NAAQS) for NO_2 are the same: 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 that micrograms per cubic meter ($\mu g/m^3$) are the standard units and the averaging time is any 12-month period instead of a calendar year. In 2010, the U.S. Environmental Protection Agency (USEPA) strengthened the primary NAAQS by adding a 1-hour NO_2 standard of 0.100 ppm, based on the 98th percentile of the daily maximum 1-hour concentration. 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)
Micrograms per Cubic Meter ($\mu g/m^3$)
Parts per Million (ppm)

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 $\mu g/m^3$)

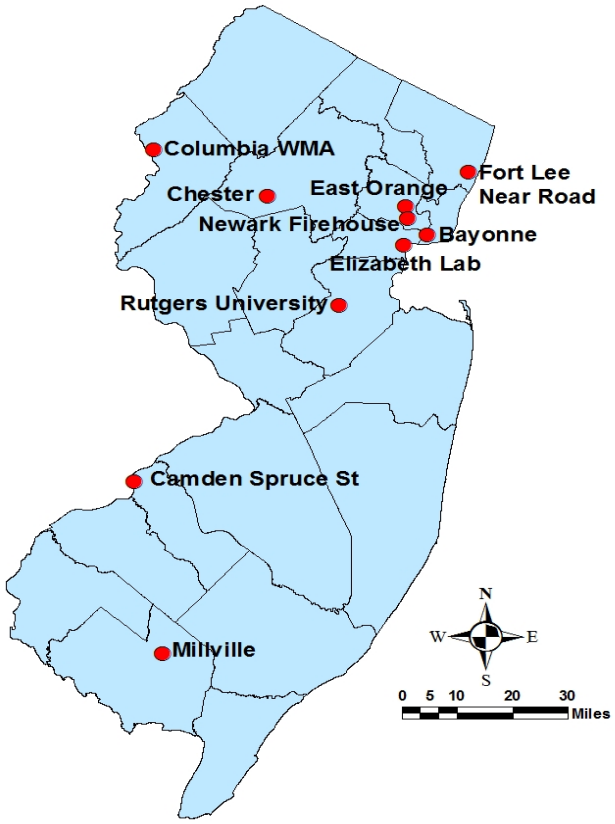
An area is in compliance with the 1-hour NO_2 standard when the 3-year average of the 98th percentile of the daily maximum 1-hour NO_2 concentrations is less than 0.100 ppm. This statistic, also known as the design value, is calculated by first obtaining the maximum 1-hour average NO_2 concentrations for each day at each monitor. Then the 98th percentile value of the daily maximum NO_2 concentrations must be determined for the current year, and for each of the previous two years. Finally, the average of these three annual 98th percentile values is the design value.

As part of the 2010 revision to the NAAQS, in addition to adopting a 1-hour NO_2 standard, USEPA required that in urban areas with populations of 1 million or more, an NO_2 near-road monitoring station be established and operational by January 1, 2014. A near-road station must be located no more than 50 meters (164 feet) from the nearest traffic lane of a major roadway. The near-road site for the New York-Northern New Jersey-Long Island Metropolitan area was established in Fort Lee, along Interstate 95 and adjacent to the tollbooths for the George Washington Bridge.

MONITORING LOCATIONS

NJDEP monitored NO_2 levels at 10 locations in 2015. These sites are shown in Figure 3.

Figure 3
2015 Nitrogen Dioxide Monitoring Network



NO_2 LEVELS IN 2015

Fort Lee Near Road, Elizabeth Lab, and Bayonne monitoring sites all recorded exceedances of the 1-hour NO_2 NAAQS (0.100 ppm) during 2015. The maximum 1-hour concentrations were 0.195 ppm at Bayonne, 0.154 ppm at Fort Lee Near Road, and 0.135 ppm at Elizabeth Lab (see Table 2). However, these are not violations of the NAAQS, which is based on the 98th percentile of the daily one-hour maximum concentrations. Those 98th percentile values are given in Table 2 and Figure 4 for each monitoring station. The design value for NO_2, which determines whether or not there is a violation of the NAAQS, is actually the 3-year average of the 98th percentile of the 1-hour daily maximum concentrations. The 2013-2015 design value for each site is given in Table 2 and Figure 5. The site with the highest design value for 2013-2015 was Elizabeth Lab, with 0.066 ppm. The three-year averages for Bayonne, Fort Lee Near Road, Millville, and Rutgers University stations could not be calculated because of incomplete data for certain years (see Table 2 footnotes). The exceedances of the 1-hour NAAQS at Bayonne and Fort Lee Near Road can be attributed to vehicles idling near the monitors. The exceedance at Elizabeth Lab occurred on March 10th during an air stagnation period, which prevented pollutants from being dispersed.

