2016 New Jersey Air Quality Report

New Jersey Department of Environmental Protection

December 7, 2017

New Jersey Department of Environmental Protection
Bureau of Air Monitoring
Mail Code: 401-02E
P. O. Box 420
Trenton, New Jersey 08625-0420
Contact: bamweb@dep.nj.gov
Telephone: 609-292-0138

www.njaqinow.net

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Cover photo: Brigantine HazeCam, http://hazecam.net/camsite.aspx?site=brigantine , 8/24/2017.

Executive Summary

This report summarizes the New Jersey Department of Environmental Protection (NJDEP) air quality monitoring data for 2016, collected from NJDEP's extensive air monitoring network. The state of New Jersey has been monitoring air quality since 1965. During that time pollution levels have improved significantly, as a result of state, regional and national air pollution reduction efforts.

The chapter on the Air Quality Index (AQI), a national air quality rating system based on the National Ambient Air Quality Standards (NAAQS), describes the overall quality of New Jersey's air in 2016, and lists the days on which the AQI was over 100 and NAAQS were exceeded. Twenty-six days were classified as "Unhealthy for Sensitive Groups" because their numerical AQI ratings were greater than 100. Two days in 2016 were classified as "Unhealthy" because their AQI ratings were greater than 150. The ratings for both days were attributed to a large wildfire in Canada, which elevated ozone levels throughout the state.

This report also includes detailed chapters for ozone, sulfur dioxide, nitrogen dioxide, particulate matter, and carbon monoxide. These are the criteria pollutants, those for which NAAQS have been set. Other information collected at our air monitoring stations includes meteorology, air toxics, and particulate species.

Figures 1-1 through 1-5 below illustrate the downward trends in concentrations of criteria pollutants in New Jersey over the past few decades.

New Jersey is getting close to meeting the ozone NAAQS, and will continue to implement emission control strategies while pursuing emissions reductions in upwind states that affect New Jersey's air. Because ozone is formed in the presence of sunlight and high temperatures, it can reach significant levels in the summer months. It also has been found to have serious health effects at lower levels than previously thought. In response, the United States Environmental Protection Agency (USEPA) periodically revises and lowers the NAAQS. USEPA lowered the ozone standard to 0.070 ppm in 2016.

The sharp increase and subsequent decrease in sulfur dioxide (SO_2) concentrations in New Jersey shown in Figure 1-2 are attributable to a coal-burning facility across the river in Pennsylvania. NJDEP established the Columbia Wildlife Management Area monitoring station in 2010 to determine the facility's impact on New Jersey's air quality. Exceedances of the SO_2 NAAQS were recorded that same year. Since the plant ceased operations under a court agreement, SO_2 levels in New Jersey have again fallen below the standard.

Nitrogen dioxide (NO_2) is a reactive gas emitted primarily from motor vehicles. It is known to cause serious health problems, especially for sensitive individuals such as children, the elderly, and people with asthma. New Jersey has long been in compliance with the NAAQS for NO_2.

Particulate air pollution less than 2.5 micrometers in diameter is referred to as fine particulate or $PM_{2.5}$. These small particles can be inhaled deep into the lungs, and are known to have a greater impact on public health than larger particles, which were the focus of previous ambient air quality standards. Monitoring data in New Jersey shows a steady decline in $PM_{2.5}$ levels that are now in compliance with the NAAQS.

Outdoor concentrations of carbon monoxide can affect people with cardiovascular problems. Levels in New Jersey have been below the NAAQS for over twenty years.

Figure 1-1

Ozone Design Value* Trend in New Jersey, 1997-2016

*3-Year Average of 4th-Highest Daily Maximum 8-Hour Average Concentration in Parts per Million (ppm)

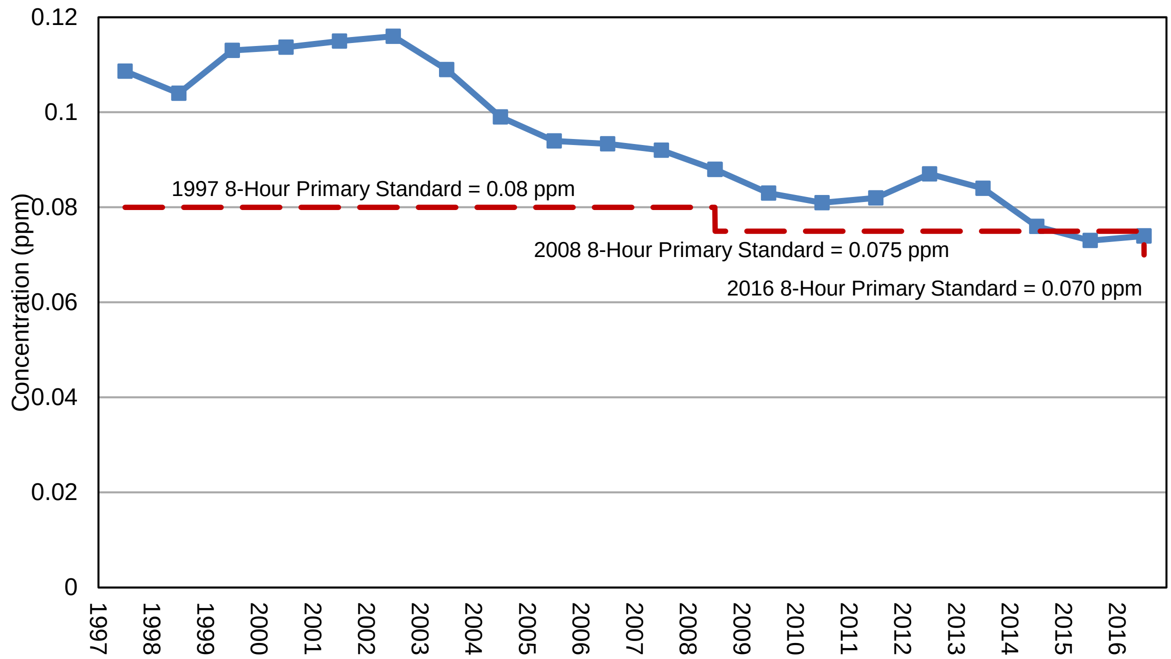


Figure 1-2

Sulfur Dioxide (SO_2) Design Value* Trend in New Jersey, 2000-2016

*3-Year Average of the 99th Percentile of Daily Maximum 1-Hour Average Concentration in Parts per Million (ppm)

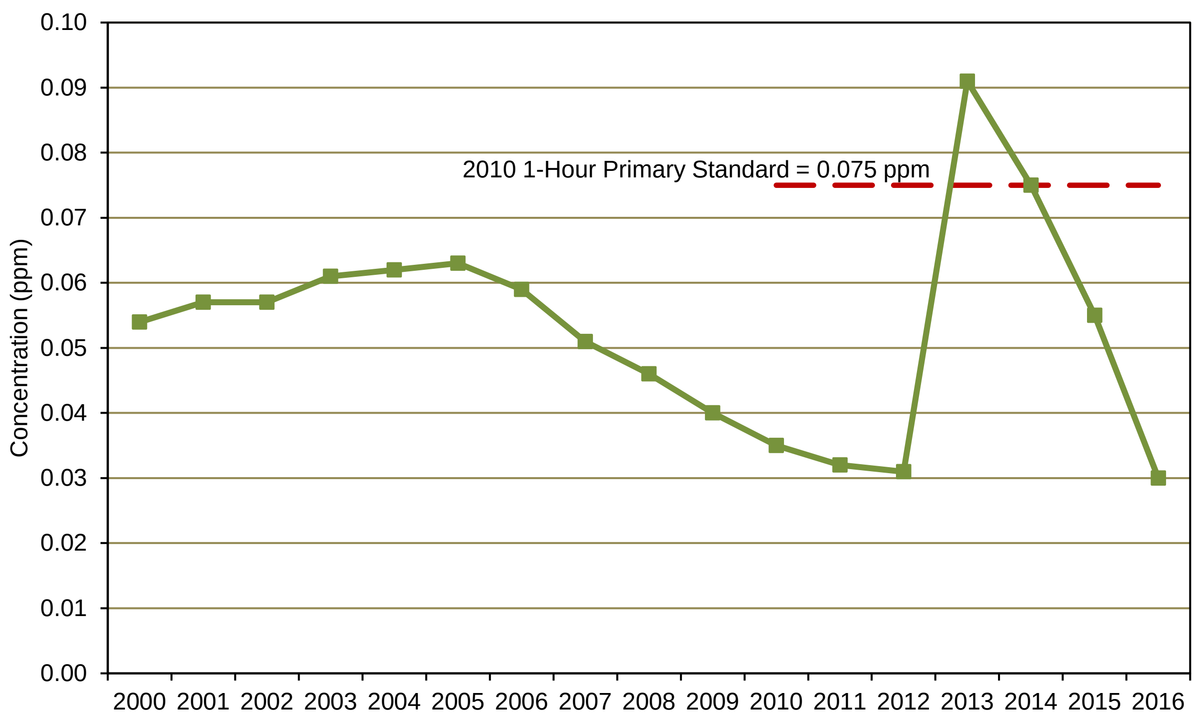


Figure 1-3
Nitrogen Dioxide (NO_2) Design Value* Trend in New Jersey, 2000-2016
*3-Year Average of the 98th Percentile Daily Maximum 1-Hour Average Concentration
in Parts per Million (ppm)

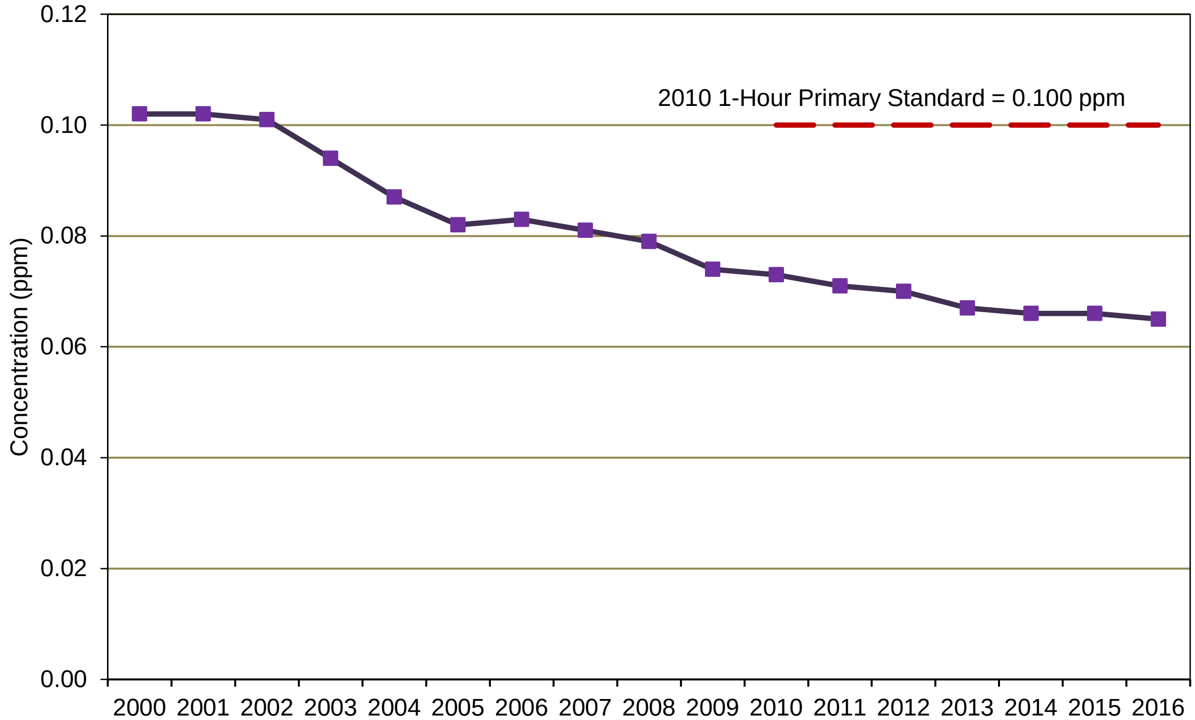


Figure 1-4
Fine Particulate ($PM_{2.5}$) 24-Hour Design Value* Trend in New Jersey, 2001-2016
*3-Year Average of the 98th Percentile 24-Hour Average Concentration
in Micrograms per Cubic Meter (µg/m³)

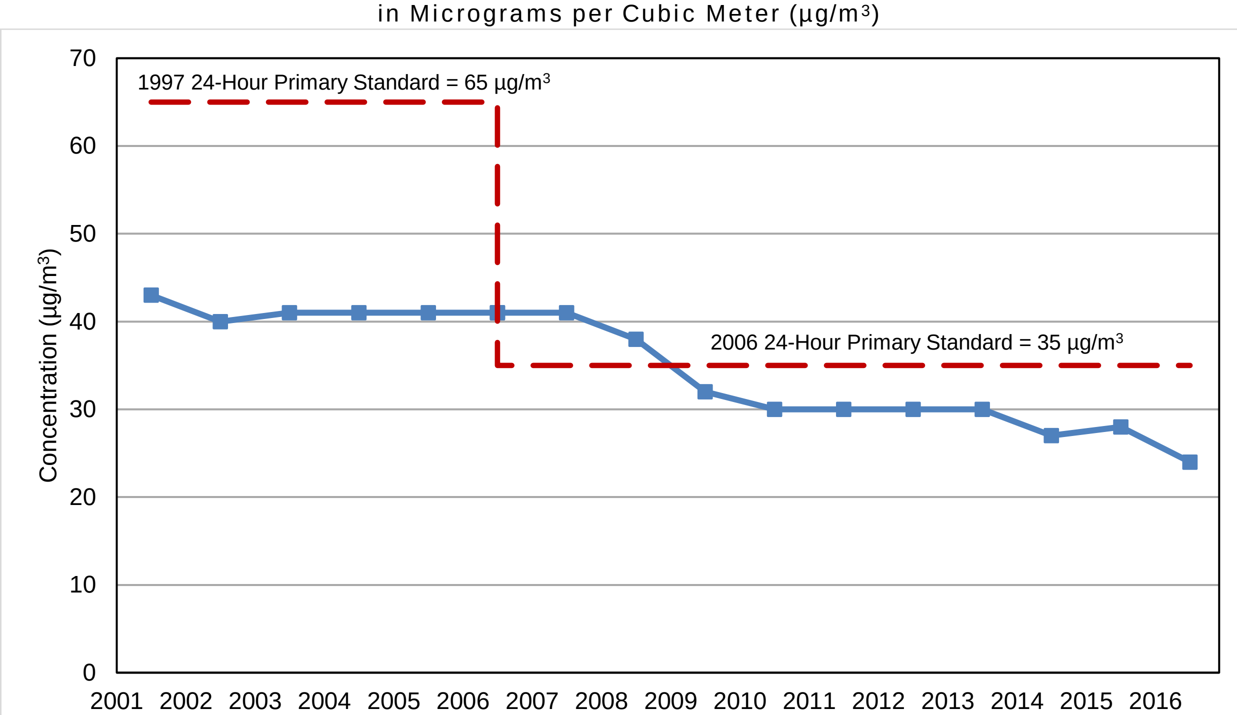
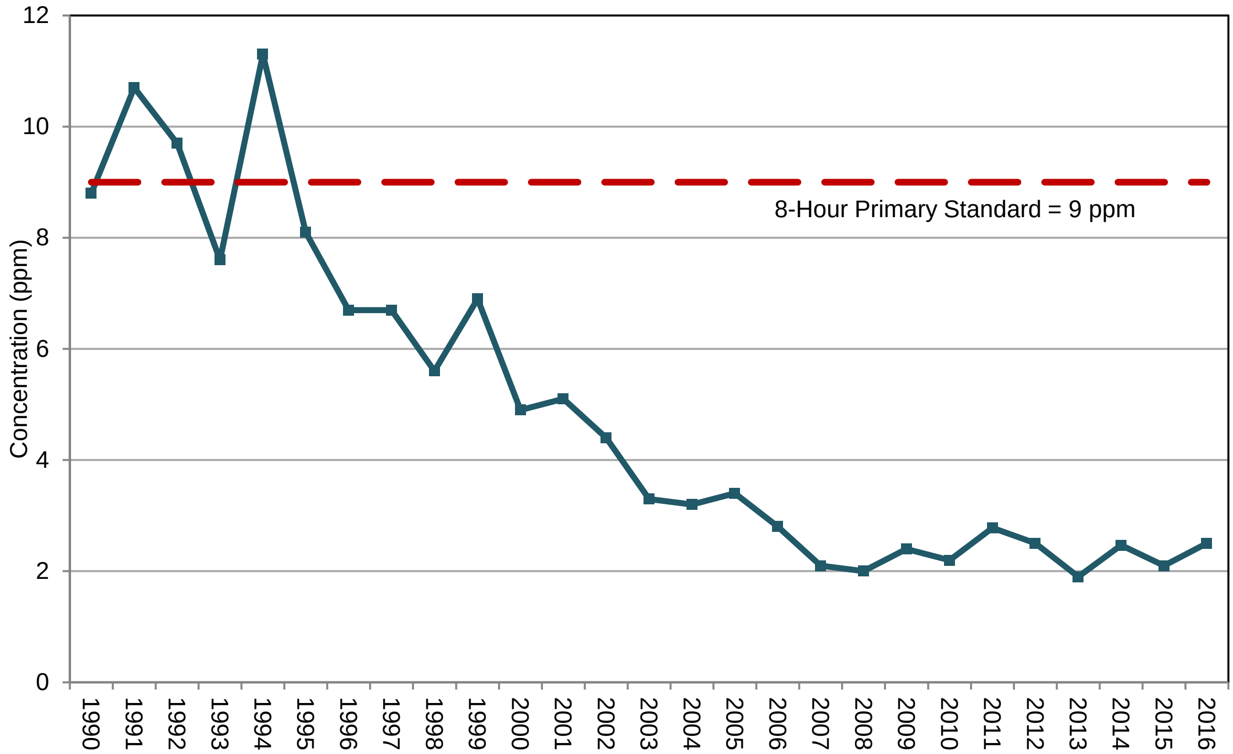


Figure 1-5
Carbon Monoxide (CO) Design Value* Trend in New Jersey, 1990-2016
*2nd-Highest 8-Hour Average Concentration
in Parts per Million (ppm)



2016 Air Monitoring Network

New Jersey Department of Environmental Protection

NETWORK DESCRIPTION

In 2016, the New Jersey Department of Environmental Protection (NJDEP) Bureau of Air Monitoring (BAM) operated 35 ambient air monitoring stations. The stations vary in the number and type of monitors operating at each site. The NJDEP air monitoring program is primarily focused on the measurement of pollutants for which National Ambient Air Quality Standards (NAAQS) have been established, also known as criteria pollutants. Criteria pollutant monitoring is regulated by the United States Environmental Protection Agency (USEPA), which prescribes the design and siting of the monitoring networks, the acceptable monitoring methods, and the minimum quality assurance activities. Only data which meet USEPA requirements can be used to determine compliance with the NAAQS. There are six criteria air pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulate matter (PM). Because particulate matter encompasses such a wide range of contaminants, there are NAAQS for two different size fractions of particles. There are separate standards for fine particles, less than 2.5 microns in size referred to as $PM_{2.5}$ (1 micron = one millionth of a meter), and for inhalable particles, less than 10 microns in size, referred to as PM_{10}.

In New Jersey, O_3, CO, NO_2, and SO_2 are measured using USEPA-approved real-time monitoring methods, and data collected for these pollutants are continuously transmitted to a central data acquisition system. Once an hour, the Bureau of Air Monitoring posts this air quality data to its website (www.njaqinow.net) and to the USEPA's Air Now website (www.airnow.gov).

$PM_{2.5}$ is measured both in real-time and with a 24-hour filter-based sampler. The filter must be installed and removed manually, and brought to the BAM lab to be weighed and analyzed. The filter-based sampler is also used to determine lead, PM_{10}, and PM_{coarse} concentrations.

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Figure 2-1
Bayonne Air Monitoring Station

In addition to monitoring criteria pollutants, the NJDEP also measures "non-criteria pollutants," or pollutants that do not have health-based National Ambient Air Quality Standards. Certain non criteria pollutants are grouped together by their purpose or collection method. USEPA's Photochemical Assessment Monitoring Station (PAMS) program, for example, measures non-criteria pollutants that are important in the formation of ozone. Since most ozone is not directly emitted from sources but forms in the atmosphere when volatile organic compounds and oxides of nitrogen react in the presence of sunlight, it is important to know the levels of these "precursor" pollutants.

Other non-criteria pollutants that the Bureau monitors include some that are commonly emitted by motor vehicles and other combustion sources: Benzene, toluene, ethylbenzene, ortho-xylene, meta-xylene, para-xylene (measured with a "BTEX" analyzer), and black carbon (measured with an aethalometer).

Figure 2-2
USEPA-Approved $PM_{2.5}$ Sampler
in Trenton

Five sites in the monitoring network collect samples of $PM_{2.5}$ that are analyzed to determine the chemical makeup of the particles. These are part of USEPA's Chemical Speciation Network (CSN). This data is used in helping to identify the primary sources of particles, and in assessing potential health effects.

Samples of volatile organic compounds (VOCs) are collected and analyzed at four monitoring sites. These non-criteria pollutants are classified as "air toxics," pollutants that have potential health effects but for which NAAQS have not been established. They can be carcinogenic or have other serious health effects, and are very diverse in their chemical composition.

Two sites, Cattus Island and Washington Crossing, are part of the National Atmospheric Deposition Network. BAM staff collect the samples and ship them to a national laboratory for analysis of acids, nutrients, and base cations in precipitation.

A number of sites within the air monitoring network also take measurements of meteorological parameters, such as temperature, relative humidity, barometric pressure, wind speed, wind direction, and solar radiation. Figure 2-1 shows the monitoring station at Bayonne (Hudson County), which measures criteria pollutant data as well as weather parameters. Figure 2-2 shows a USEPA-approved manual $PM_{2.5}$ sampler located on the roof of the Trenton Free Public Library on Academy Street.

The map in Figure 2-3 shows the locations of all the monitoring stations that operated in 2016, and Table 2-1 lists the parameters that were measured at each site.

Figure 2-3
New Jersey Air Monitoring Sites
2016 Network Summary

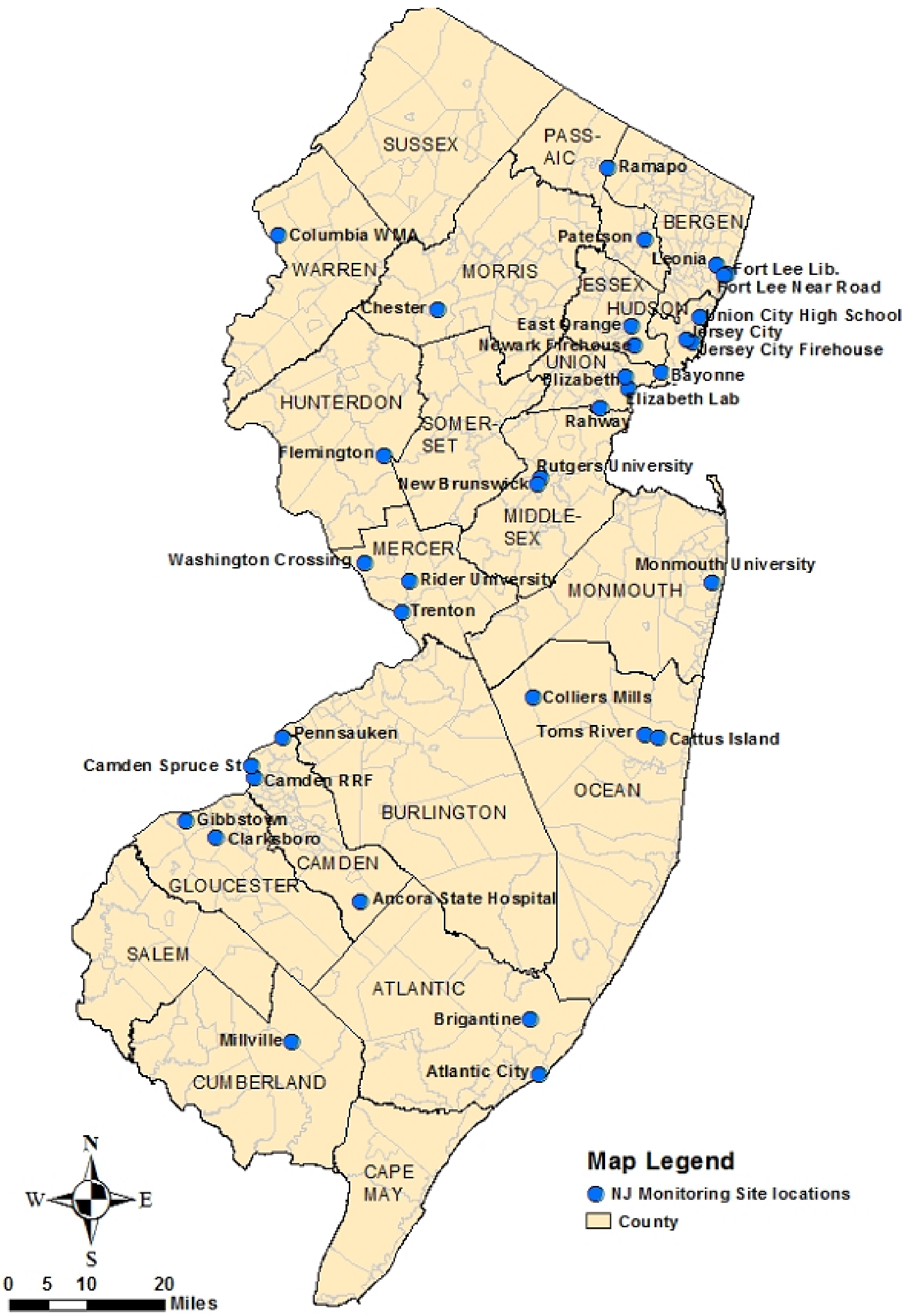

Table 2-1
2016 New Jersey Air Monitoring Network Summary

	Monitoring Station	CO	NO_x	NOy	O_3	SO_2	Smoke Shade	$PM_{2.5}$	Real-Time $PM_{2.5}$ TEOM	Real-Time $PM_{2.5}$ Beta	Visibility	PM_{10}	Lead/PM_{coarse}	$PM_{2.5}$-Speciation	O_3 Precursors (PAMS)	Toxics	BTEX/ Black Carbon	Acid Deposition	Mercury	Meteorological#	Rain	Solar Radiation
1	Ancora State Hospital				1																	
2	Atlantic City							1														
3	Bayonne		1		1	1											1			1	1	
4	Brigantine				1	1		1		1	1							1	1b			
5	Camden RRF											1										
6	Camden Spruce Street	1	1		1	1		1		1				1		1	1			1	1	
7	Cattus Island																	1				
8	Chester		1		1	1		1						1		1			1b			
9	Clarksboro				1																	
10	Colliers Mills				1																	
11	Columbia WMA		1		1	1		1		1										1	1	
12	East Orange*	1b	1b																	1b		
13	Elizabeth	1				1	1b															
14	Elizabeth Lab	1	1			1	1b	2		1				1		1	1		1	1	1	
15	Flemington				1					1a										1	1	
16	Fort Lee Library							1														
17	Fort Lee Near Road	1	1							1							1			1	1	
18	Gibbstown							1														
19	Jersey City	1	1			1	1b															
20	Jersey City Firehouse							2		1		2										
21	Leonia				1																	
22	Millville		1		1					1												
23	Monmouth University				1																	
24	New Brunswick*							1b		1b				2b		1b			1b			
25	Newark Firehouse	1	1	1	1	1		1		1		1	1	1			1			1	1	1
26	Paterson							1														
27	Pennsauken							1														
28	Rahway							1	1													
29	Ramapo				1																	
30	Rider University				1					1										1		1
31	Rutgers University		1		1			1a		1				2a	1	1a			1a			
32	Toms River							1														
33	Trenton							1														
34	Union City High School**							1														
35	Washington Crossing																	1				
	YEAR-END TOTAL	6	9	1	16	9	0	19	1	11	1	3	1	5	1	4	5	3	2	9	7	2

Meteorological parameters include temperature, relative humidity, barometric pressure, wind direction & wind speed.
* Monitoring site shut down in 2016
** Monitoring site started up in 2016
1 - Parameter measured in 2016
2 - Collocated parameter measured in 2016
a - Monitor started up in 2016
b - Monitor shut down in 2016

CHANGES TO THE NETWORK IN 2016

In 2016, monitoring stations in Ewing ($PM_{2.5}$), South Camden ($PM_{2.5}$), and East Orange (NO_x, CO and meteorological data) were shut down because they were close to other monitoring sites that were measuring similar data. Concern about safe access led to the relocation of the $PM_{2.5}$ monitor from the Union City site to Union City High School. The obsolete forty-year-old smoke shade instruments at Jersey City, Elizabeth and Elizabeth Trailer were officially removed at the close of the year. The New Brunswick site was shut down after the last of the monitors were moved to the Rutgers University site, located approximately a mile away. The Jersey City site began measuring NO_2, NO and NO_x.

Table 2-2
2016 Network Changes (by Date)

Monitoring Site	Parameter(s)	Action	Date
Jersey City	NO_2, NO, NO_x	Startup	1/1/2016
Rutgers University	$PM_{2.5}$	Startup	1/1/2016
Rutgers University	Toxics	Startup	1/1/2016
Union City High School	$PM_{2.5}$	Startup	1/1/2016
South Camden	$PM_{2.5}$ TEOM	Discontinued	1/14/2016
Washington Crossing	$PM_{2.5}$	Discontinued	1/14/2016
Ewing	$PM_{2.5}$ TEOM	Discontinued	1/15/2016
New Brunswick	$PM_{2.5}$	Relocated to Rutgers	2/15/2016
Flemington	$PM_{2.5}$ Beta	Startup	2/19/16
Ancora	Ozone	Moved from trailer to building	3/1/2016
New Brunswick	$PM_{2.5}$ Speciation	Relocated to Rutgers	6/30/16
East Orange	CO	Shut down	7/1/16
East Orange	NOx	Shut down	7/1/16
East Orange	Meteorological Data	Shut down	7/1/16
Rutgers University	$PM_{2.5}$ Speciation	Startup	7/5/16
New Brunswick	Mercury	Relocated to Rutgers	10/1/16
Rutgers University	Mercury	Startup	10/31/16
Brigantine	Mercury	Discontinued	12/31/16
Chester	Mercury	Discontinued	12/31/16
Elizabeth	Smoke Shade	Discontinued	12/31/16
Elizabeth Trailer	Smoke Shade	Discontinued	12/31/16
Jersey City	Smoke Shade	Discontinued	12/31/16

Table 2-3
Key for Tables 2-1 and 2-2

CO	Carbon monoxide
NO	Nitric oxide
NO_X	Nitrogen oxides
NO_X	Nitrogen dioxide
$PM_{2.5}$	Fine particles (2.5 microns or less)
$PM_{2.5}$ Beta	Real-time Beta Attenuation $PM_{2.5}$ analyzer
$PM_{2.5}$ TEOM	Real-time Tapered Element Oscillating Microbalance (TEOM) $PM_{2.5}$ analyzer
Toxics	Air toxics

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2016 Air Quality Index

New Jersey Department of Environmental Protection

WHAT IS THE AIR QUALITY INDEX (AQI)?

The Air Quality Index (AQI) is a national air quality rating system based on the National Ambient Air Quality Standards (NAAQS). An index value of 100 is equal to the primary, or health-based, NAAQS for each pollutant. This allows for a direct comparison of each of the pollutants used in the AQI. These pollutants are ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide. Although air concentrations of pollutants have been dropping over the past few years, the U.S. Environmental Protection Agency (USEPA) periodically reviews the NAAQS to make sure that they are protective of public health, and adjusts them accordingly in response to new research. The latest NAAQS revision (for ozone) occurred in October 2015.

Every morning an air pollution forecast for the current and following day is prepared by the New Jersey Department of Environmental Protection (NJDEP) using the AQI format. The forecast is provided to USEPA and is disseminated through the Enviroflash system to subscribers who sign up to receive air quality forecast and alert emails or texts (www.enviroflash.info). Anyone can view the forecast and current air quality conditions at USEPA's AirNow website (www.airnow.gov) or at NJDEP's air monitoring webpage (www.njaqinow.net/).

In an effort to make the AQI easier to understand, a color code and descriptive interpretation are assigned to the numerical ratings (see Table 3-1). Table 3-2 contains suggested actions to take to protect public health for different AQI levels. For more information on the AQI, visit EPA's web site at www.airnow.gov.

Table 3-1
Air Quality Index Levels and Associated Health Impacts

AQI Level of Health Concern	Numerical Value	Meaning	Color Code
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.	Green
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.	Yellow
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.	Orange
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.	Red
Very Unhealthy	201 to 300	Health warnings of emergency conditions. The entire population is more likely to be affected.	Purple
Hazardous	301 to 500	Health alert: everyone may experience more serious health effects.	Maroon

Table 3-2
AQI Value Suggested Actions to Protect Health

Air Quality Index Level	AQI Value Actions to Protect Your Health
Good (1-50)	None
Moderate (51-100)	Unusually sensitive individuals should consider limiting prolonged outdoor exertion.
Unhealthy for Sensitive Groups (101-150)	Children, active adults, and people with respiratory disease such as asthma should limit prolonged outdoor exertion.
Unhealthy (151-200)	Children, active adults, and people with respiratory disease such as asthma should avoid prolonged outdoor exertion: Everyone else should limit prolonged outdoor exertion.
Very Unhealthy (201-300)	Children, active adults, and people with respiratory disease such as asthma should avoid outdoor exertion. Everyone else should limit outdoor exertion.
Hazardous (301-500)	Everyone should avoid all physical activity outdoors.

Table 3-3 shows the pollutant-specific ranges for the AQI categories. These are set according to the corresponding NAAQS.

Table 3-3
AQI Pollutant-Specific Ranges

Category	AQI	O_3	$PM_{2.5}$	CO	SO_2	NO_2
		(ppm) 8-hour	(µg/m³) 24-hour	(ppm) 8-hour	(ppm) 1-hour	(ppm) 1-hour
Good	0-50	0.000-0.054	0.0-12.0	0.0-4.4	0-0.035	0-0.053
Moderate	51-100	0.055-0.070	12.1-35.4	4.5-9.4	0.036-0.075	0.054-0.100
Unhealthy for Sensitive Groups	101-150	0.071-0.085	35.5-55.4	9.5-12.4	0.076-0.185	0.101- 0.360
Unhealthy	151- 200	0.086-0.105	55.5-150.4	12.5-15.4	0.186-0.304	0.361-0.649
Very Unhealthy	201-300	0.106-0.200	150.5-250.4	15.5-30.4	0.305-0.604	0.605-1.249
Hazardous	301-500	>0.200	250.5-500.4	30.5-1004	0.605-1.004	1.250-2.049

Pollutants:
O_3 – Ozone
$PM_{2.5}$ – Fine particulate matter
CO – Carbon monoxide
SO_2 – Sulfur dioxide
NO_2 – Nitrogen dioxide

On days when the air quality is expected to reach the “Unhealthy for Sensitive Groups” range or above, cautionary statements similar to those in Tables 3-1 and 3-2 are provided as part of the forecast. These air quality alerts are issued through Enviroflash emails, are displayed on the AirNow and NJDEP air monitoring websites, and can also be viewed on the National Weather Service page for the Philadelphia/Mount Holly area (http://airquality.weather.gov/). Maps, charts, site photos, and other air quality information are also available on the NJDEP air monitoring web site, as shown in Figure 3-1 below.

Figure 3-1
Examples of Information Available on NJDEP’s Air Monitoring Website
www.njaqinow.net

Current Air Quality

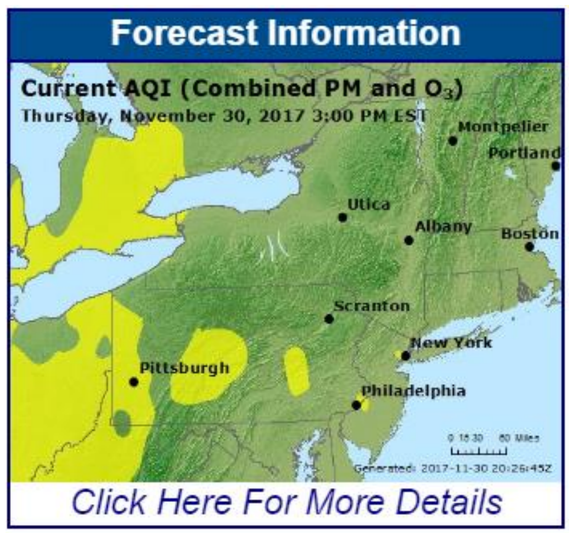
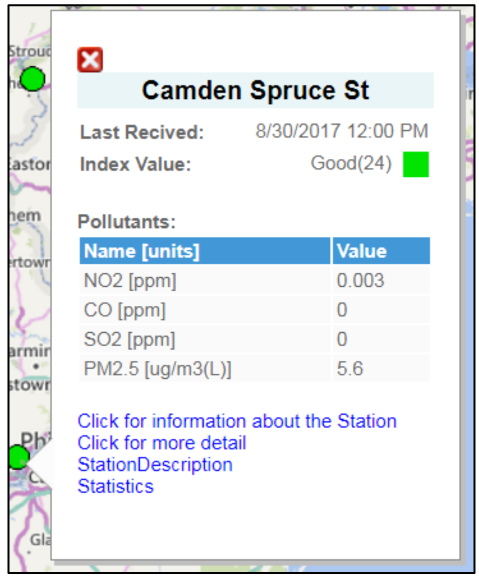
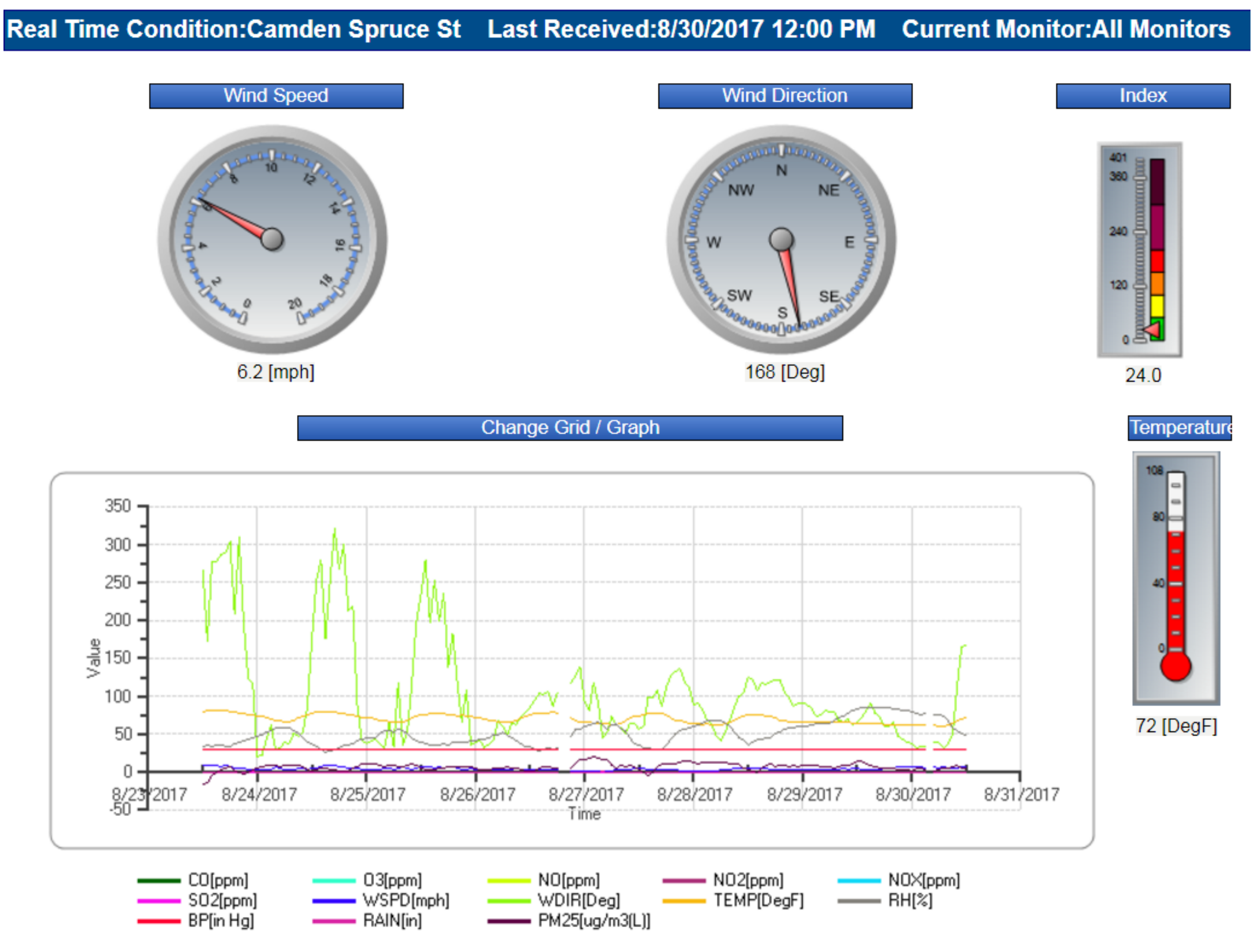


Figure 3-1 (continued)
Examples of Information Available on NJDEP's Air Monitoring Website

Monitors	
Monitor	Value
CO[ppm]	0.0
O3[ppm]	--
NO[ppm]	0.001
NO2[ppm]	0.003
NOX[ppm]	0.005
SO2[ppm]	0.000
WSPD[mph]	6.2
WDIR[Deg]	168
TEMP[DegF]	72
RH[%]	48.3
BP[in Hg]	29.97
RAIN[in]	0.000
PM25[ug/m3(L)]	5.6





2016 AQI SUMMARY

Not all of New Jersey's monitoring sites have 365 valid days of reported air quality index values. Certain ozone monitors only operate during "ozone season," from April through October. Table 3-4 shows which pollutants are used to determine the daily AQI at different monitoring stations.

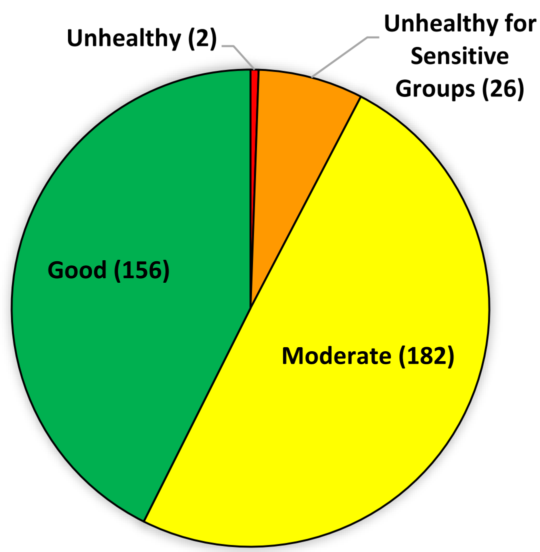
Table 3-4
Pollutants Monitored at Each Air Quality Index Monitoring Site in New Jersey in 2016

	Monitoring Site	Ozone	Particulate Matter	Carbon Monoxide	Sulfur Dioxide	Nitrogen Dioxide
1	Ancora State Hospital	√ (s)				
2	Bayonne	√			√	√
3	Brigantine	√	√		√	
4	Camden Spruce St.	√	√	√	√	√
5	Chester	√			√	√
6	Clarksboro	√ (s)				
7	Colliers Mills	√ (s)				
8	Columbia WMA	√	√		√	√
9	East Orange			√		√
10	Elizabeth			√	√	
11	Elizabeth Lab		√	√	√	√
12	Flemington	√	√			
13	Fort Lee Near Road		√	√		√
14	Jersey City			√	√	√
15	Jersey City Firehouse		√			
16	Leonia	√ (s)				
17	Millville	√	√			√
18	Monmouth University	√ (s)				
19	Newark Firehouse	√	√	√	√	√
20	Rahway		√			
21	Ramapo	√ (s)				
22	Rider University	√	√			
23	Rutgers University	√	√			√

(s) – Seasonal operation only (April 1 through October 31)

A summary of the AQI ratings for New Jersey in 2016 is presented in the pie chart in Figure 3-2 below. In 2016, there were 156 "Good" days, 183 were "Moderate," 25 were rated "Unhealthy for Sensitive Groups," 2 were considered "Unhealthy." None were rated "Very Unhealthy." This indicates that air quality in New Jersey is considered good or moderate most of the time, but that pollution is still bad enough to adversely affect some people on about one day in thirteen. This is similar to last year when one in fourteen was unhealthy for sensitive groups. It is, however, the first year in the last four to have any days exceed the unhealthy limit for the general population. Table 5 lists the dates when the AQI reached the "Unhealthy for Sensitive Groups" or "Unhealthy" threshold at any monitoring location, and shows the responsible pollutants and their concentrations.

Figure 3-2
2016 Air Quality Summary by Days



New Jersey ozone concentrations on May 25 and 26, 2016, were unusually high because they were impacted by emissions from a large wildfire in Alberta, Canada. Every ozone monitor in the state except Bayonne recorded exceedances of the NAAQS on May 25. Two sites even went into the "Unhealthy" range. The next day, ten sites exceeded the ozone standard. In May 2017, NJDEP submitted a report to USEPA demonstrating that the emissions from the wildfire influenced New Jersey's air quality on May 25 and May 26, 2016, and requested that the data from the ozone monitors on those days be excluded from determining New Jersey's compliance with the ozone NAAQS and other regulatory actions. USEPA has agreed that ozone exceedances for this day will not be included in calculating New Jersey's 2016 design values because of the influence of the fire. Some neighboring states have also requested that exceedances on those days be excluded from their compliance determinations. More information about these ozone concentrations and how they affect regulatory issues can be found in the NJDEP 2016 Ozone Summary.

Table 3-5
AQI "Unhealthy" or "USG" Days in New Jersey During 2016

Day	Date	Location	AQI Value	Pollutant	Rating	Concen-tration	Units
1	3/9/2016	Fort Lee Near Road	110	$PM_{2.5}$	USG	39.3	ug/m^3
2	5/12/2016	Colliers Mills	104	O_3	USG	72	ppb
3	5/25/2016*	Ancora	118	O_3	USG	76	ppb
		Brigantine	129	O_3	USG	79	ppb
		Camden Spruce St.	125	O_3	USG	78	ppb
		Chester	143	O_3	USG	83	ppb
		Clarksboro	143	O_3	USG	83	ppb
		Colliers Mills	158	O_3	Unhealthy	90	ppb
		Columbia	118	O_3	USG	76	ppb
		Flemington	143	O_3	USG	83	ppb
		Leonia	153	O_3	Unhealthy	86	ppb
		Millville	136	O_3	USG	81	ppb
		Monmouth University	136	O_3	USG	81	ppb
		Newark Firehouse	136	O_3	USG	81	ppb
		Ramapo	129	O_3	USG	79	ppb
		Rider University	139	O_3	USG	82	ppb
		Rutgers University	146	O_3	USG	84	ppb
		Washington Crossing**	143	O_3	USG	83	ppb
4	5/26/2016*	Bayonne	118	O_3	USG	76	ppb
		Chester	153	O_3	Unhealthy	86	ppb
		Columbia	108	O_3	USG	73	ppb
		Flemington	154	O_3	Unhealthy	88	ppb
		Leonia	150	O_3	USG	85	ppb
		Newark Firehouse	122	O_3	USG	77	ppb
		Ramapo	136	O_3	USG	81	ppb
		Rider University	139	O_3	USG	82	ppb
		Rutgers University	153	O_3	Unhealthy	86	ppb
		Washington Crossing**	153	O_3	Unhealthy	86	ppb
5	5/27/2016	Ramapo	103	O_3	USG	71	ppb
		Rutgers University	115	O_3	USG	75	ppb
		Washington Crossing**	111	O_3	USG	74	ppb
6	5/28/2016	Leonia	122	O_3	USG	77	ppb
		Rutgers University	108	O_3	USG	73	ppb
		Washington Crossing**	111	O_3	USG	74	ppb
7	6/1/2016	Chester	104	O_3	USG	72	ppb
		Columbia	104	O_3	USG	72	ppb
		Flemington	111	O_3	USG	74	ppb
		Ramapo	104	O_3	USG	72	ppb
		Washington Crossing**	103	O_3	USG	71	ppb

Continued on next page.