The highest running-12-month and calendar-year average concentrations of NO_2 were the same, 0.022 ppm at the Elizabeth Lab site, located at Exit 13 of the New Jersey Turnpike (Table 2 and Figure 6).

Table 2
2015 Nitrogen Dioxide Concentrations in New Jersey
1-Hour and 12-Month Averages
Parts per Million (ppm)

Monitoring Site	1-Hour Average (ppm)				12-Month Average (ppm)	
	Daily Maximum	2nd Highest Daily Max.	98th %-ile	2013-2015 98th%-ile 3-year Avg.	Maximum Running 12-Month	Calendar Year
Bayonne	0.195	0.090	0.057	a	0.016	0.016
Camden Spruce Street	0.066	0.058	0.051	0.049	0.013	0.013
Chester	0.055	0.046	0.028	0.035	0.004	0.003
Columbia WMA	0.057	0.054	0.051	0.048	0.012	0.012
East Orange	0.075	0.067	0.055	0.058	0.015	0.014
Elizabeth Lab	0.135	0.091	0.067	0.066	0.022	0.022
Fort Lee Near Road	0.154	0.081	0.066	b	0.019	0.019
Millville	0.048	0.045	0.039	c	0.007	0.006
Newark Firehouse	0.078	0.077	0.058	0.063	0.018	0.016
Rutgers University	0.074	0.054	0.048	d	0.010	0.010

a Bayonne site temporarily shut down October 2012 through July 2013 due to damage from Superstorm Sandy.
b Fort Lee Near Road site began operating March 2014.
c Millville temporarily shut down for site renovations December 2012 to March 2013.
d Rutgers University temporarily shut down for site renovations April 2015 to June 2015.

Figure 4
2015 Nitrogen Dioxide Concentrations in New Jersey
Daily Maximum 1-Hour Values
Parts per Million (ppm)