Table 3-5 (continued)
AQI "Unhealthy" or "USG" Days in New Jersey During 2016

Day	Date	Location	AQI Value	Pollutant	Rating	Concen-tration	Units
8	6/11/2016	Camden Spruce St.	118	O_3	USG	76	ppb
		Clarksboro	111	O_3	USG	74	ppb
		Colliers Mills	108	O_3	USG	73	ppb
		Monmouth University	108	O_3	USG	73	ppb
		Rutgers University	104	O_3	USG	72	ppb
9	6/15/2016	Colliers Mills	103	O_3	USG	71	ppb
		Rider University	103	O_3	USG	71	ppb
		Rutgers University	103	O_3	USG	71	ppb
10	6/19/2016	Leonia	111	O_3	USG	74	ppb
		Rutgers University	108	O_3	USG	73	ppb
11	6/20/2016	Camden Spruce St.	115	O_3	USG	75	ppb
		Clarksboro	122	O_3	USG	77	ppb
		Flemington	108	O_3	USG	73	ppb
		Ramapo	129	O_3	USG	79	ppb
		Rutgers University	111	O_3	USG	74	ppb
		Washington Crossing**	104	O_3	USG	72	ppb
12	6/24/2016	Flemington	125	O_3	USG	78	ppb
		Washington Crossing**	111	O_3	USG	74	ppb
13	6/26/2016	Washington Crossing**	111	O_3	USG	74	ppb
14	7/6/2016	Bayonne	111	O_3	USG	74	ppb
		Monmouth University	104	O_3	USG	72	ppb
15	7/8/2016	Camden Spruce St.	111	O_3	USG	74	ppb
		Clarksboro	118	O_3	USG	76	ppb
16	7/16/2016	Leonia	108	O_3	USG	73	ppb
17	7/21/2016	Leonia	103	O_3	USG	71	ppb
		Rider University	111	O_3	USG	74	ppb
		Rutgers University	111	O_3	USG	74	ppb
18	7/22/2016	Camden Spruce St.	136	O_3	USG	81	ppb
		Clarksboro	111	O_3	USG	74	ppb
		Flemington	108	O_3	USG	73	ppb
		Leonia	115	O_3	USG	75	ppb
		Rider University	104	O_3	USG	72	ppb
		Rutgers University	125	O_3	USG	78	ppb
		Washington Crossing**	104	O_3	USG	72	ppb
19	7/25/2016	Camden Spruce St.	103	O_3	USG	71	ppb
20	7/27/2016	Camden Spruce St.	125	O_3	USG	78	ppb
		Clarksboro	103	O_3	USG	71	ppb

Continued on next page.

Table 3-5 (continued)
AQI "Unhealthy" or "USG" Days in New Jersey During 2016

Day	Date	Location	AQI Value	Pollutant	Rating	Concen-tration	Units
21	7/28/2016	Newark Firehouse	103	O_3	USG	71	ppb
22	7/29/2016	Rutgers University	118	O_3	USG	76	ppb
23	8/24/2016	Leonia	104	O_3	USG	72	ppb
		Rider University	118	O_3	USG	76	ppb
		Rutgers University	115	O_3	USG	75	ppb
24	8/31/2016	Camden Spruce St.	104	O_3	USG	72	ppb
25	9/14/2016	Colliers Mills	103	O_3	USG	71	ppb
26	9/23/2016	Ancora	118	O_3	USG	76	ppb
		Camden Spruce St.	125	O_3	USG	78	ppb
		Clarksboro	129	O_3	USG	79	ppb
		Colliers Mills	122	O_3	USG	77	ppb
		Flemington	125	O_3	USG	78	ppb
		Washington Crossing**	115	O_3	USG	75	ppb
27	11/11/2016	Camden Spruce St.	103	SO_2	USG	0.081	ppm
28	11/21/2016	Camden Spruce St.	142	SO_2	USG	0.167	ppm

Rating
USG – Unhealthy for sensitive groups

Pollutants
$PM_{2.5}$ – Fine particulate matter
O_3 – Ozone
SO_2 – Nitrogen dioxide

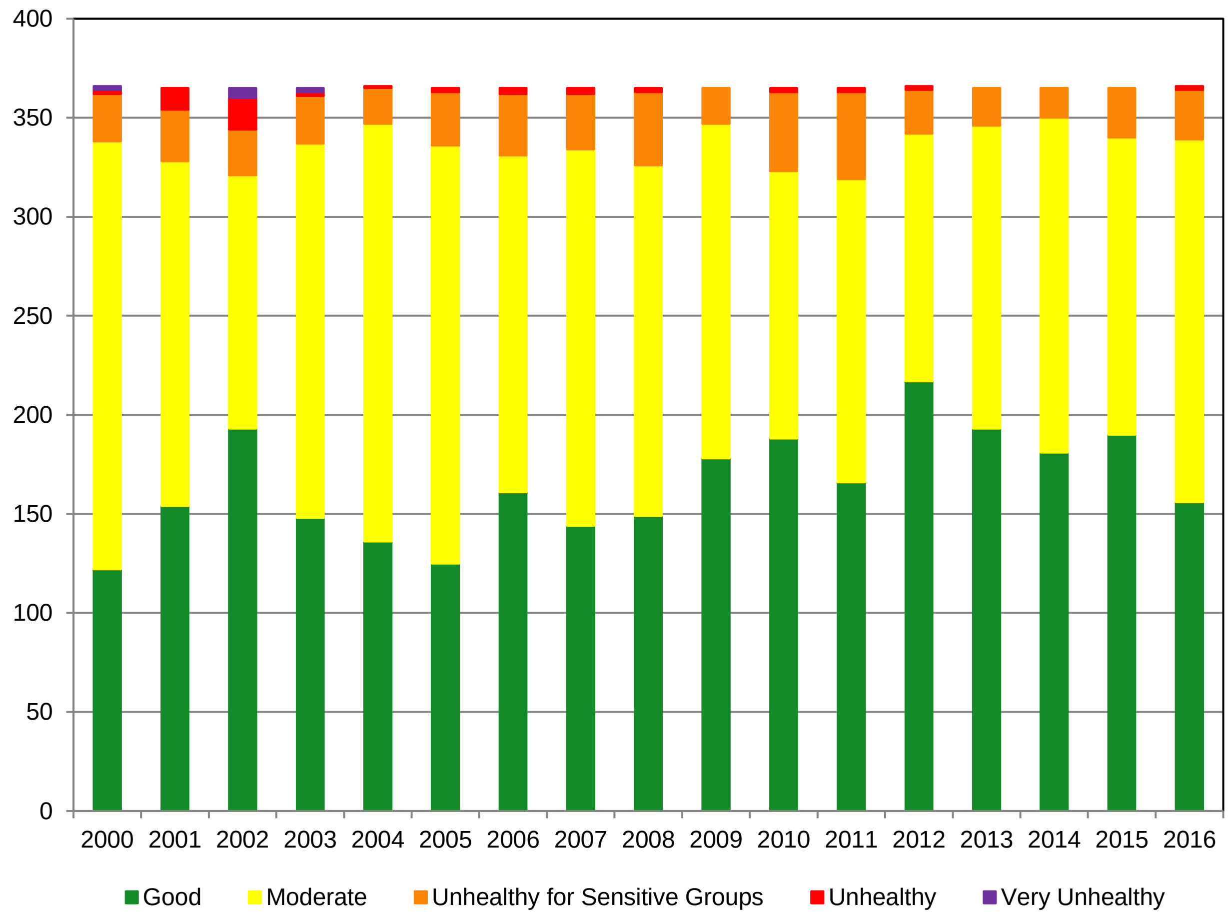
*USEPA has determined that ozone exceedances for this day will not be included in calculating New Jersey's 2016 design values because of the influence of a wildfire in Canada.

** Washington Crossing air monitoring station is operated by USEPA. The site's data is included in determining exceedances in New Jersey.

Figure 3-3 shows the distribution of AQI days since 2000. It should be noted that AQI ranges change whenever the NAAQS is revised (so far, always to be more stringent) for a specific pollutant. So even though improvement in AQI days appears to be somewhat erratic, to see how things have really improved, refer to the concentration trend graphs in the individual criteria pollutant reports.

Of all the criteria pollutants, ozone is predominantly responsible for AQI days above the moderate range in New Jersey.

Figure 3-3
Number of Days in Each AQI Category Since 2000



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2016 Ozone Summary

New Jersey Department of Environmental Protection

SOURCES

Ozone (O_3) is a gas consisting of three oxygen atoms. It occurs naturally in the upper atmosphere (stratospheric ozone) where it protects us from harmful ultraviolet rays (see Figure 4-1). However, at ground-level (tropospheric ozone), it is considered an air pollutant and can have serious adverse health effects. Ground-level ozone is created when nitrogen oxides (NO_x) and volatile organic compounds (VOCs) react in the presence of sunlight (see Figure 4-2). NO_x is primarily emitted by motor vehicles, power plants, and other sources of combustion. VOCs are emitted from sources such as motor vehicles, chemical plants, factories, consumer and commercial products, and even natural sources such as trees. The pollutants that form ozone, referred to as "precursor" pollutants, and ozone itself can also be transported into an area from sources hundreds of miles upwind.

Since ground-level ozone needs sunlight to form, it is mainly a problem in the daytime during the summer months. Weather patterns have a significant effect on ozone formation, and hot dry summers will result in more ozone than cool wet ones. In New Jersey, the ozone monitoring season runs from April 1st to October 31st. For a more complete explanation of the difference between ozone in the upper and lower atmosphere, see the U.S. Environmental Protection Agency (USEPA) publication, "Good Up High, Bad Nearby – What is Ozone?"

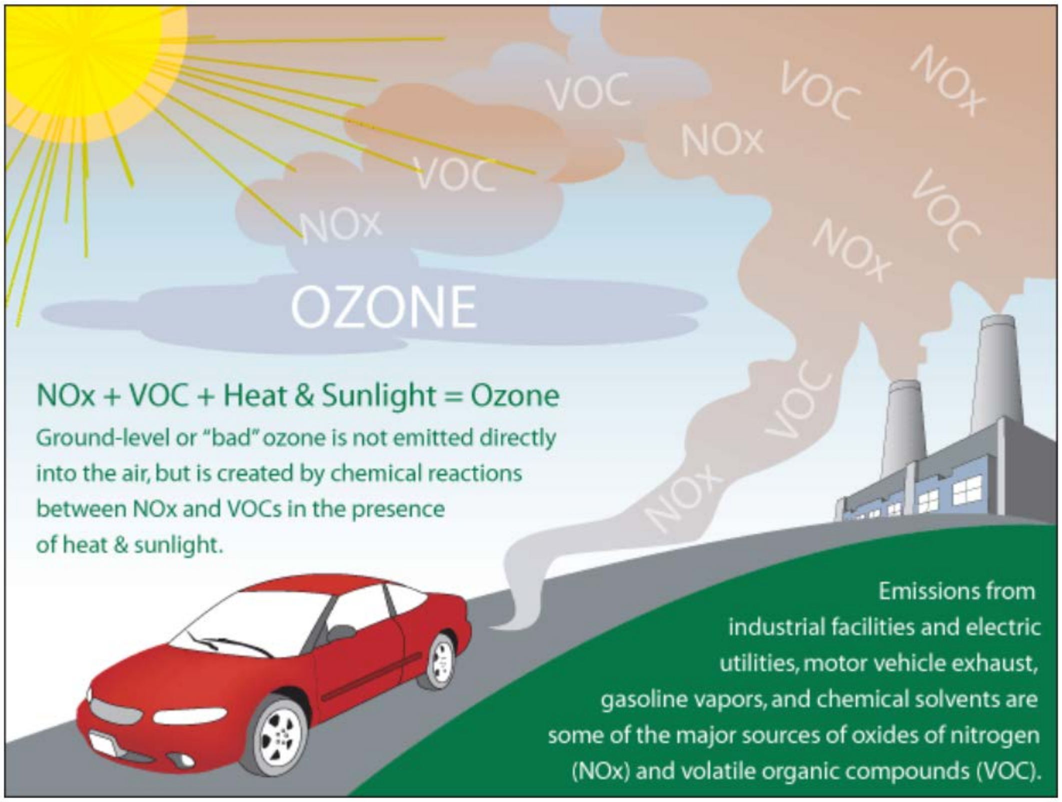
Figure 4-1. Good and Bad Ozone

OZONE IS GOOD UP HERE…MANY POPULAR CONSUMER PRODUCTS LIKE AIR CONDITIONERS AND REFRIGERATORS INVOLVE CFCS OR HALONS DURING EITHER MANUFACTURING OR USE. OVER TIME, THESE CHEMICALS DAMAGE THE EARTH'S PROTECTIVE OZONE LAYER.

OZONE IS BAD DOWN HERE… CARS, TRUCKS, POWER PLANTS AND FACTORIES ALL EMIT AIR POLLUTION THAT FORMS GROUND-LEVEL OZONE, A PRIMARY COMPONENT OF SMOG.

Source: USEPA AirNow

Figure 4-2
Ozone Formation



Source: USEPA. https://airnow.gov/index.cfm?action=aqibasics.ozone

Health and Environmental Effects

Ozone can irritate the entire respiratory tract. Repeated exposure to ozone pollution may cause permanent damage to the lungs. Even when ozone is present at low levels, inhaling it can trigger a variety of health problems including chest pains, coughing, nausea, throat irritation, and congestion. Ozone also can aggravate other medical conditions such as bronchitis, heart disease, emphysema, and asthma, and can reduce lung capacity. People with pre-existing respiratory ailments are especially prone to the effects of ozone. For example, asthmatics affected by ozone may have more frequent or severe attacks during periods when ozone levels are high. Children are at special risk for ozone-related problems. They breathe more air per pound of body weight than adults, and ozone can impact the development of their immature respiratory systems. They tend to be active outdoors during the summer when ozone levels are at their highest. Anyone who spends time outdoors in the summer can be affected, and studies have shown that even healthy adults can experience difficulty in breathing when exposed to ozone. Anyone engaged in strenuous outdoor activities, such as jogging, should limit activity to the early morning or late evening hours on days when ozone levels are expected to be high.

Figure 4-3
Leaf Damage Caused by Ozone

Photos: Gerald Holmes, NCSU Dept. of Horticulture

Ground-level ozone damages plant life and is responsible for 500 million dollars in reduced crop production in the United States each year. It interferes with the ability of plants to produce and store food, making them more susceptible to harsh weather, disease, insects, and other pollutants. It damages the foliage of trees and other plants, sometimes marring the landscape of cities, national parks and forests, and recreation areas. The black areas on the leaves of the watermelon plant, shown in Figure 4-3, are damage caused by exposure to ground-level ozone.

AMBIENT AIR QUALITY STANDARDS

National and state air quality standards for ground-level ozone were first promulgated in 1971. There are both primary standards, which are set to provide public health protection (including protecting the health of sensitive populations such as asthmatics, children, and the elderly), and secondary standards, which are based on welfare effects (such as damage to trees, crops and materials). For ground-level ozone, the primary and secondary National Ambient Air Quality Standards (NAAQS) are the same (see Table 4-1). USEPA must periodically review the NAAQS to determine if they are sufficiently protective of public health based on the latest studies. In 2008 the 0.08 parts per million (ppm) 8-hour average daily maximum ozone NAAQS was changed to 0.075 ppm. There was also a primary 1-hour NAAQS that was revoked in 2008. It is still used for comparison purposes, although not to determine compliance. In October 2015 the 8-hour ozone NAAQS was lowered once again, to 0.070 ppm, effective in 2016.

Compliance with a NAAQS is based on meeting the design value, the actual statistic that determines whether the standard is being met. For ozone, calculating the design value is a two-step process using data from the most recent three years. The first step involves determining the fourth-highest daily maximum 8-hour average concentration for each monitoring site in the state for each of the three years. The values for each site are then used to calculate a three-year average. If this value exceeds the NAAQS at any site in the state, the state is determined to be in nonattainment.

Table 4-1
National and New Jersey Ambient Air Quality Standards for Ozone
Parts per Million (ppm)

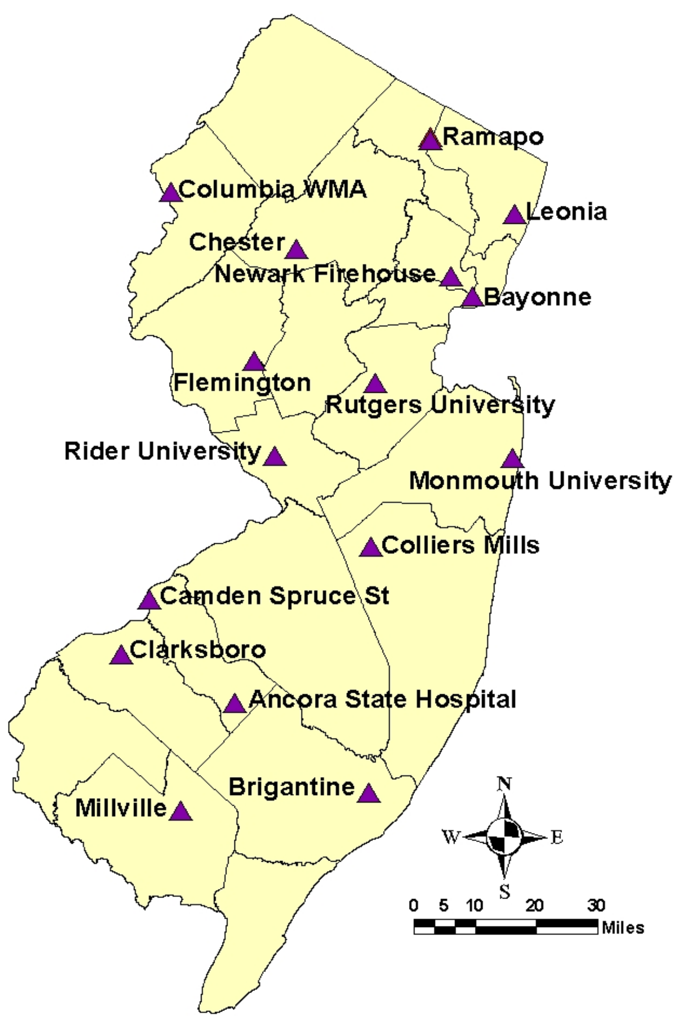
Averaging Period	Type	National	New Jersey
1-Hour	Primary	---	0.12 ppm
8-Hours	Primary & secondary	0.070 ppm	---

OZONE MONITORING NETWORK

Ozone was measured at 16 monitoring stations in New Jersey during 2016 (see Figure 4-5). Of those 16 sites, ten operate year-round and six operate only during the ozone season, which for 2016 was April 1st through October 31st. Bayonne, Brigantine, Camden Spruce Street, Chester, Columbia Wildlife Management Area (WMA), Flemington, Millville, Newark Firehouse, Rider University and Rutgers University operate year-round. Ancora, Clarksboro, Colliers Mills, Leonia, Monmouth University, and Ramapo sites operate only during the ozone season.

There is an ozone monitor at Washington Crossing State Park in Mercer County which is maintained and operated by USEPA. Data from the site is also used in determining New Jersey's NAAQS compliance status, although it is not presented here.

Figure 4-5
2016 Ozone Monitoring Network



OZONE LEVELS IN 2016

During the 2016 ozone season, all 16 New Jersey monitoring sites recorded levels above the 8-hour standard of 0.070 ppm. However, on May 25 and 26 New Jersey ozone concentrations were unusually high because they were impacted by emissions from a huge wildfire in Fort McMurray, Alberta, Canada. Every ozone monitor in the state except Bayonne recorded exceedances of the 8-hour NAAQS on May 25. Two sites even went into the “Unhealthy” range. On May 26, ten sites exceeded the ozone standard.

In May 2017, NJDEP submitted a report to USEPA demonstrating that the emissions from the wildfire influenced New Jersey’s air quality on May 25 and May 26, 2016, and requested that the data from the ozone monitors on those days be excluded from determining New Jersey’s compliance with the ozone NAAQS. The federal Clean Air Act allows for the exclusion of air quality monitoring data that may be influenced by exceptional events, such as large fires, in determining attainment of the NAAQS. USEPA has stated that they concur with the exclusion of the data for all the monitors on May 25, and for ten of the monitors on May 26. Some neighboring states have also requested that USEPA allow exceedances on those days to be excluded from their compliance determinations.

For more information, see www.nj.gov/dep/baqp/ee.html.

Table 4-2 presents all the USEPA-approved 2016 ozone data (May 25 and May 26 exceedances are excluded). Of the 16 monitoring sites that operated during the 2016 ozone season, none recorded levels above the old 1-hour standard of 0.12 ppm. The highest 1-hour concentration was 0.103 ppm, recorded at Ramapo on June 20th. The last time the revoked 1-hour standard was exceeded in New Jersey was in 2010.

The highest daily maximum 8-hour average concentration was 0.081 at Camden Spruce Street on July 22. Seven sites in New Jersey (Camden Spruce Street, Clarksboro, Colliers Mills, Flemington, Leonia, Rider University, and Rutgers University) were above the design value (4th-highest 8-hour daily maximum >0.070 ppm). Figure 4-6 shows the one-hour and eight-hour data for each site. Figure 4-7 presents each site’s 3-year average 8-hour design value for the 2014-2016 period.

The daily maximum 8-hour values for all sites for May 25 and 26 can be found in Table 4-3. The table also shows whether USEPA concurs with the exclusion of the data from the calculation of the 2016 design values.