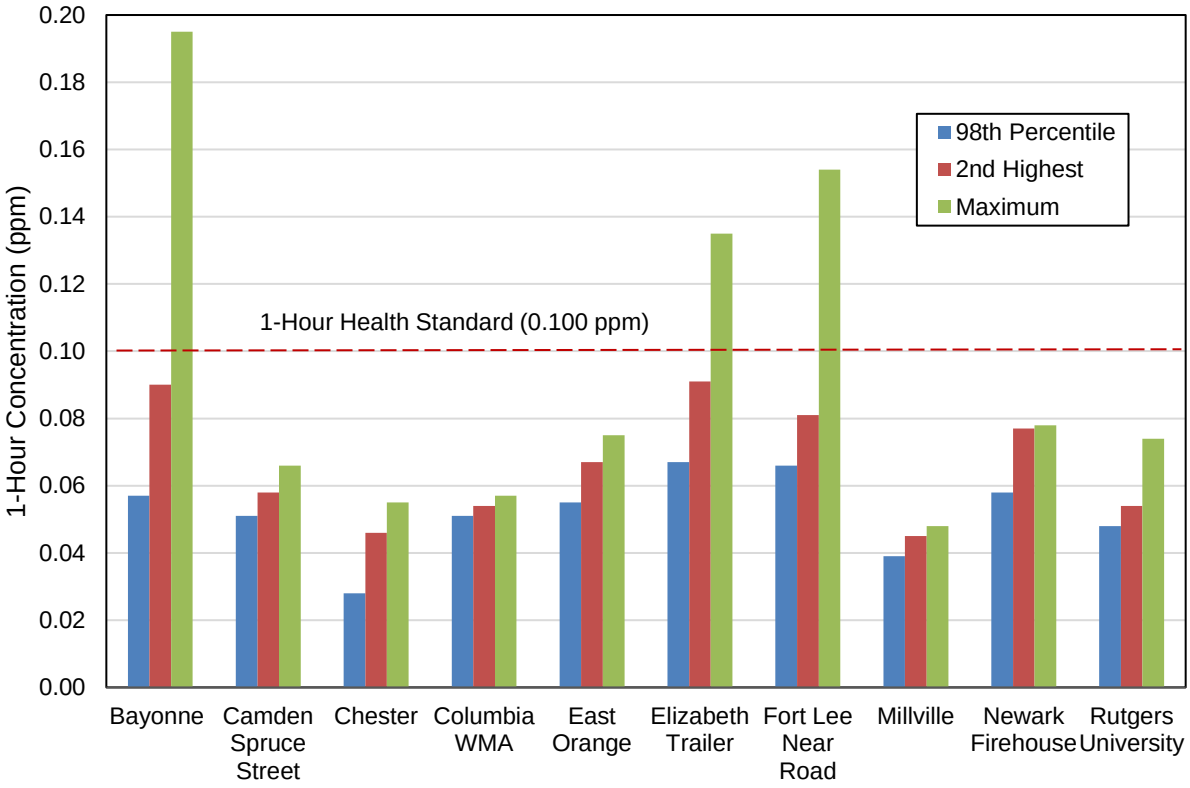


Figure 5
2015 Nitrogen Dioxide Concentrations in New Jersey
3-Year Design Value (2013-2015)
(Average of 98th Percentile Daily Maximum 1-Hour Average Concentrations)
Parts per Million (ppm)

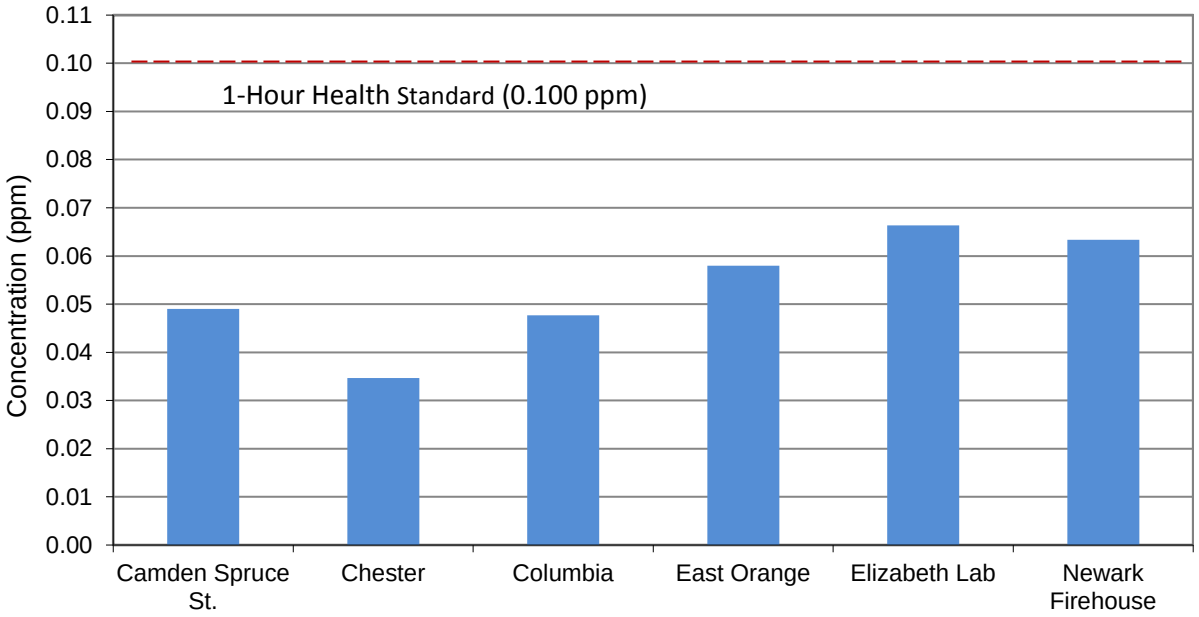
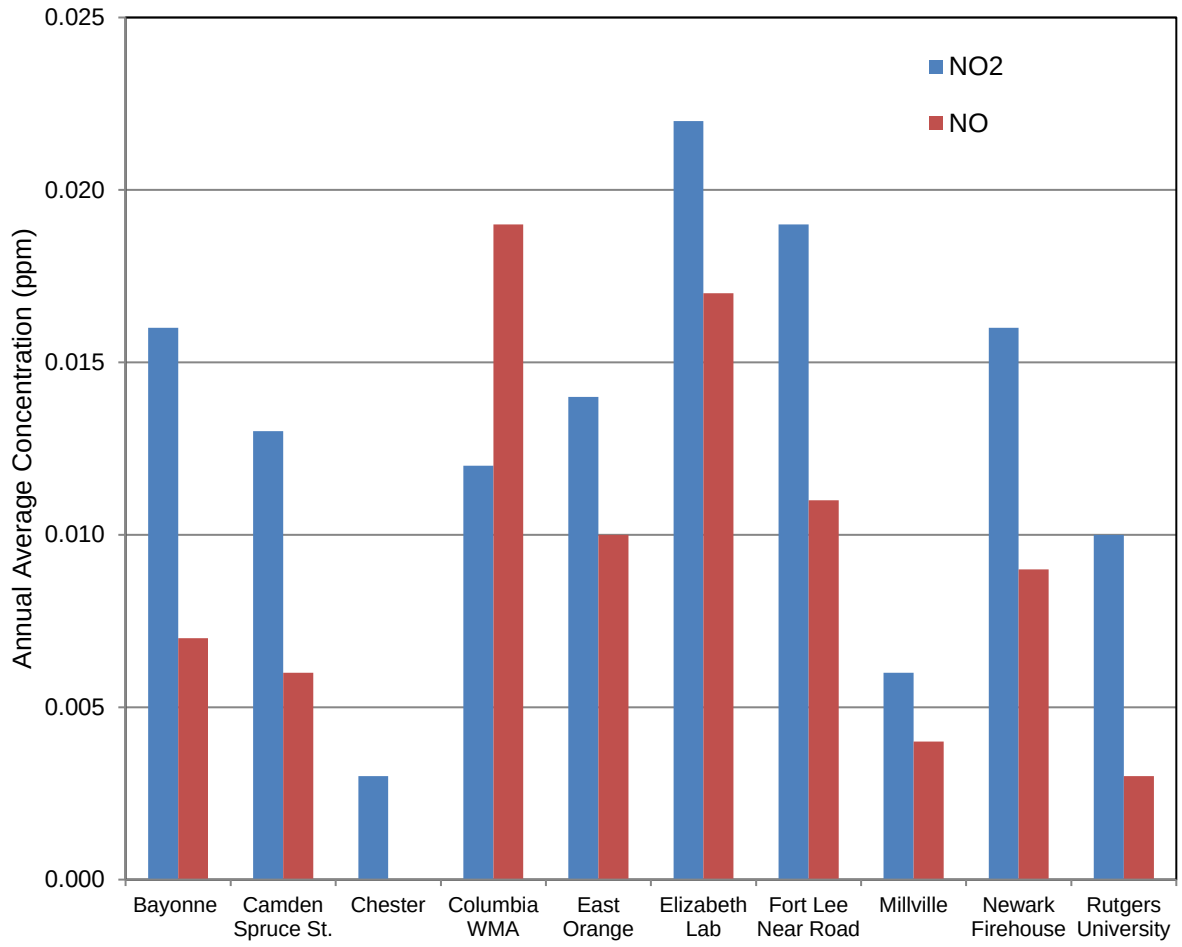


Figure 6 shows the calendar year annual average concentrations for nitrogen dioxide at each site. The annual NAAQS is 0.053 ppm (or 53 parts per billion). Figure 6 also includes values for nitric oxide. The New Jersey monitoring stations that measure NO_2 levels also measure NO and NOx levels. NOx levels are approximately the sum of the NO_2 and NO concentrations. The concentration of NO tends to be lower than NO_2, because as it is emitted it quickly reacts with other air pollutants (particularly ozone) and converts to NO_2. The higher concentration at the Columbia WMA monitor is believed to result from high NO emissions from vehicles on nearby Interstate 80 and relatively low levels of other pollutants.

Figure 6
2015 Nitrogen Dioxide & Nitric Oxide Concentrations in New Jersey
Calendar Year Annual Average
Parts per Million (ppm)



Note: The annual average concentration of NO at Chester was 0 ppm.

NOx Trends

Figure 7 shows that NOx concentrations tend to be higher in the winter than in the summer. This is due in part to building heating, and to 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 in New Jersey began in 1966, but 1974 was the last year in which the annual mean NO_2 concentrations exceeded the NAAQS. The graph of NO_2 levels in Figure 8 shows the statewide average annual mean concentrations recorded from 1975 to 2015 in the form of a trend line. The graph also includes the levels at of the sites that measured the highest annual mean and lowest annual mean in each year, as points above and below this trend line. Although NO_2 concentrations are well within the NAAQS, there is still a great deal of concern about oxides of nitrogen because of their role in the formation of other pollutants, most notably ozone and fine particles. Both of these pollutants are of interest over much of the northeastern United States, and efforts to reduce levels of ozone and fine particles are likely to require continued reductions in NOx emissions.