Table 4-2
2016 Ozone Concentrations in New Jersey
(Excluding 5/25-26/2016 Exceedance Data)
Parts per Million (ppm)

Monitoring Site	1-Hour Daily Maximum	8-Hour Averages		
		Highest Daily Maximum	4th-Highest Daily Maximum	2014-2016 Average of 4th-Highest Daily Max.
Ancora	0.092	0.076	0.064	0.068
Bayonne	0.090	0.074	0.068	0.072
Brigantine	0.077	0.068	0.063	0.064
Camden Spruce St.	0.091	0.081	0.076	0.074
Chester	0.092	0.072	0.068	0.068
Clarksboro	0.101	0.079	0.074	0.073
Colliers Mills	0.095	0.077	0.071	0.072
Columbia	0.085	0.072	0.065	0.063
Flemington	0.088	0.078	0.073	0.070
Leonia	0.095	0.077	0.073	0.074
Millville	0.081	0.070	0.068	0.067
Monmouth University	0.090	0.073	0.068	0.069
Newark Firehouse	0.094	0.071	0.068	0.070
Ramapo	0.103	0.079	0.068	0.068
Rider University	0.094	0.076	0.071	0.071
Rutgers University	0.093	0.078	0.075	0.074

Table 4-3
2016 Ozone Concentrations in New Jersey
Daily Maximum 8-Hour Values for 5/25-26/2016
Parts per Million (ppm)

Monitoring Site	May 25		May 26	
	Concen-tration	Excluded	Concen-tration	Excluded
Ancora	0.076	Yes	0.064	No
Bayonne	0.069	Yes	0.076	Yes
Brigantine	0.079	Yes	0.062	No
Camden Spruce St.	0.078	Yes	0.068	No
Chester	0.083	Yes	0.086	Yes
Clarksboro	0.083	Yes	0.070	No
Colliers Mills	0.090	Yes	0.070	No
Columbia	0.076	Yes	0.073	Yes
Flemington	0.083	Yes	0.088	Yes
Leonia	0.086	Yes	0.085	Yes
Millville	0.081	Yes	0.069	No
Monmouth University	0.081	Yes	0.065	No
Newark Firehouse	0.081	Yes	0.077	Yes
Ramapo	0.079	Yes	0.081	Yes
Rider University	0.082	Yes	0.082	Yes
Rutgers University	0.084	Yes	0.086	Yes

Figure 4-6
2016 Ozone Concentrations in New Jersey
(Excluding 5/25-26/2016 Exceedance Data), Parts per Million (ppm)

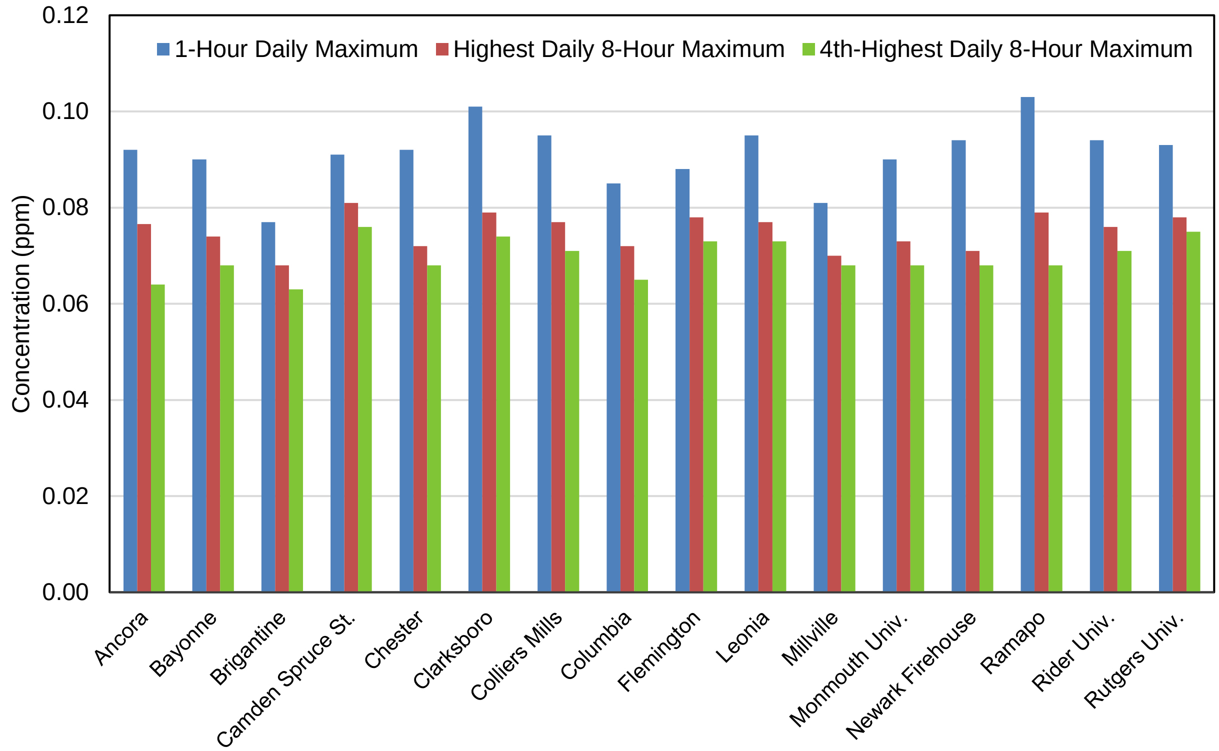
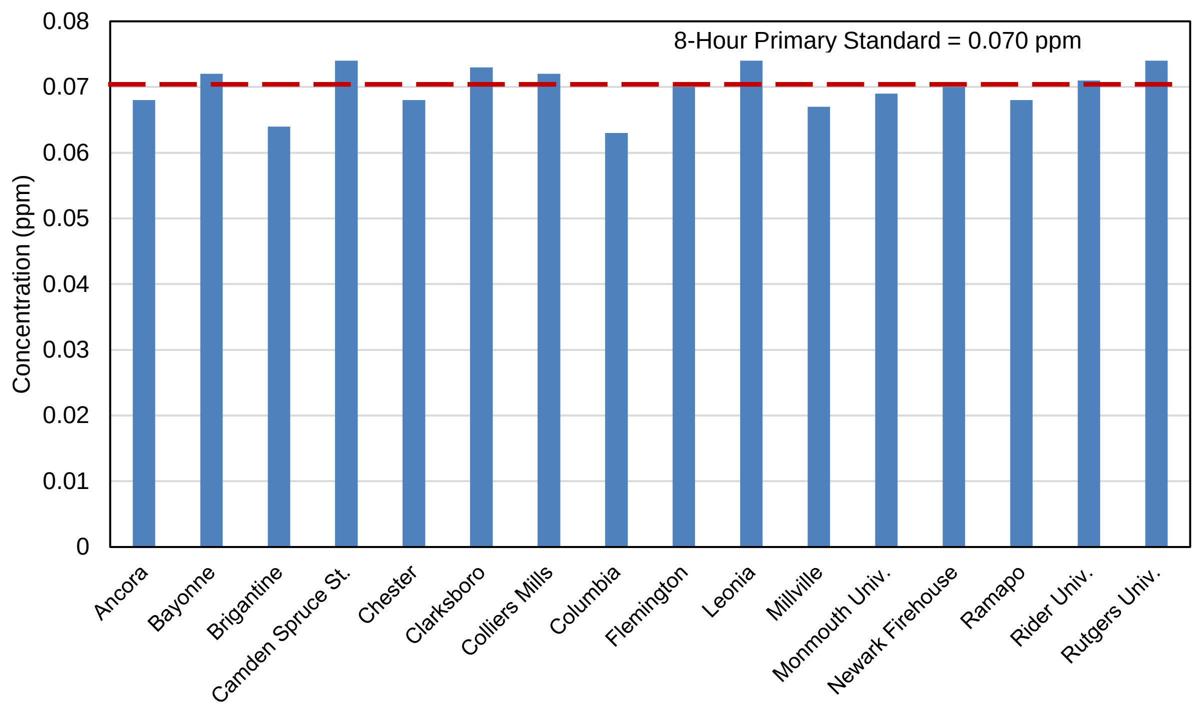


Figure 4-7
New Jersey Ozone Design Values for 2014-2016
3-Year Average of the 4th Highest Daily Maximum 8-Hour Average
(Excluding 5/25-26/2016 Exceedance Data), Parts per Million (ppm)



OZONE TRENDS

Studies have shown that in order to lower ground-level ozone concentrations, emissions of VOCs and NOx must be reduced. Over the past couple of decades, this effort has resulted in a relatively steady decrease in ozone levels in New Jersey. The chart in Figure 4-8 shows the fourth-highest statewide 8-hour maximum average concentration recorded each year since 1986. In 2016, the value was 0.076 ppm. In 2016, the design value (three-year average of the 4th-highest maximum daily 8-hour concentration at any site) was 0.074 ppm, as shown in Figure 4-9. This exceeds the 0.070 ppm NAAQS, but is an improvement over earlier design values. Ozone levels in New Jersey are greatly impacted by emissions from upwind sources in other states, so the effort to reduce VOC and NOx emissions must be implemented in regions beyond our state borders.

Figure 4-8
Ozone Concentrations in New Jersey, 1997-2016
4th-Highest Daily Maximum 8-Hour Averages
(Excluding 5/25-26/2016 Exceedance Data), Parts per Million (ppm)

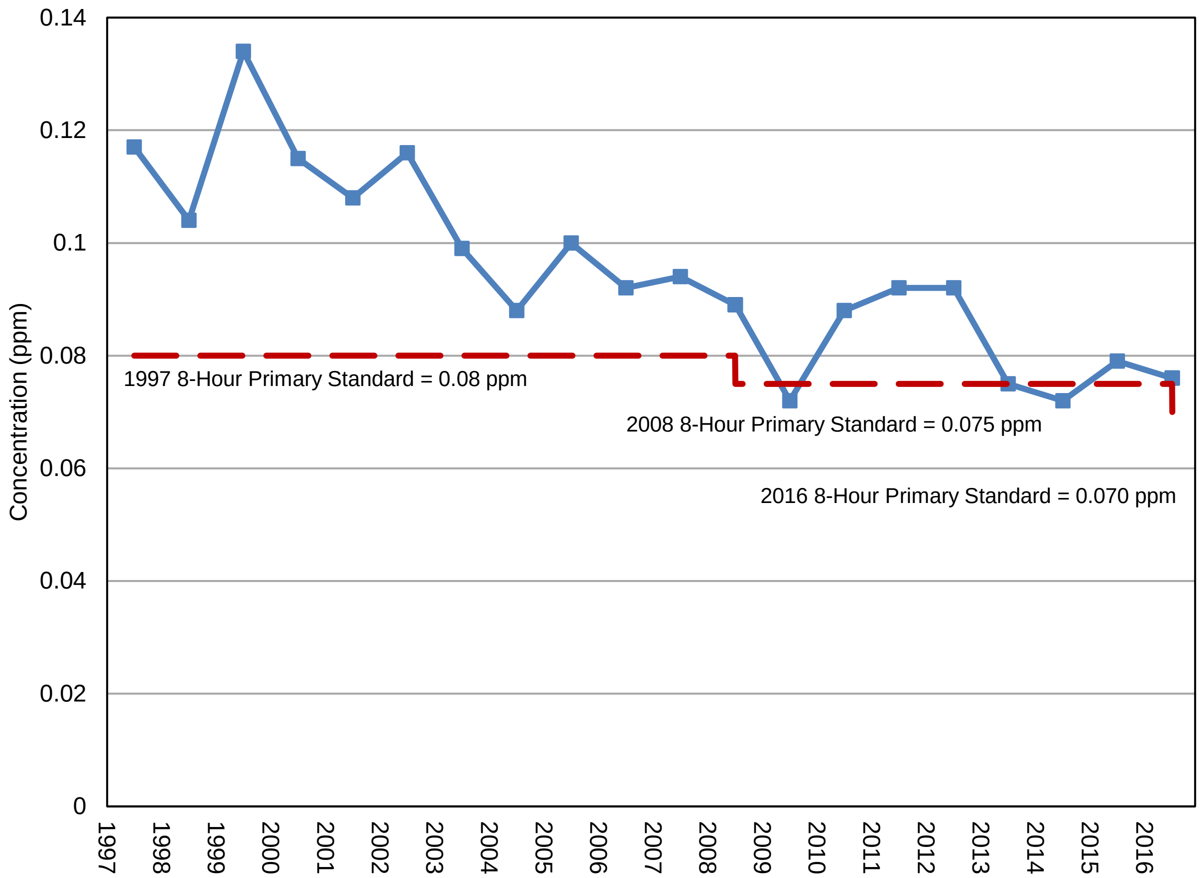
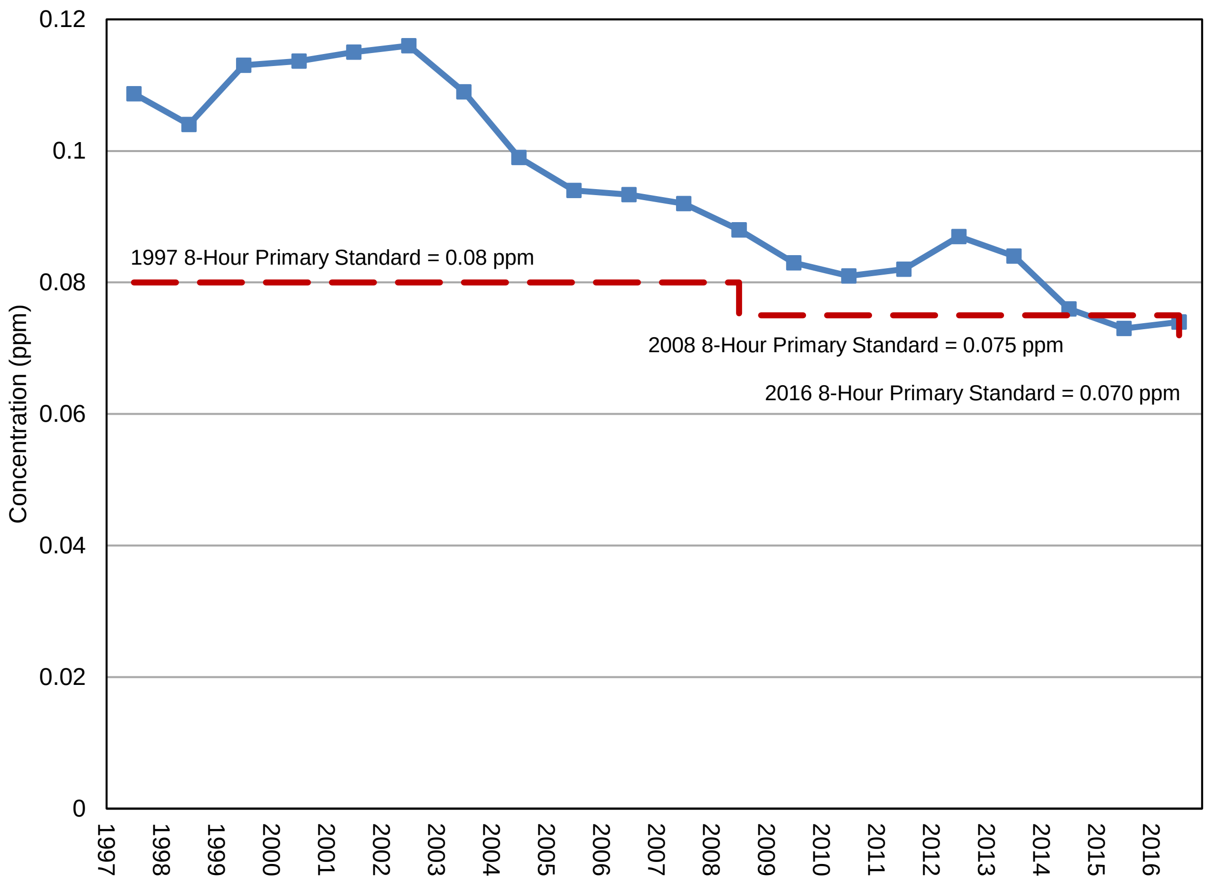


Figure 4-9
Ozone Design Values in New Jersey, 1990-2016
3-Year Average of 4th-Highest Daily Maximum 8-Hour Average Concentration
(Excluding 5/25-26/2016 Exceedance Data), Parts per Million (ppm)

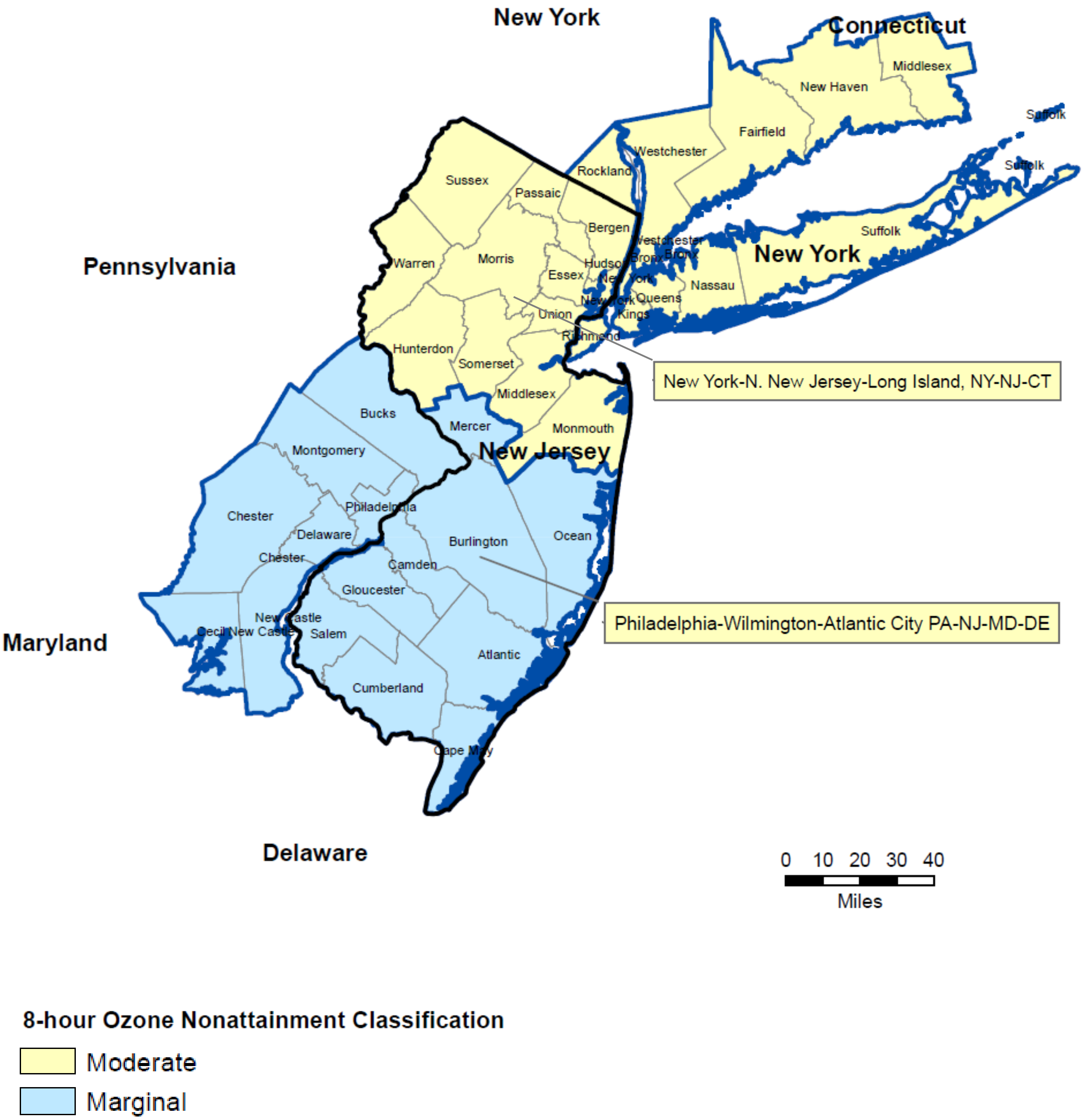


Ozone Nonattainment Areas in New Jersey

The Clean Air Act requires that all areas of the country be evaluated for attainment or nonattainment for each of the NAAQS. The 1990 amendments to the Clean Air Act required that areas be further classified based on the severity of nonattainment. The classifications range from “marginal” to “extreme” and are based on the design values that determine whether an area meets the standard.

The state of New Jersey has been in nonattainment for the ozone NAAQS with the northern part of the state classified as being “moderate” and the southern part of the state classified as being “marginal.” New Jersey’s current classification with respect to the 2008 8-hour standard is shown in Figure 4-10.

Figure 4-10
New Jersey 8-Hour Ozone Nonattainment Areas



Source: www3.epa.gov/airquality/greenbook/map/nj8_2008.pdf

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2016 Particulate Matter Summary

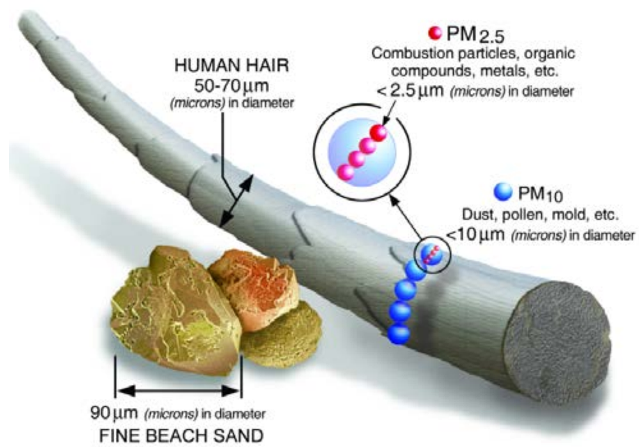
New Jersey Department of Environmental Protection

SOURCES

Particulate air pollution is a complex mixture of organic and inorganic substances in the atmosphere, present as either liquids or solids. Particulates may be as large as 70 microns in diameter or smaller than 1 micron in diameter. Most particulates are small enough that individual particles are undetec by the human eye. Particulates may travel hundreds of miles from their original sources, suspended in the atmosphere, before falling to the ground.

Particulate pollution is categorized by size. Particulates with diameters of 2.5 micrometers (or microns) or less are considered "fine particulate matter," referred to as $PM_{2.5}$ (Figure 5-1). Particulates with diameters of 10 microns or less are considered to be "inhalable particulate matter," or "coarse particulate matter," and are referred to as PM_{10}. "Total suspended particulates" (TSP) refers to all suspended particulates, including the largest ones.

Figure 5-1
Size Comparisons for PM Particles



USEPA. www.epa.gov/pm-pollution

Particulates can occur naturally or can be man-made. Examples of naturally-occurring particles are windblown dust and sea salt. Man-made particulates, which come from sources such as fossil fuel combustion and industrial processes, can be categorized as either primary particulates or secondary particulates. Primary particulates are directly emitted from their sources, while secondary particulates form in the atmosphere through reactions of gaseous emissions.

HEALTH AND ENVIRONMENTAL EFFECTS

The size of particles is directly linked to their potential for causing health problems. Fine particles ($PM_{2.5}$) pose the greatest health risk. They can get deep into the lungs and some may even get into the bloodstream. Exposure to these particles can affect a person's lungs and heart. They can lead to premature death in people with heart or lung disease, can cause nonfatal heart attacks, decrease lung function, and aggravate asthma. Coarse particles ($PM_{10-2.5}$) are of less concern, although they are inhalable and can irritate a person's eyes, nose, and throat.

Particulates of all sizes have an impact on the environment. PM is the major cause of reduced visibility in many parts of the United States. Figure 5-2a provides an example of reduced visibility due to particulate pollution, recorded by the Camnet visibility camera in Newark (www.hazecam.net) which focuses on the New York City skyline. Figure 5-2b is an example of a day with low particulate pollution and good visibility. Airborne particles can also impact vegetation and aquatic ecosystems, and can cause damage to paints and building materials.

Figure 5-2a.

Figure 5-2b.

AMBIENT AIR QUALITY STANDARDS

The U.S. Environmental Protection Agency (USEPA) first established National Ambient Air Quality Standards (NAAQS) for particulate matter in 1971. It set primary (health-based) and secondary (welfare-based) standards for total suspended particulate (TSP), which included PM up to about 25 to 45 micrometers. Over the years, new health data shifted the focus toward smaller and smaller particles. In 1987, USEPA replaced the TSP standards with standards for PM_{10}. The 24-hour PM_{10} primary and secondary standards were set at 150 µg/m^3. Ten years later, USEPA began regulating $PM_{2.5}$. The annual $PM_{2.5}$ primary and secondary standards were set at 15.0 µg/m^3 until 2013, when the primary annual standard was lowered to 12.0 µg/m^3. A 24-hour $PM_{2.5}$ standard of 65 µg/m^3.was promulgated in 1997, then lowered in 2006 to 35 µg/m^3. Table 5-1 provides a summary of the current particulate matter standards.