Figure 9 shows the highest, lowest, and average 98th percentile values of the daily maximum one-hour concentrations for the years 2000 to 2015 at each New Jersey monitoring site. The average values are well below the 1-hour NAAQS of 0.100 ppm.

Figure 7
2015 Concentrations of Nitrogen Oxides in New Jersey
Monthly Variation

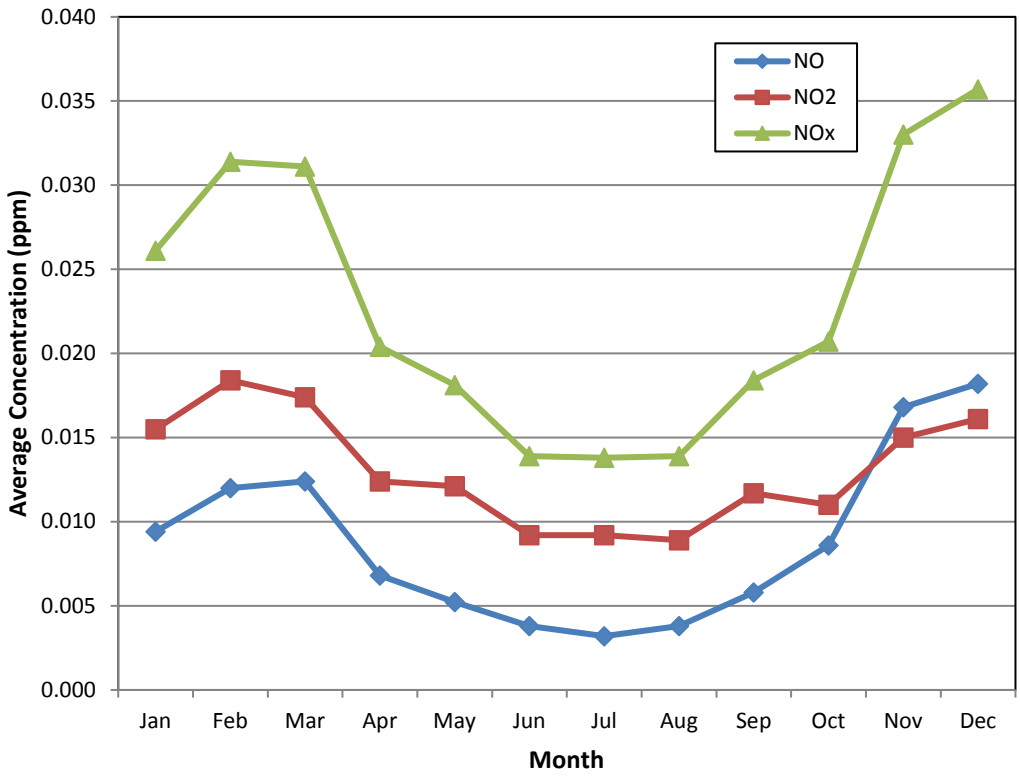


Figure 8
Nitrogen Dioxide Concentrations in New Jersey, 1975-2015
12-Month (Calendar Year) Average
Parts per Million (ppm)

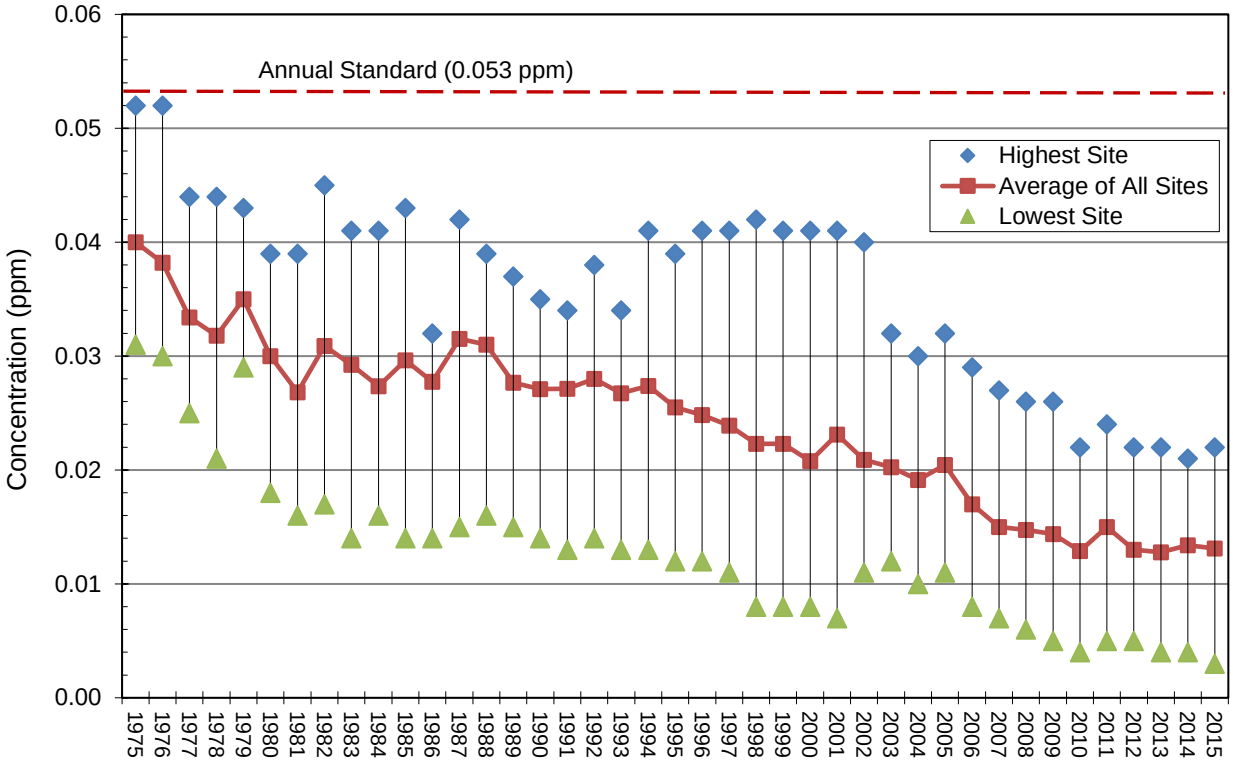
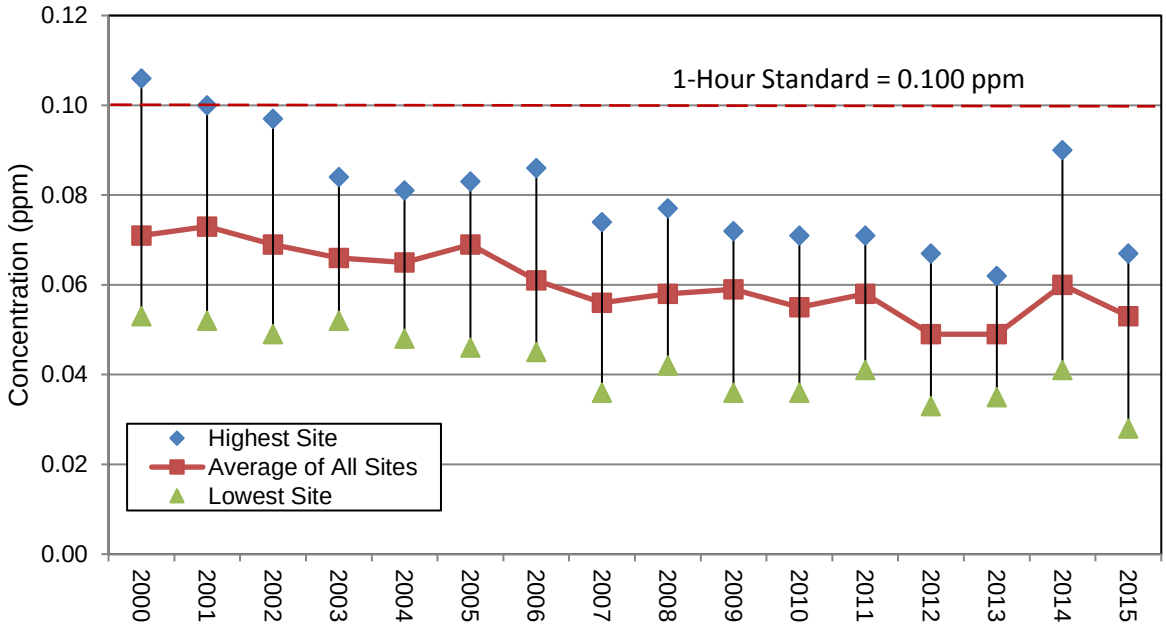


Figure 9
Nitrogen Dioxide Concentrations in New Jersey, 2000-2015
98th Percentile of Daily Maximum 1-Hour Concentrations
Parts per Million (ppm)



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