Compliance with the standards is determined by calculating a statistic called the design value. For the annual $PM_{2.5}$ NAAQS, the design value is the highest statewide 3-year average of each site's annual average concentrations. For the 24-hour NAAQS, the 98th percentile of the 24-hour concentrations for each monitoring site must be averaged for the three most recent years. The highest site's value is the state's design value. For PM_{10}, the design value is the second-highest 24-hour average concentration in a given year.

Table 5-1
National Ambient Air Quality Standards for Particulate Matter
Micrograms Per Cubic Meter (µg/m^3)

Pollutant	Averaging Period	Type	Level
Fine Particulate ($PM_{2.5}$)	Annual	Primary	12.0 µg/m^3
	Annual	Secondary	15.0 µg/m^3
	24-Hours	Primary & Secondary	35 µg/m^3
Inhalable Particulate (PM_{10})	24-Hours	Primary & Secondary	150 µg/m^3

PARTICULATE MONITORING NETWORK

The New Jersey Department of Environmental Protection (NJDEP) Particulate Monitoring Network consists of twenty-one $PM_{2.5}$ monitoring sites and three PM_{10} monitoring sites. Criteria pollutant monitors must meet strict USEPA requirements in order to determine compliance with the NAAQS. NJDEP uses three different types of particulate monitors.

Seventeen $PM_{2.5}$ sites and the three PM_{10} sites use filter-based samplers, which pull a predetermined amount of air through $PM_{2.5}$ or PM_{10} size-selective inlets for a 24-hour period. The filters are weighed before and after sampling under controlled environmental conditions to determine the concentration of the captured particles. This filter-based method has for years been designated as the Federal Reference Method (FRM) for particulate matter compliance determination.

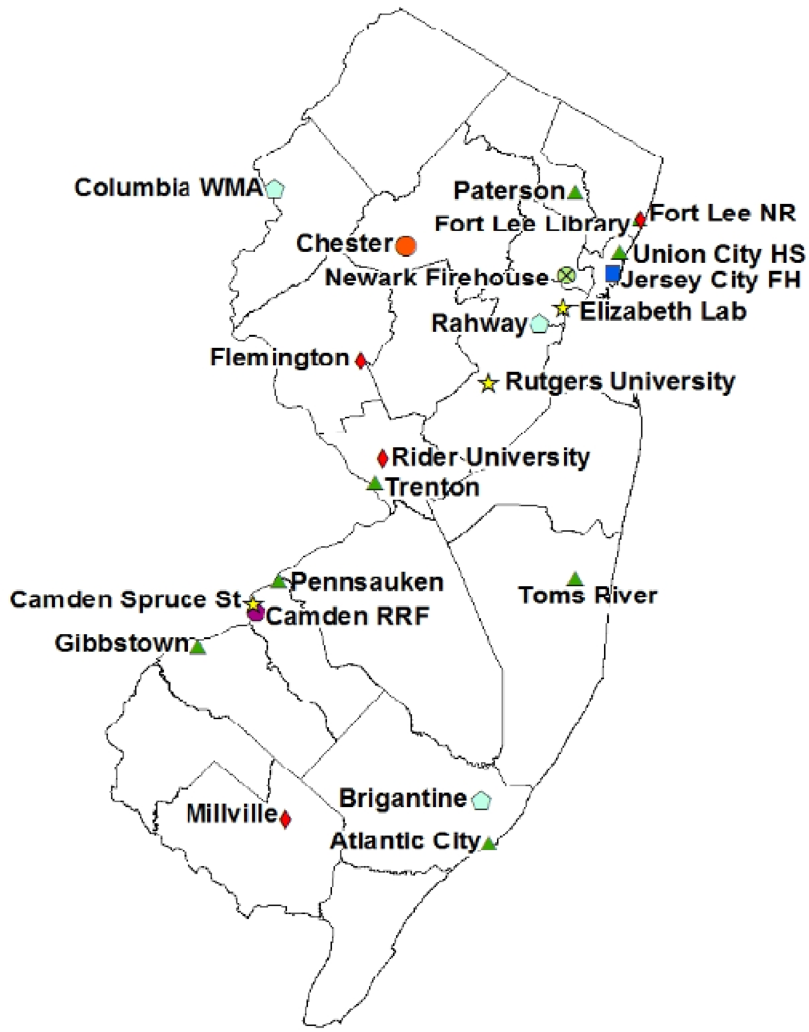
In order to provide real-time hourly data to the public (through the Air Quality Index at www.njaqinow.net), NJDEP has also been using particulate monitors that operate continuously. These monitors are classified by USEPA as Federal Equivalent Methods (FEM) for $PM_{2.5}$, and can also be used to determine compliance with the NAAQS. Eleven sites in New Jersey use Beta Attenuation Monitors (BAM), which measure the loss of intensity (attenuation) of beta particles due to absorption by $PM_{2.5}$ particles collected on a filter tape. One site, Rahway, uses a Tapered Element Oscillating Microbalance (TEOM) analyzer. TEOM analyzers collect a sample of $PM_{2.5}$ on an oscillating filter and determine the concentration based on the change in the frequency at which the filter oscillates. TEOM monitors are being phased out in New Jersey.

At one time, the NJDEP PM_{10} monitoring network consisted of more than twenty sampling sites. Due to many years of low concentrations and the shift in emphasis to $PM_{2.5}$ monitoring, the network has been reduced to only three sites, the Camden Resource Recovery Facility (RRF), Jersey City Firehouse, and Newark Firehouse. PM_{10} samples are taken once every six days at Camden and Jersey City, and every three days at Newark.

Five monitoring stations are part of the national Chemical Speciation Network (CSN). They use a separate 24-hour filter-based $PM_{2.5}$ sampler to determine the concentrations of the chemical analytes that make up the particle sample. The sample is collected on three types of filter media which are subsequently analyzed using ion chromatography (IC), X-ray fluorescence (XRF), and Thermal Optical Transmittance (TOT). CSN sampling was moved from the now-shuttered New Brunswick site to the Rutgers University site in July 2016. The other sites in the network are Camden Spruce Street, Chester, Elizabeth Lab and Newark Firehouse. CSN data can be found in Appendix B of the Air Quality Summaries.

Figure 5-3 shows the locations of all the particulate monitors in New Jersey.

Figure 5-3
2016 Particulate Monitoring Network



Particulate Network

- ▲ PM2.5 Filter
- ♦ PM2.5 Continuous
- ⬠ PM2.5 Filter & PM2.5 Continuous
- ☆ PM2.5 Filter, PM2.5 Continuous & Speciation
- ● PM2.5 Filter & Speciation
- ⊗ PM2.5 Filter, PM2.5 Continuous, Speciation & PM10
- ■ PM2.5 Filter, PM2.5 Continuous & PM10
- ⬢ PM10

FINE PARTICLE ($PM_{2.5}$) LEVELS IN 2016

$PM_{2.5}$ LEVELS FOR FILTER-BASED FRM MONITORS

The annual mean concentrations of $PM_{2.5}$ measured by the seventeen filter-based FRM samplers ranged from 5.99 $\mu g/m^3$ at the Chester monitoring site to 9.40 $\mu g/m^3$ at the Camden Spruce Street monitoring site. The highest 24-hour concentrations ranged from 15.6 $\mu g/m^3$ at Chester to 33.6 $\mu g/m^3$ at Camden Spruce Street. Table 5-2 shows the 2016 annual mean, highest 24-hour and 98^{th} percentile 24-hour concentrations, as well as the number of valid samples collected. Four sites (Elizabeth Lab, Jersey City Firehouse, Toms river and Trenton) operate every day. The other thirteen sites (Atlantic City, Brigantine, Camden Spruce Street, Chester, Columbia, Fort Lee Library, Gibbstown, Newark Firehouse, Paterson, Pennsauken, Rahway, Rutgers University, and Union City High School) take a sample every third day. Figures 5-4 and 5-5 show the annual mean concentrations and the 98^{th} percentile 24-hour average concentrations for all the sites in 2016. In 2016, no sites were in violation of either the annual standard of 12.0 $\mu g/m^3$ or the 24-hour standard of 35 $\mu g/m^3$.

Table 5-2
2016 $PM_{2.5}$ Concentrations in New Jersey
Annual and 24-Hour Averages (FRM)
Micrograms Per Cubic Meter ($\mu g/m^3$)

Monitoring Site	Number of Samples	Annual Mean Concentration	Highest 24-Hour Concentration	98^{th}%-ile 24-Hour Concentration
Atlantic City	115	7.18	20.7	15.1
Brigantine	118	6.54	17.3	14.2
Camden Spruce Street	113	9.40	33.6	24.0
Chester	117	5.99	15.6	12.5
Columbia	117	7.43	22.5	17.8
Elizabeth Lab	340	9.07	29.9	19.6
Fort Lee Library	120	8.10	21.8	19.0
Gibbstown	112	7.44	21.9	15.2
Jersey City Firehouse	352	7.99	29.3	17.6
Newark Firehouse	114	8.31	28.0	17.4
Paterson	111	7.39	21.0	16.1
Pennsauken	118	8.13	24.0	17.0
Rahway	110	7.87	20.5	17.3
Rutgers University	110	7.33	16.3	16.2
Toms River	348	6.64	28.8	15.5
Trenton Library	352	7.27	22.1	16.7
Union City High School	117	8.50	28.5	19.0

Figure 5-4
2016 $PM_{2.5}$ Concentrations in New Jersey
Annual Averages (Filter-Based Monitors)
Micrograms Per Cubic Meter (µg/m³)

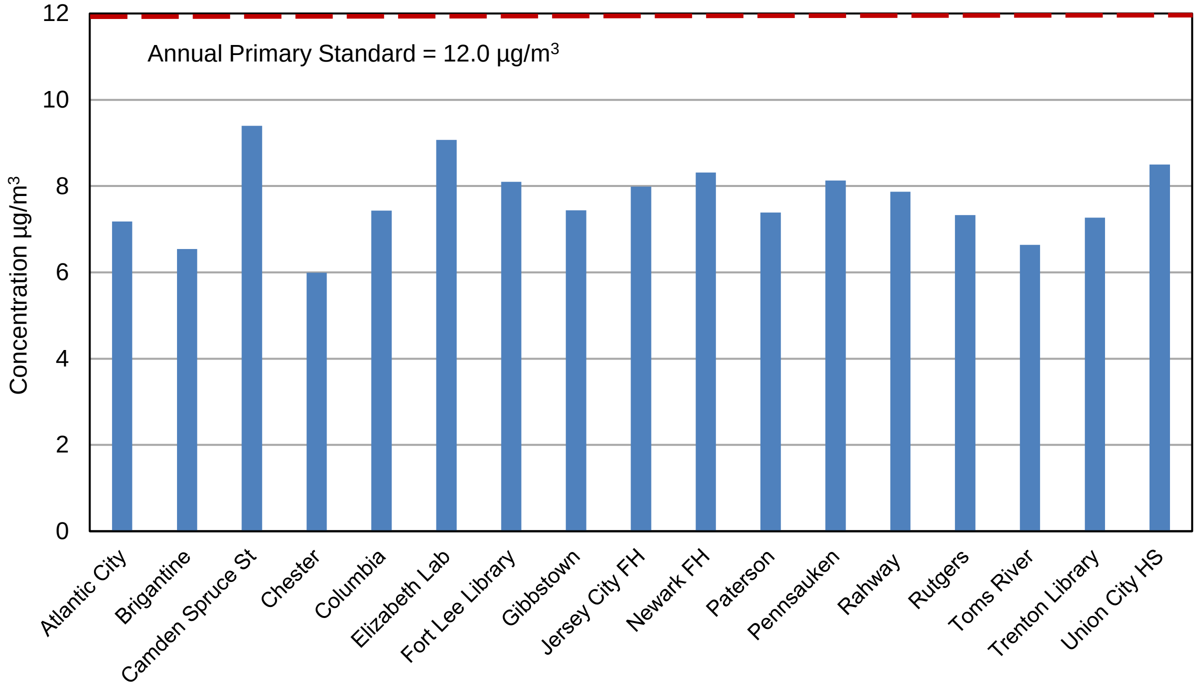
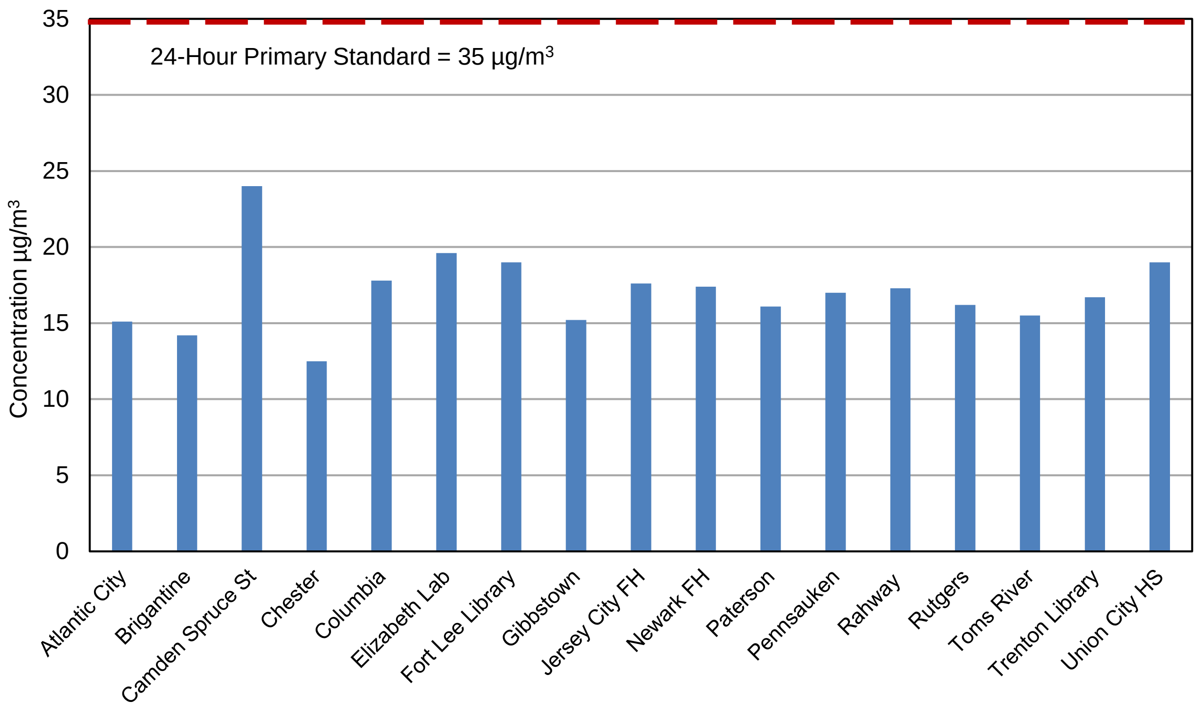


Figure 5-5
2016 $PM_{2.5}$ Concentrations in New Jersey
98th Percentile of 24-Hour Averages (Filter-Based Monitors)
Micrograms Per Cubic Meter (µg/m³)



$PM_{2.5}$ LEVELS FOR CONTINUOUS FEM MONITORS

New Jersey's continuous $PM_{2.5}$ monitoring network consists of twelve sites: Brigantine, Camden Spruce Street, Columbia, Elizabeth Lab, Flemington, Fort Lee Near Road, Jersey City Firehouse, Millville, Newark Firehouse, Rahway, Rider University, and Rutgers University. One-minute readings are transmitted to a central computer in Trenton, where they are averaged every hour and automatically updated on the NJDEP website at www.njaqinow.net. Table 5-3 presents the annual mean, highest 24-hour, and 98th percentile 24-hour values from these sites for 2016. Figures 5-6 and 5-7 show the annual means and the 98th percentile 24-hour averages. Although there was an exceedance of the 24-hour standard at the Fort Lee Near Road monitor on March 9 (39.3 µg/m^3), this did not contribute to a violation of the NAAQS because the 98th percentile value (design value) for the site was 21.7 µg/m^3.

Table 5-3
2016 $PM_{2.5}$ Concentrations in New Jersey
Annual and 24-Hour Averages (Continuous Monitors)
Micrograms Per Cubic Meter (µg/m^3)

Monitoring Site	Annual Mean Concentration	Highest 24-Hour Concentration	98th%-ile 24-Hour Concentration
Brigantine	6.76	19.7	15.9
Camden Spruce Street	10.03	33.9	22.9
Columbia	9.37	31.0	21.4
Elizabeth Lab	10.08	28.1	21.1
Flemington	8.48	19.5	17.1
Fort Lee Near Road	10.09	39.3	21.7
Jersey City Firehouse	9.50	33.6	19.2
Millville	7.83	19.8	17.6
Newark Firehouse	8.73	26.3	18.4
Rahway	8.8	22.7	18.5
Rider University	8.62	23.9	16.7
Rutgers University	8.29	28.3	18.4

Figure 5-6
2016 $PM_{2.5}$ Concentrations in New Jersey
Annual Averages from Continuous Monitors
Micrograms Per Cubic Meter (µg/m³)

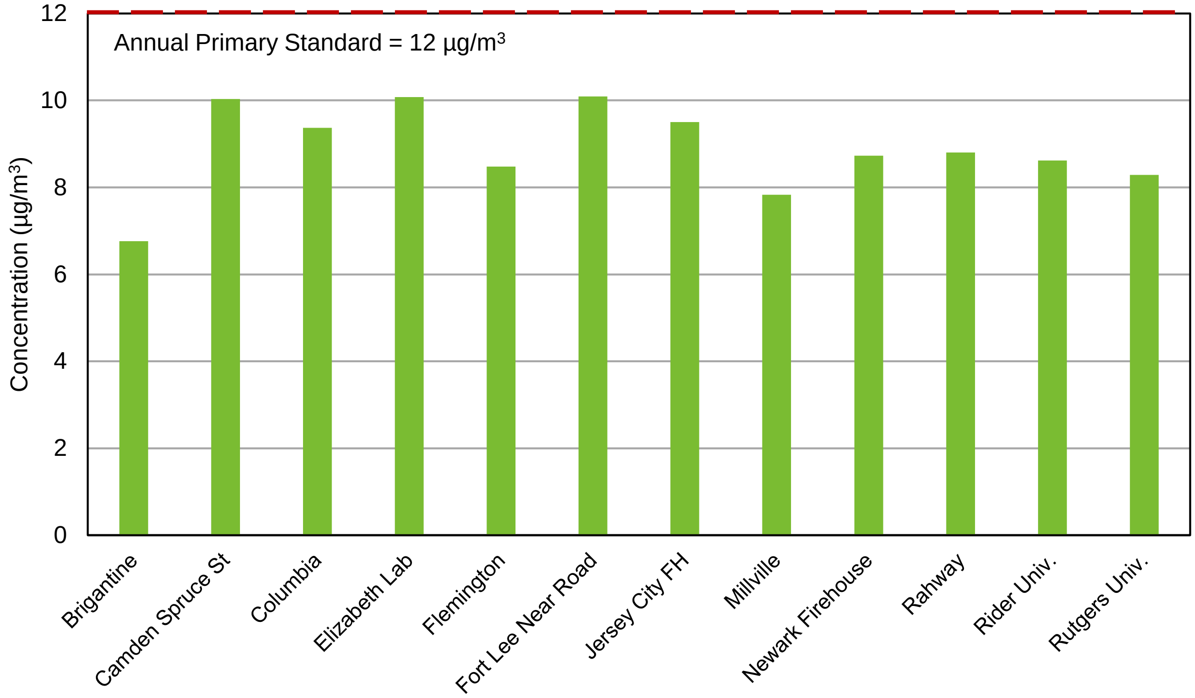
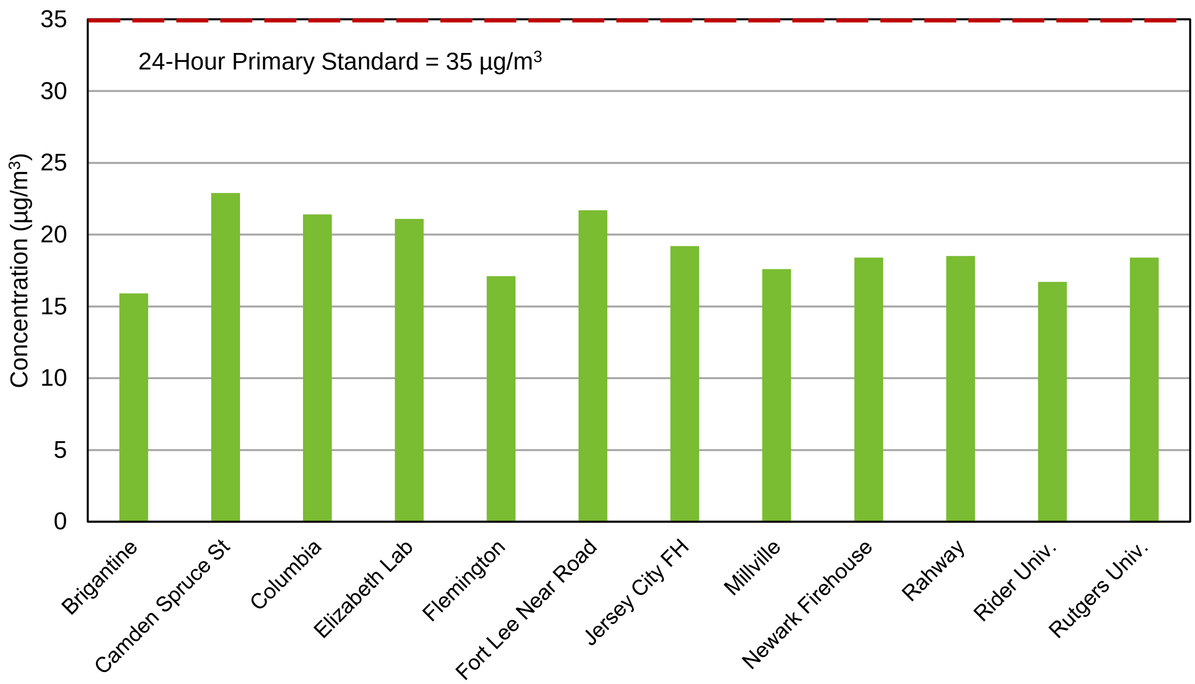


Figure 5-7
2016 $PM_{2.5}$ Concentrations in New Jersey
98th Percentile 24-Hour Averages from Continuous Monitors
Micrograms Per Cubic Meter (µg/m³)



PM2.5 DESIGN VALUES

Figures 5-8 and 5-9 show the design values for each of the New Jersey monitors, as determined by USEPA. Some sites have both a filter-based FRM monitor and a continuous FEM monitor. At sites with both FRM and FEM monitors, the data from the FRM monitor takes precedence, and data from the FEM monitor is included in calculating the design value when the FRM data is missing. Six sites are omitted from these graphs because USEPA does not have three years of data for them. Flemington, Rutgers University, and Union City High School began measuring $PM_{2.5}$ in 2016. Millville and Rider University data was not submitted to USEPA until 2016, and the Fort Lee Near Road $PM_{2.5}$ monitor began operating in 2015.

Figure 5-8
New Jersey $PM_{2.5}$ Design Values for 2014-2016
3-Year Average of the Annual Average Concentrations
Micrograms Per Cubic Meter (µg/m³)

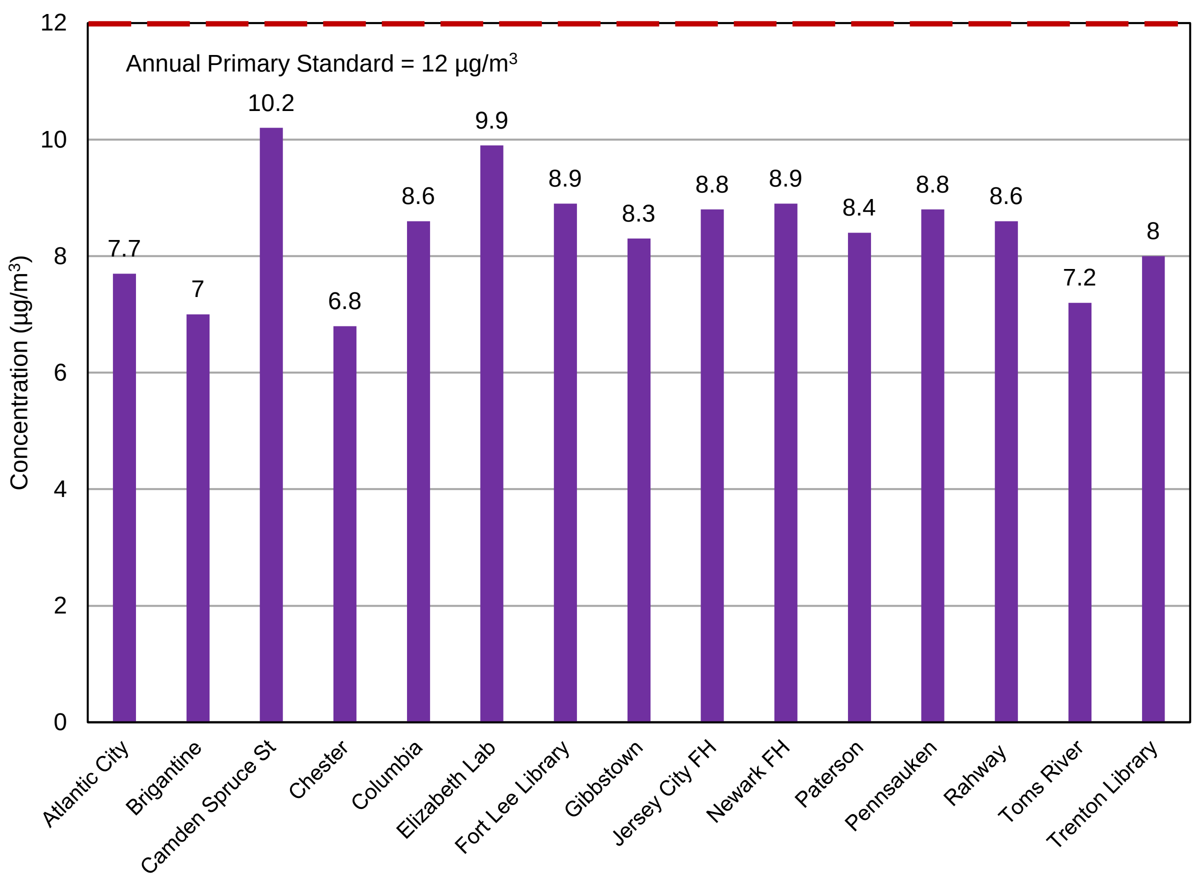
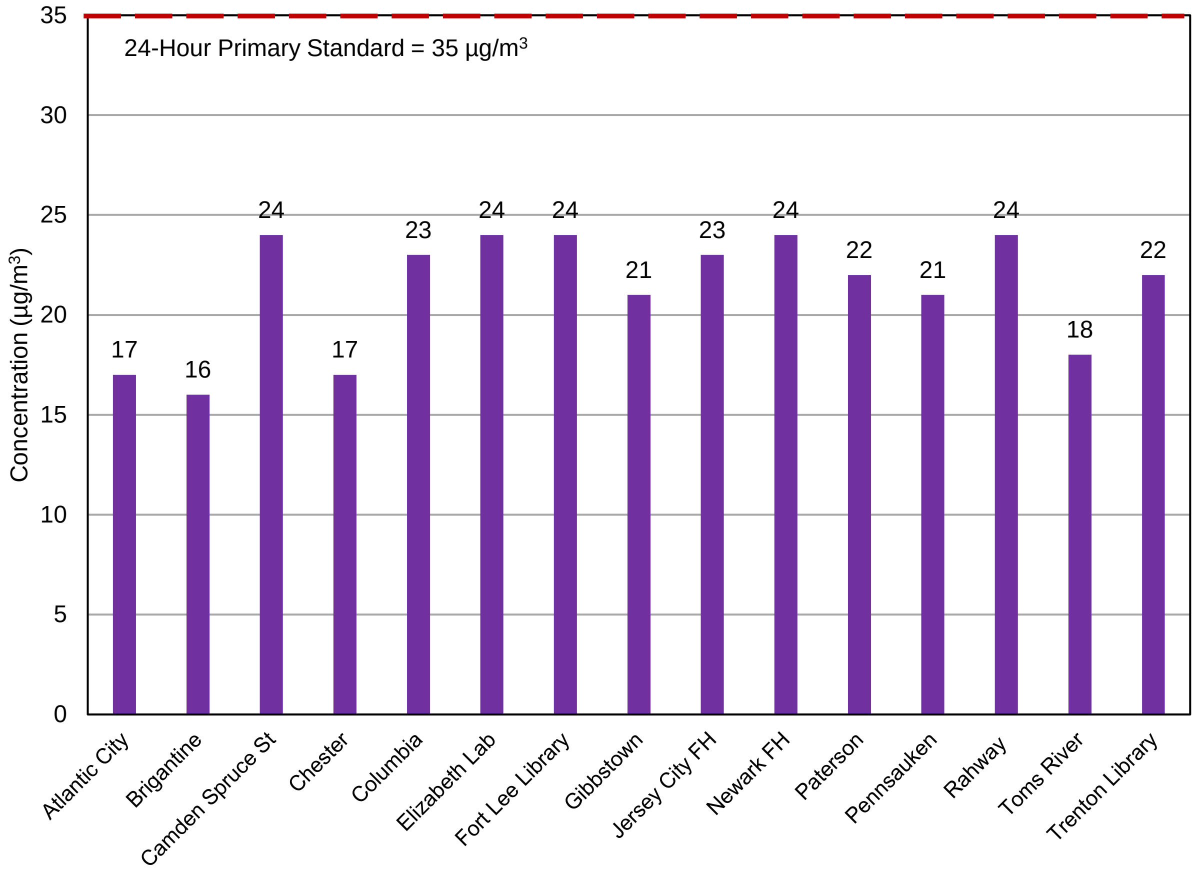


Figure 5-9
New Jersey $PM_{2.5}$ Design Values for 2014-2016
3-Year Average of the 98th Percentile of the 24-Hour Average Concentrations
Micrograms Per Cubic Meter (µg/m³)



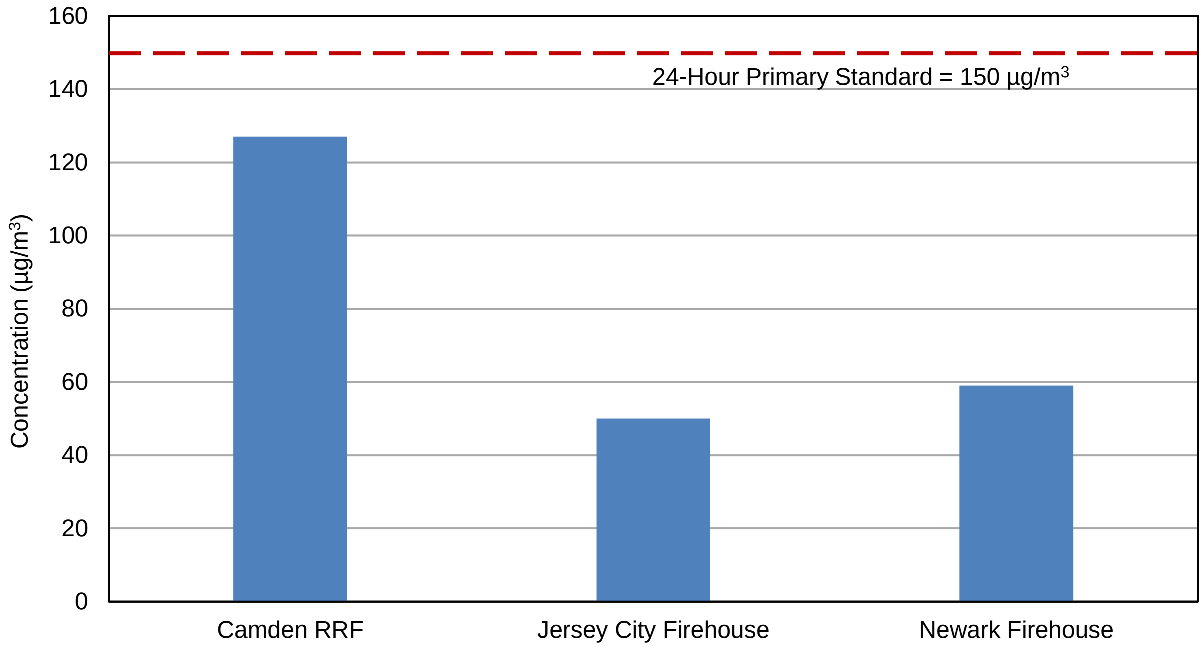
INHALABLE PARTICULATE (PM_{10}) LEVELS IN 2016

Table 5-4 shows 2016 values for each of the New Jersey PM_{10} monitors. The highest and second-highest 24-hour concentrations, as well as the annual average, are presented. All areas of the state are in attainment for the 24-hour standard of 150 µg/m³, as can be seen in Figure 5-10. In 2016, the highest PM_{10} values were measured at the Camden RRF site. Major road construction activities nearby may have contributed to the elevated PM_{10} levels.

Table 5-4
2016 PM_{10} Concentrations in New Jersey
24-Hour and Annual Averages
Micrograms Per Cubic Meter (µg/m³)

Monitoring Site	Number of Samples	24-Hour Averages		Annual Mean
		Highest	Second-Highest	
Camden RRF	58	127	113	39
Jersey City Firehouse	57	50	32	16
Newark Firehouse	114	59	45	14

Figure 5-10
2016 PM_{10} Concentrations in New Jersey
Maximum 24-Hour Averages
Micrograms per Cubic Meter (µg/m³)



PARTICULATE TRENDS

The $PM_{2.5}$ monitoring network has been in place since 1999. Figures 5-11 and 5-12 show the trend in the design values (3-year averages) since then. Seventeen years of data show a noticeable decline in fine particulate concentrations.

Figure 5-11
$PM_{2.5}$ Design Value Trend in New Jersey, 2001-2016
3-year Average of the Annual Average Concentrations
Micrograms per Cubic Meter (µg/m³)

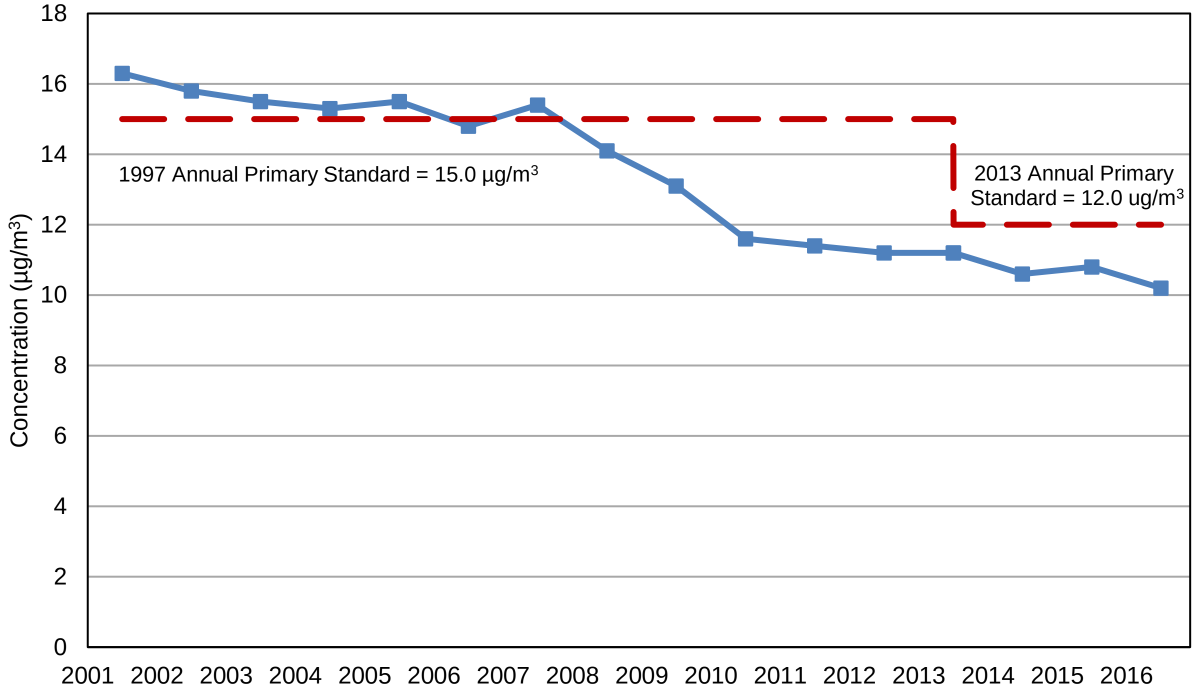
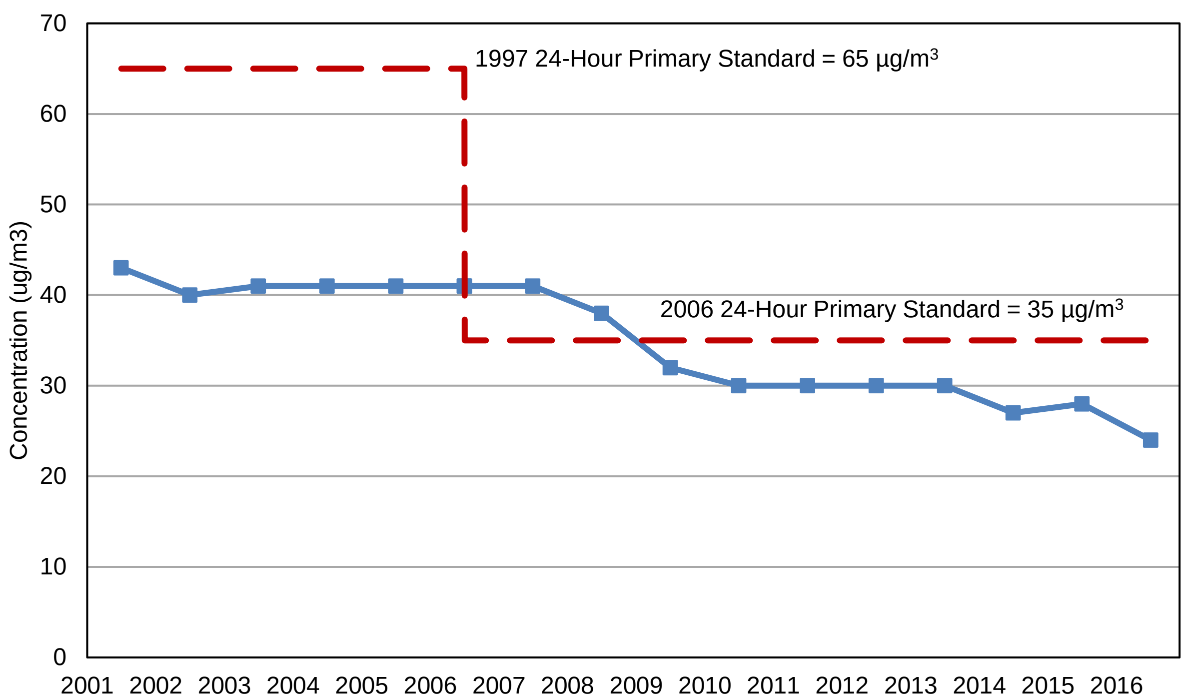


Figure 5-12
$PM_{2.5}$ Design Value Trend in New Jersey, 2001-2016
3-year Average of the 98th Percentile 24-Hour Average Concentrations
Micrograms per Cubic Meter (µg/m³)



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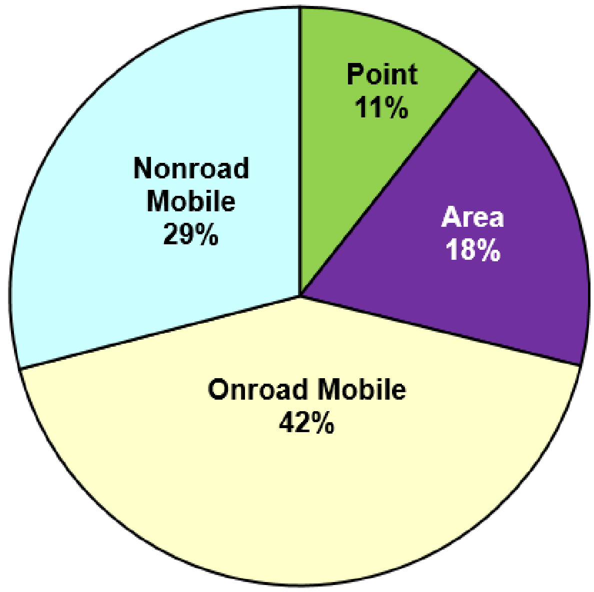
2016 Nitrogen Dioxide Summary

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 in 2017 is shown in Figure 6-1. 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 6-2.

Figure 6-1
2017 New Jersey NOx Projected Emissions



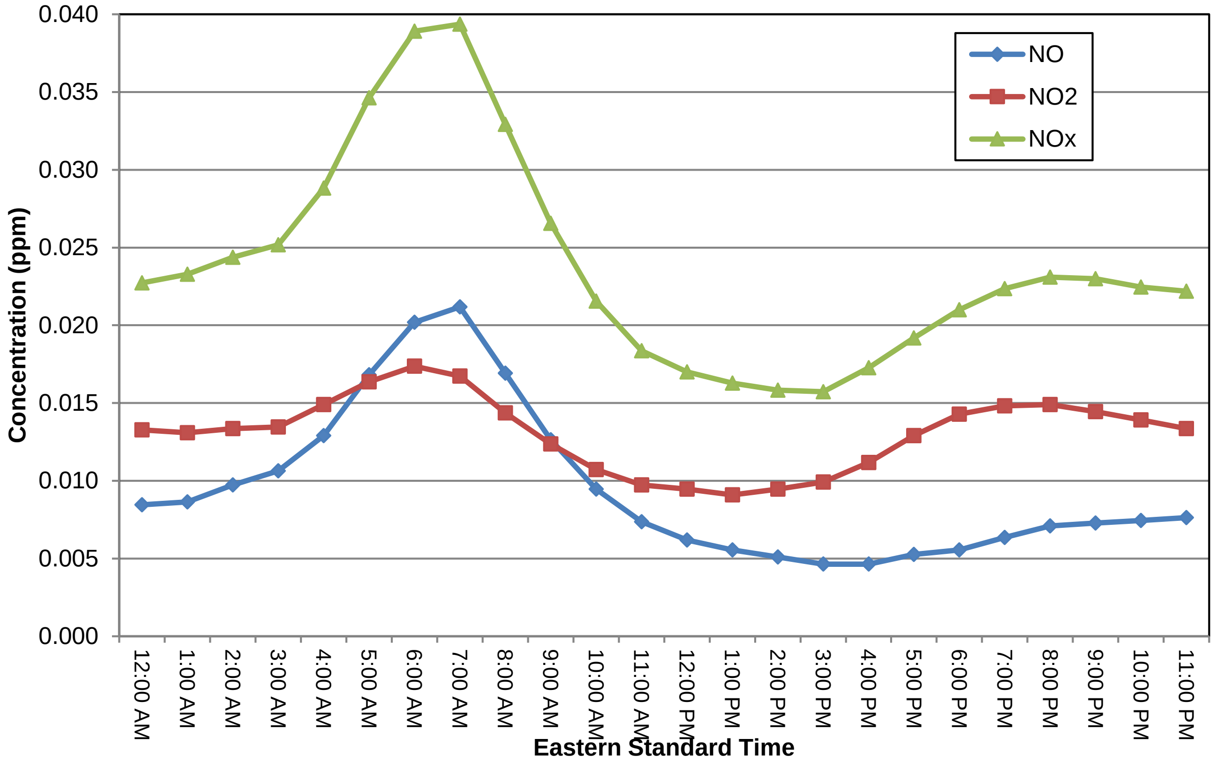
Inventory Source: MARAMA 2017 BETA2

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 6-2
2016 Nitrogen Oxides Concentrations in New Jersey
1-Hour Average Hourly Variation
Parts per Million (ppm)



Ambient Air Quality Standards

There are two types of National Ambient Air Quality Standards (NAAQS) established by the U.S. Environmental Protection Agency (USEPA). Primary standards are set to provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. The primary and secondary annual 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 (µg/m^3) are the standard units and the averaging time is any 12-month period (a rolling average) instead of a calendar year. In 2010, a 1-hour NO_2 NAAQS of 0.100 ppm was established. Table 6-1 provides a summary of the NO_2 standards.

Table 6-1
National and New Jersey Ambient Air Quality Standards for Nitrogen Dioxide (NO_2)
Micrograms per Cubic Meter (µg/m^3)
Parts per Million (ppm)
Parts per Billion (ppb)

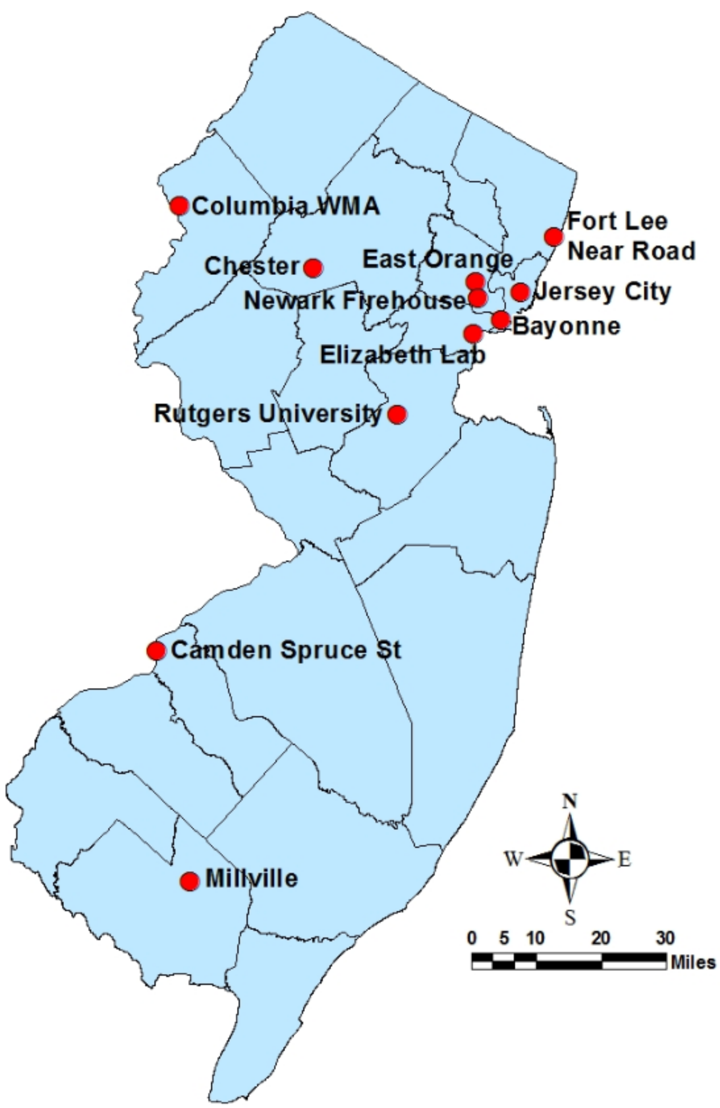
Averaging Period	Type	National	New Jersey
12-Month	Primary & secondary	---	100 µg/m^3 (0.053 ppm)
Annual	Primary & secondary	53 ppb (0.053 ppm)	---
1-Hour	Primary	100 ppb (0.100 ppm)	---

A state or other area is in compliance with a NAAQS when it meets the design value. For the annual standard, the annual average is the design value. However, for the 1-hour NO_2 standard, the NAAQS is met 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 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.

NO_2 MONITORING NETWORK

NJDEP monitored NO_2 levels at 11 locations in 2016. These sites are shown in Figure 6-3. The East Orange monitoring station was shut down in July 2016, because of duplication of efforts. The Millville NOx monitor was temporarily shut down, from February to late June. The Jersey City NOx monitor was added in January 2016.

Figure 6-3
2016 Nitrogen Dioxide Monitoring Network



NO_2 LEVELS IN 2016

None of New Jersey's monitoring sites exceeded the annual or 1-hour NO_2 NAAQS in 2016. Newark Firehouse had the highest daily maximum 1-hour concentration at 0.095 ppm (see Table 6-2). The 98th percentile values are given in Table 6-2 and Figure 6-4 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 2014-2016 design value for each site is given in Table 6-2 and Figure 6-5. The site with the highest design value for 2014-2016 was Elizabeth Lab, with 0.065 ppm. The three-year averages for East Orange, Fort Lee Near Road, Jersey City, Millville, and Rutgers University stations could not be calculated because of incomplete data for certain years (see Table 6-2 footnotes).

The highest running 12-month average concentration of NO_2 was 0.023 ppm at the Jersey City site, located in the Journal Square section of Jersey City. The highest calendar-year average NO_2 concentration of 0.020 ppm occurred at both the Jersey City and Elizabeth Lab sites. Elizabeth Lab is located at Exit 13 of the New Jersey Turnpike.

Table 6-2
2016 Nitrogen Dioxide Concentrations in New Jersey
1-Hour and 12-Month Averages
Parts per Million (ppm)

Monitoring Site	1-Hour Average (ppm)				12-Month Maximum Average (ppm)	
	Daily Maximum	2nd Highest Daily Max.	98^{th} %-ile	2014-2016 98^{th}%-ile 3-year Avg.	Highest Running 12-Month	Calendar Year
Bayonne	0.073	0.070	0.058	0.059	0.016	0.016
Camden Spruce Street	0.061	0.058	0.052	0.051	0.013	0.012
Chester	0.059	0.043	0.032	0.034	0.003	0.003
Columbia	0.076	0.064	0.048	0.050	0.012	0.011
East Orange	0.060	0.060	0.059	a	0.017	0.016
Elizabeth Lab	0.074	0.068	0.059	0.065	0.022	0.020
Fort Lee Near Road	0.080	0.065	0.055	b	0.019	0.018
Jersey City	0.084	0.082	0.051	c	0.023	0.020
Millville	0.039	0.037	0.033	d	0.007	0.006
Newark Firehouse	0.095	0.070	0.058	0.062	0.016	0.015
Rutgers University	0.053	0.049	0.039	e	0.010	0.008

a East Orange site shut down July 2016.
b Fort Lee Near Road site began operating March 2014.
c Jersey City site began operating January 2016.
d Millville temporarily shut down February 2016 to June 2016.
e Rutgers University temporarily shut down for site renovations April 2015 to June 2015.

Figure 6-4
2016 Nitrogen Dioxide Concentrations in New Jersey
Daily Maximum 1-Hour Values
Parts per Million (ppm)

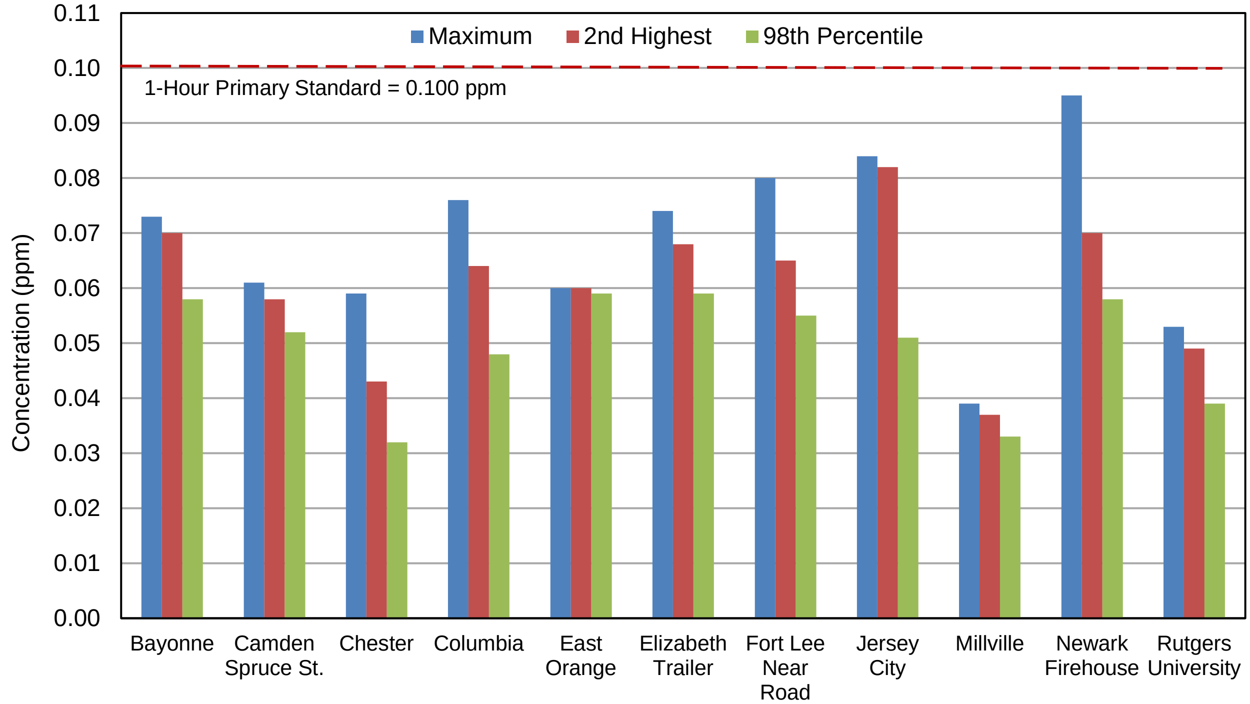
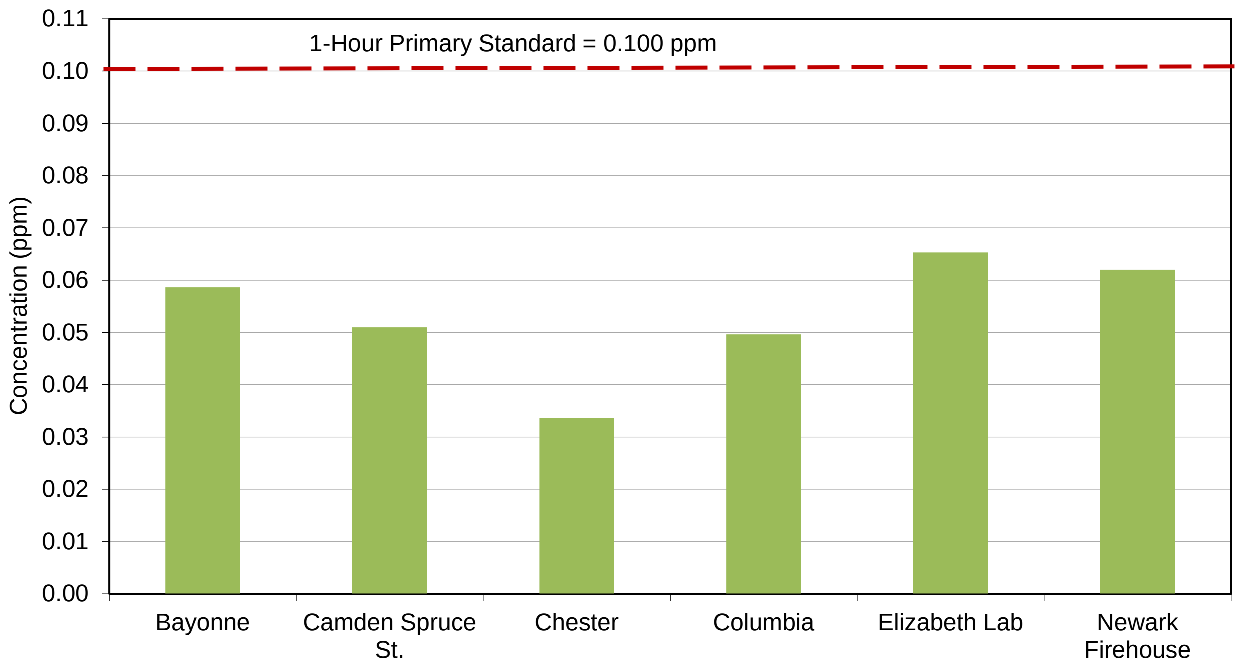


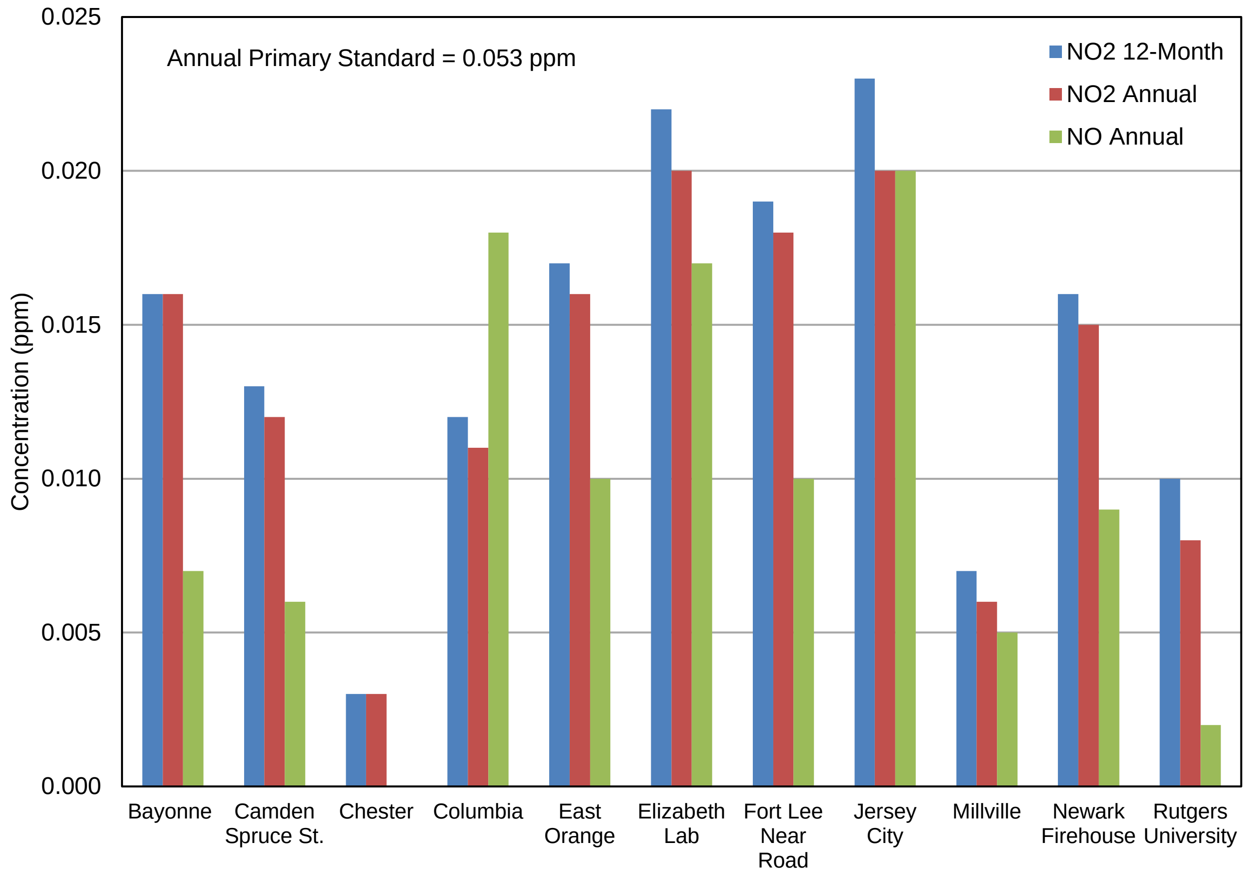
Figure 6-5
2016 Nitrogen Dioxide Design Values in New Jersey
3-Year Average of the 98th Percentile Daily Maximum 1-Hour Concentrations (2014-2016)
Parts per Million (ppm)



Note: East Orange, Ft. Lee Near Road, Jersey City, Millville, and Rutgers University sites do not have enough data to calculate a 2014-2016 average.

Figure 6-6 shows the highest rolling 12-month average concentrations of NO_2, and calendar year annual average concentrations for nitrogen dioxide and nitric oxide at each monitoring site. The annual NAAQS is 0.053 ppm (or 53 parts per billion), but there is no standard for NO. 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 monitor is believed to result from its proximity to Interstate 80, which is a source of NO emissions from vehicles, and the site's relatively low levels of other pollutants that would otherwise trigger conversion of NO to NO_2.

Figure 6-6
2016 Nitrogen Dioxide & Nitric Oxide Concentrations in New Jersey
Rolling 12-Month and Calendar-Year Annual Averages
Parts per Million (ppm)

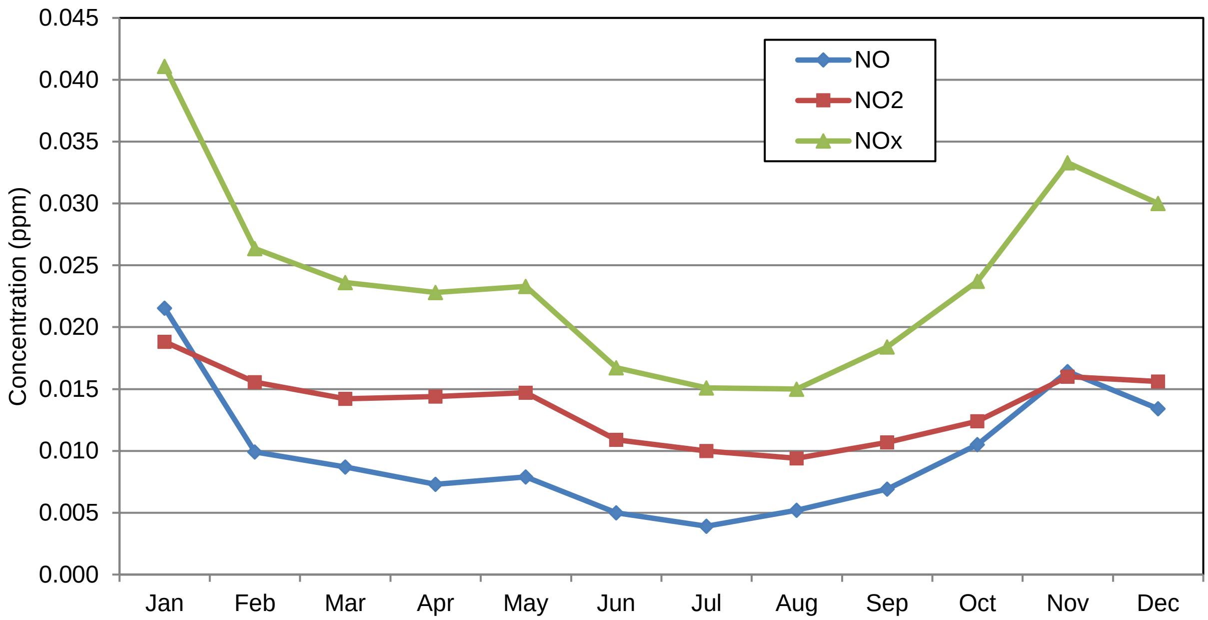


Note: The annual average concentration of NO at Chester was 0.000 ppm.

NOx Trends

Figure 6-7 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 weather conditions that are more prevalent in the colder months of the year, such as poorer local dispersion conditions caused by light winds.

Figure 6-7
2016 Nitrogen Oxides Concentrations in New Jersey
Average Monthly Variation
Parts per Million (ppm)



Routine monitoring for NO_2 in New Jersey began in 1966. The last year in which the annual average NO_2 concentration exceeded the NAAQS was 1974. The graph of NO_2 levels in Figure 6-8 shows the highest statewide annual average concentrations recorded from 1990 to 2016 in the form of a trend line. Although NO_2 concentrations are well within the NAAQS, there is still a great deal of concern about the role of nitrogen oxides in the formation of other pollutants, most notably ozone and fine particles. Both of these pollutants still occasionally reach problematic levels in the northeastern United States. Efforts to reduce levels of ozone and fine particles are likely to require continued reductions in NOx emissions.

Figure 6-9 shows the highest 98th percentile values of the daily maximum one-hour concentrations of NO_2 for the years 2000 to 2016 in New Jersey. Although the highest value exceeded the 1-hour NAAQS of 0.100 in 2000, there has not been an exceedance of the standard since then.

Figure 6-10 shows the New Jersey design values for the 1-hour NAAQS for the years 2000-2016. The design value, which determines compliance with the 1-hour NO_2 NAAQS, is the highest 3-year average of the 98th percentile values of the daily maximum one-hour concentrations at each New Jersey monitoring site. New Jersey has not violated the 1-hour NAAQS since it was implemented by USEPA in 2010.

Figure 6-8
Nitrogen Dioxide Concentrations in New Jersey, 1990-2016
Highest Annual (Calendar Year) Averages
Parts per Million (ppm)

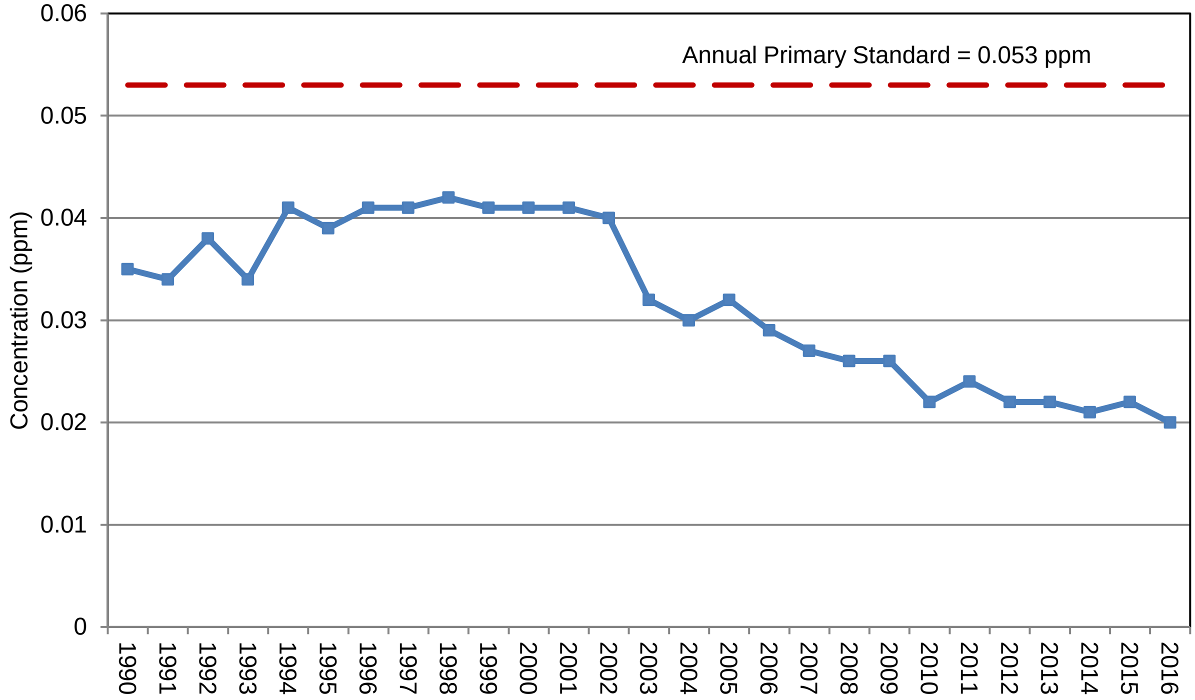


Figure 6-9
Nitrogen Dioxide Concentrations in New Jersey, 2000-2016
98th Percentile of the Daily Maximum 1-Hour Concentrations
Parts per Million (ppm)

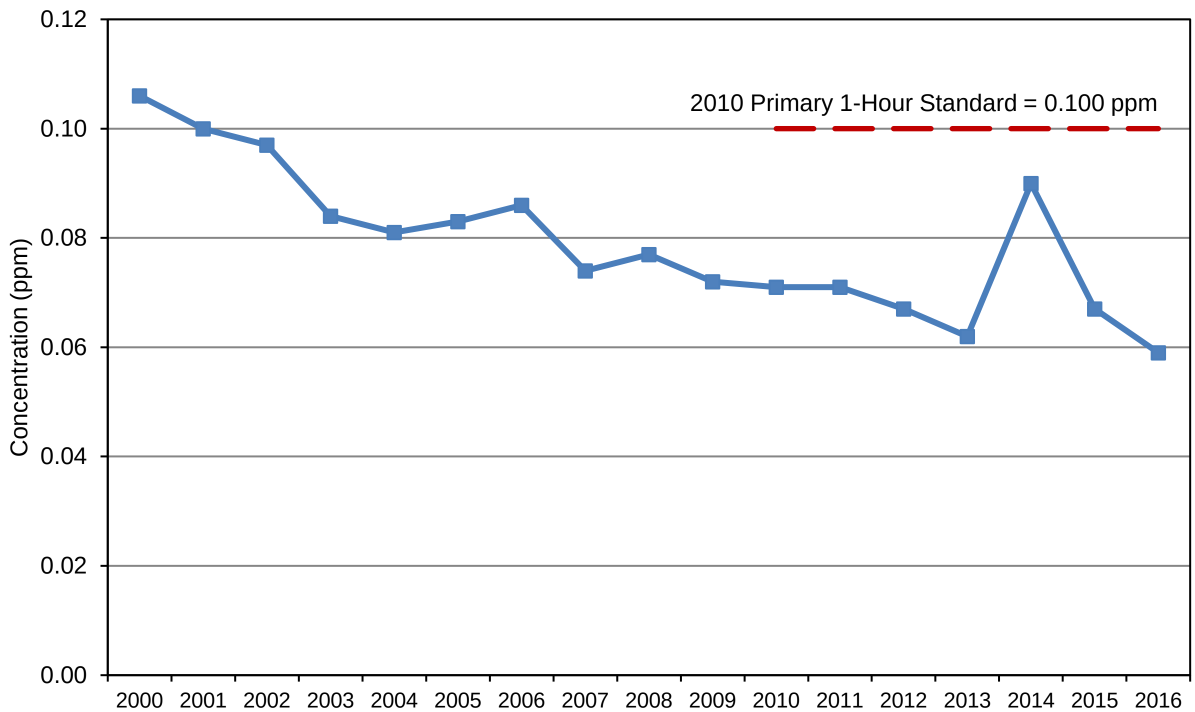
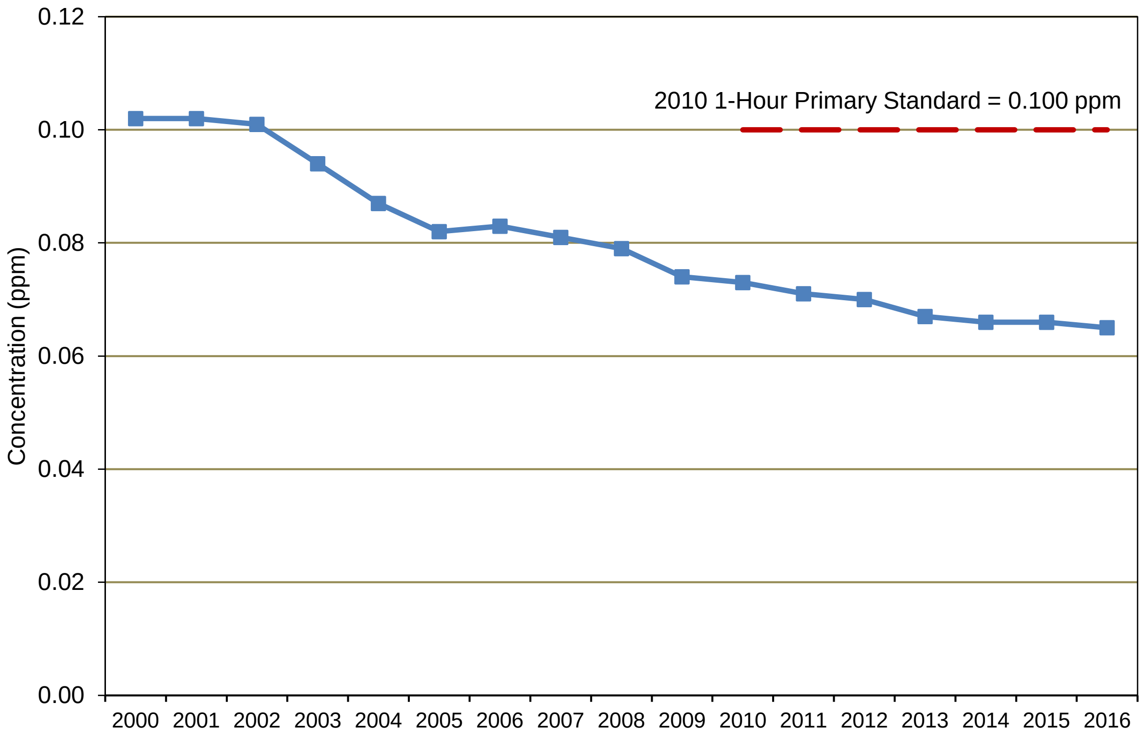


Figure 6-10
Nitrogen Dioxide Design Value Trend in New Jersey, 2000-2016
3-Year Average of the 98th Percentile Daily Maximum 1-Hour Concentrations
Parts per Million (ppm)



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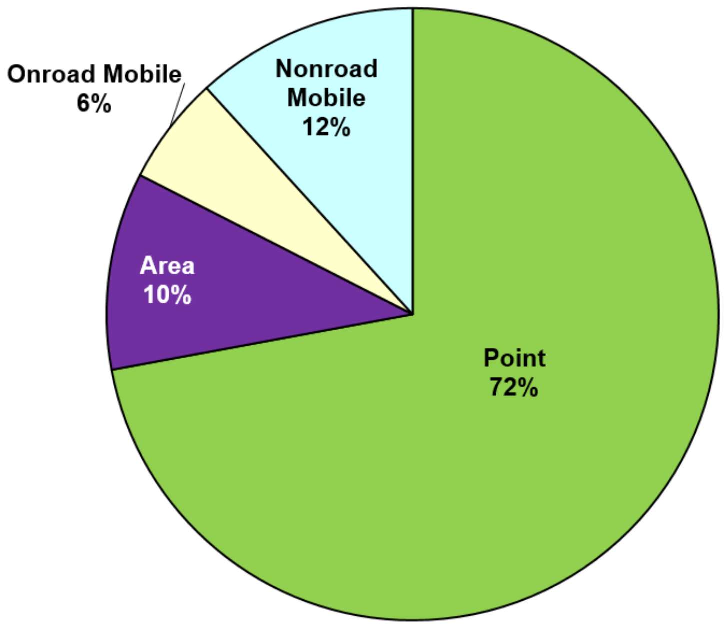
2016 Sulfur Dioxide Summary

New Jersey Department of Environmental Protection

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 are formed when fuels containing sulfur (coal, oil, and gasoline) are burned, or when gasoline is extracted from oil. Most of the sulfur dioxide released into the air comes from fuel combustion in electric utilities, especially those that burn coal with a high sulfur content. Sulfur is found in raw materials such as crude oil, coal, and ores that contain metals. Industrial facilities that derive their products from these materials may also release SO_2. The pie chart in Figure 7-1 summarizes the primary sources of SO_2 in New Jersey in 2017.

Figure 7-1
2017 New Jersey SO_2 Projected Emissions



Inventory Source: MARAMA 2017 BETA2

HEALTH AND ENVIRONMENTAL EFFECTS

Sulfur dioxide causes irritation of the mucous membranes. This is probably the result of sulfurous acid forming when the highly soluble SO_2 gas 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 in these sensitive groups and those who are active outdoors may have trouble breathing.

Sulfur dioxide reacts with other gases and particles in the air to form sulfates, which also can be harmful to people and the environment. Sulfate particles are the major cause of reduced visibility in the eastern United States. SO_2 forms 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 can speed up the decay of building materials and paints.

AMBIENT AIR QUALITY STANDARDS

The current National Ambient Air Quality Standards (NAAQS) for SO_2 are shown in Table 7-1. Primary standards are set to provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. In June 2010 the United States Environmental Protection Agency (USEPA) established a new primary 1-hour NAAQS for SO_2 at a level of 75 parts per billion (ppb). At the same time, the old 24-hour and annual average NAAQS were revoked, and the 3-hour secondary NAAQS was retained.

Compliance with the 1-hour standard is determined by calculating the 99th percentile of 1-hour daily maximum concentrations for each monitoring site in the state each year, and then averaging each site's values for the three most recent years. This statistic is called the design value. Table 7-1 also shows New Jersey's ambient air quality standards for SO_2. The NJAAQS for SO_2 are expressed in micrograms per cubic meter (µg/m^3) instead of ppm, and are based on running averages (consecutive 12-month averages recorded during two years, and any consecutive 24-hours). The secondary 3-hour New Jersey standard is the same as the NAAQS.

Table 7-1
National and New Jersey Ambient Air Quality Standards for Sulfur Dioxide (SO_2)
Micrograms per Cubic Meter (µg/m^3)
Parts per Million (ppm)
Parts per Billion (ppb)

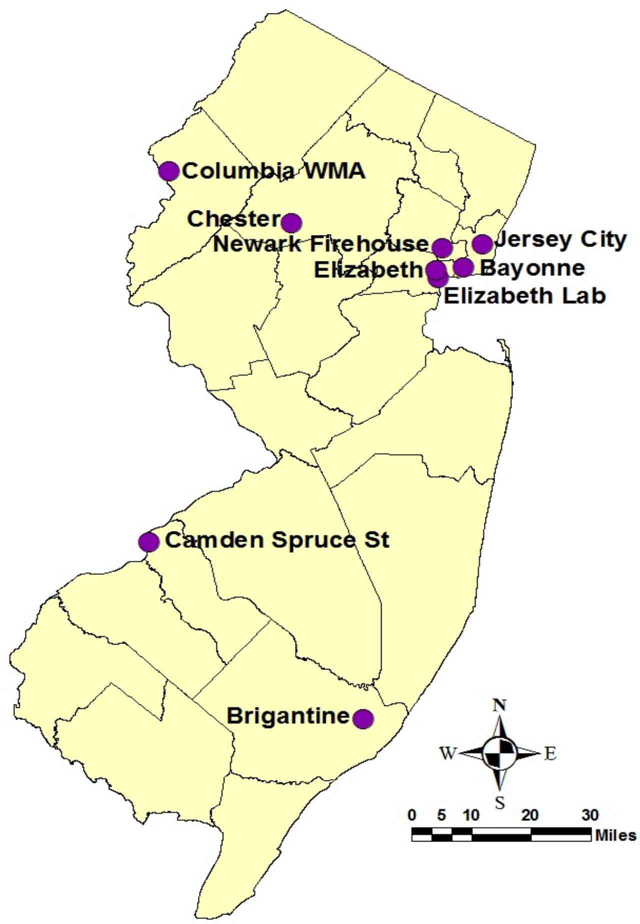
Averaging Period	Type	New Jersey	National
12–months [a]	Primary	80 µg/m^3 (0.03 ppm)	---
12–months [a]	Secondary	60 µg/m^3 (0.02 ppm)	---
24–hours [b]	Primary	365 µg/m^3 (0.14 ppm)	---
24–hours [b]	Secondary	260 µg/m^3 (0.10 ppm)	---
3–hours [b,c]	Secondary	1300 µg/m^3 (0.5 ppm)	0.5 ppm
1–hour [d]	Primary	---	75 ppb

[a] Based on rolling averages.
[b] Based on non-overlapping rolling averages.
[c] Not to be exceeded more than once per year.
[d] To meet this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour averages at each monitor within the state must not exceed 75 ppb.

SO_2 MONITORING NETWORK

The New Jersey Department of Environmental Protection (NJDEP) monitored SO_2 levels at nine locations in 2016. These sites are shown in Figure 7-2. Two sites, Brigantine and Newark Firehouse, measure SO_2 concentrations at trace levels, down to a ten-thousandth part per million (0.0000 ppm). The other sites measure SO2 concentrations to the thousandth a part per million (0.000 ppm).

Figure 7-2
2016 Sulfur Dioxide
Monitoring Network



SO$_2$ LEVELS IN 2016

In 2016, there were two exceedances of the 1-hour NAAQS of 75 ppb, recorded at Camden Spruce Street. These occurred on November 11 and November 21, and may have been caused by activity in the port nearby. However, the 99th-percentile value for the site, 11 ppb, fell below the NAAQS. This was the highest 99th-percentile value in the state. For 2016 Columbia still has the highest design value (the 3-year average of the 99th-percentile of the daily maximum 1-hour SO_2 concentration) at 30 ppb, because of high values recorded at the site in 2014.

No monitoring sites had exceedances of the 12-month or 24-hour New Jersey SO_2 standards during 2016. The maximum 12-month average concentration was 0.001 ppm, recorded at Elizabeth and Jersey City. The maximum 24-hour average concentration was 0.029 ppm, measured at the Camden Spruce Street site. The highest 3-hour average recorded was 0.126 ppm, also at the Camden Spruce Street site. This falls below the 3-hour secondary NAAQS of 0.5 ppm. Summaries of the 2016 data are provided in Tables 7-2, 7-3, 7-4, and 7-5, and Figures 7-3, 7-4 and 7-5.

Table 7-2
2016 Sulfur Dioxide Concentrations in New Jersey
Daily Maximums and 99th Percentile 1-Hour Averages
Parts per Billion (ppb)

Monitoring Site	1-Hour Average (ppb)			2014-2016 Design Value[a]
	Highest Daily Maximum	2nd-Highest Daily Maximum	99th %-ile Daily Maximum	
Bayonne	12	9	4	6
Brigantine	8.1	6.3	5.3	6
Camden Spruce St.	167	81	11	12
Chester	8	5	5	8
Columbia	8	8	8	30
Elizabeth	6	5	4	5
Elizabeth Lab	25	13	7	12
Jersey City	5	5	4	6
Newark Firehouse	6.5	5.5	3.8	6

[a] 3-Year (2014-2016) average of the 99th %-ile 1-hour daily maximum concentrations.

Figure 7-3
New Jersey Sulfur Dioxide Design Values for 2014-2016
3-Year Average of the 99th Percentile of the 1-Hour Daily Maximum Concentrations
Parts per Billion (ppb)

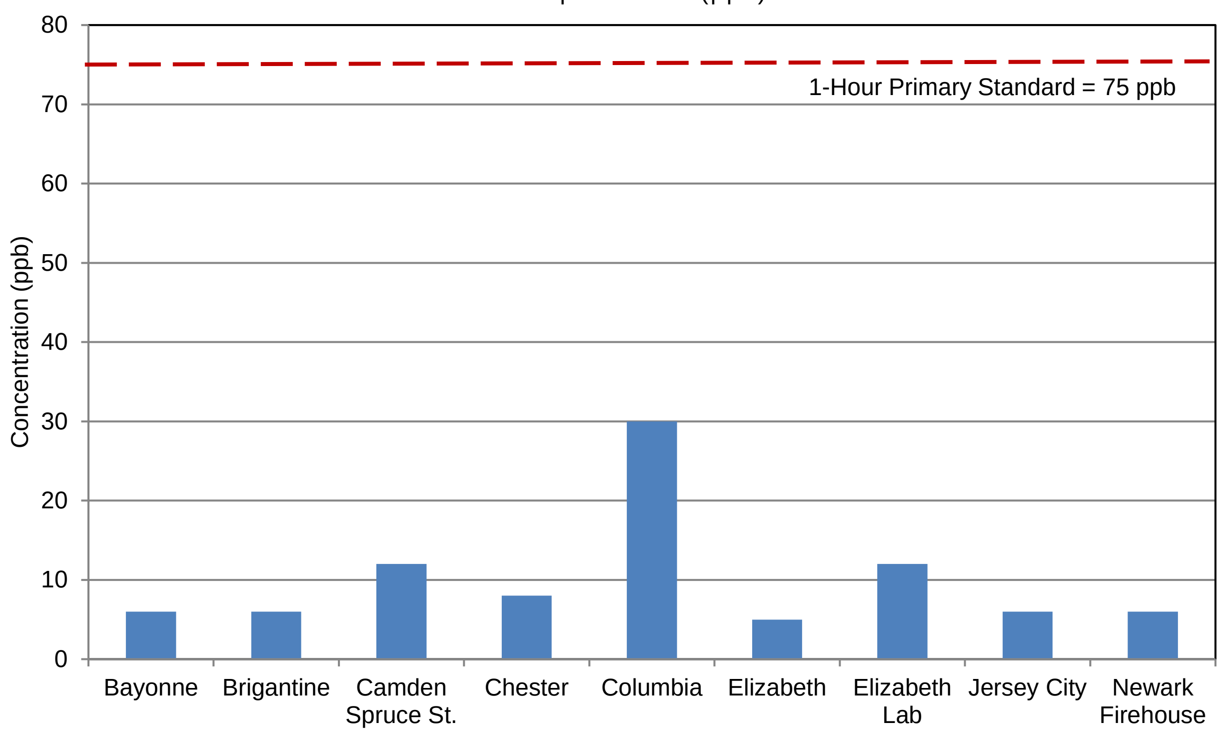


Table 7-3
2016 Sulfur Dioxide Concentrations in New Jersey
3-Hour Averages
Parts per Million (ppm)

Monitoring Site	3-Hour Average	
	Maximum	**2nd Highest**
Bayonne	0.0040	0.0030
Brigantine	0.0054	0.0045
Camden Spruce St.	0.1260	0.0670
Chester	0.0050	0.0040
Columbia	0.0060	0.0060
Elizabeth	0.0050	0.0040
Elizabeth Lab	0.0140	0.0090
Jersey City	0.0050	0.0040
Newark Firehouse	0.0046	0.0044

[a] Based on non-overlapping 3–hour rolling averages.

Figure 7-4
2016 Sulfur Dioxide Concentrations in New Jersey
2nd Highest 3-Hour Running Averages
Parts per Million (ppm)

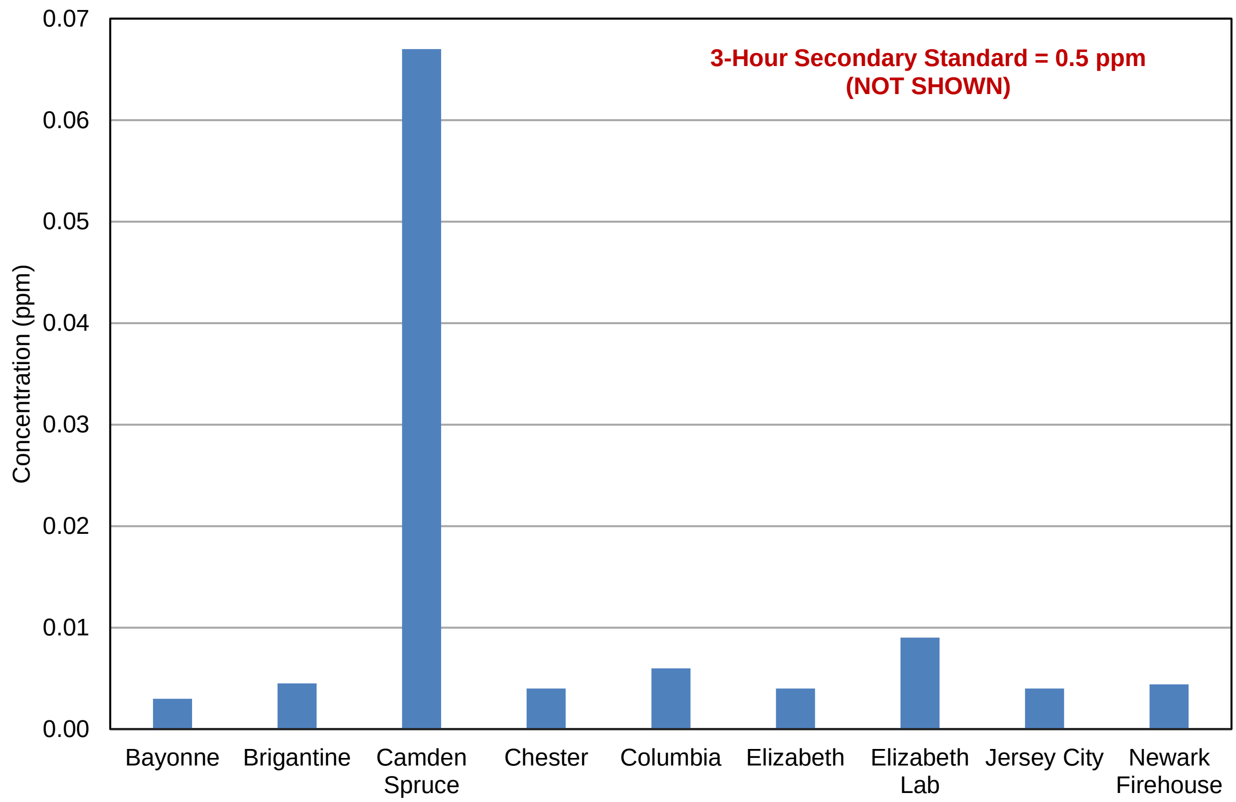


Table 7-4
2016 Sulfur Dioxide Concentrations in New Jersey
24-Hour and Daily Averages
Parts per Million (ppm)

Monitoring Site	24-Hour Average [a]		Daily Average [b]	
	Maximum	2nd-Highest	Maximum	2nd Highest
Bayonne	0.001	0.001	0.002	0.001
Brigantine	0.0017	0.0014	0.0017	0.0011
Camden Spruce St.	0.029	0.013	0.030	0.006
Chester	0.002	0.002	0.003	0.002
Columbia	0.003	0.002	0.003	0.002
Elizabeth	0.003	0.003	0.004	0.003
Elizabeth Lab	0.003	0.003	0.003	0.003
Jersey City	0.003	0.003	0.004	0.003
Newark Firehouse	0.0031	0.0023	0.0031	0.0021

[a] Based on non-overlapping 24–hour rolling averages.
[b] Based on daily 24-hour block averages, midnight to midnight.

Figure 7-5
2016 Sulfur Dioxide Concentrations in New Jersey
Highest and 2nd-Highest 24-Hour Averages
Parts per Million (ppm)

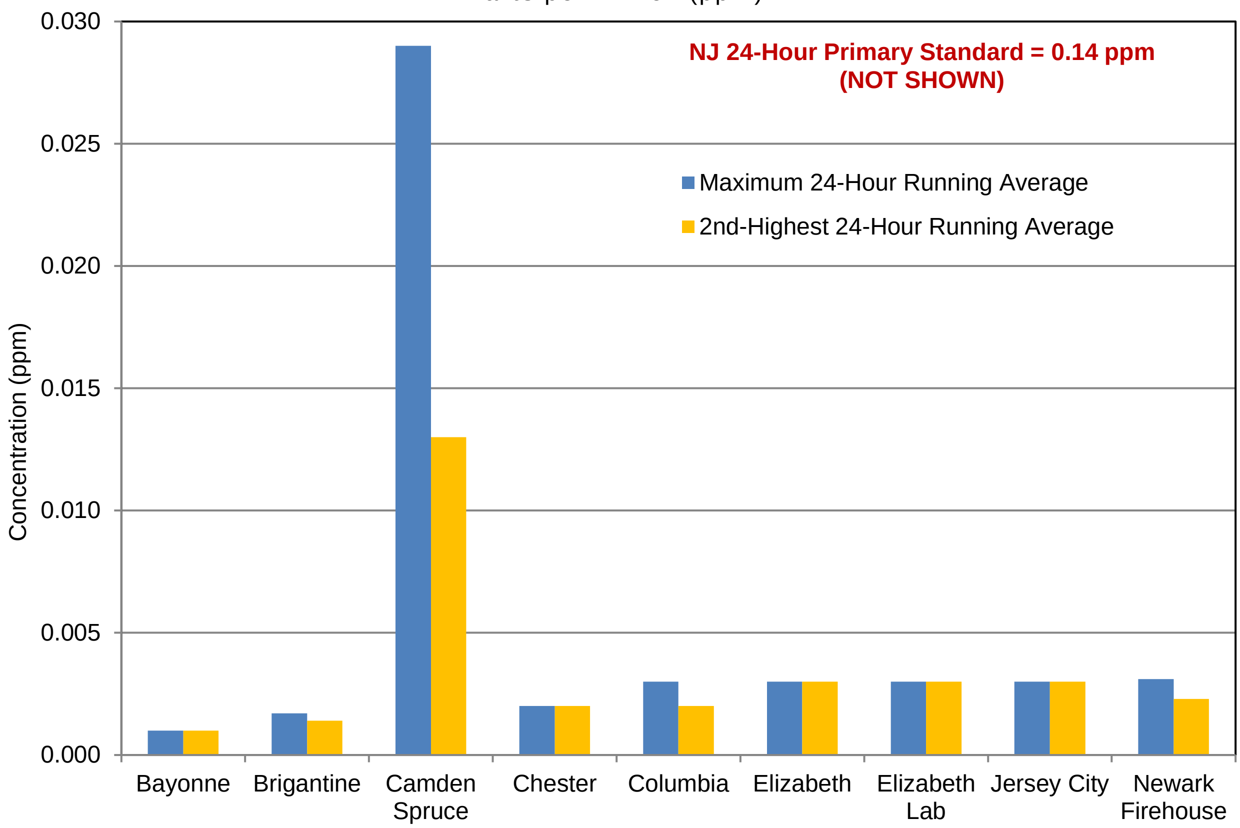


Table 7-5
2016 Sulfur Dioxide Concentrations in New Jersey
12-Month* and Annual Averages
Parts per Million (ppm)

Monitoring Site	12-Month Maximum Average*	Annual Average
Bayonne	0.000	0.000
Brigantine	0.0002	0.0002
Camden Spruce St.	0.000	0.000
Chester	0.000	0.000
Columbia	0.000	0.000
Elizabeth	0.001	0.000
Elizabeth Lab	0.000	0.000
Jersey City	0.001	0.001
Newark Firehouse	0.0005	0.0003

*Running average

SO_2 TRENDS

Sulfur dioxide concentrations across the country have decreased significantly since the first NAAQS were set in 1971. Figure 7-6 shows the second-highest daily average concentrations of SO_2 recorded in New Jersey each year since 1975. In addition to capturing emissions at sources, nationwide reduction efforts have focused on sulfur in fuels. Regulations passed in 2000 reduced the sulfur content of gasoline by up to 90 percent, and enabled the use of new emission control technologies in cars, sport utility vehicles (SUVs), minivans, vans and pick-up trucks (beginning with model year 2004). Even more stringent gasoline and emissions controls for sulfur went into effect in 2017. And in New Jersey, limits on sulfur in commercial fuel oil were implemented beginning in 2014.

A coal-burning power plant across the Delaware River in Pennsylvania had for many years been suspected of causing high SO_2 levels in New Jersey. Air dispersion modeling carried out by NJDEP showed that the facility was causing likely violations of the SO_2 NAAQS. New Jersey petitioned the USEPA under Section 126 of the Clean Air Act to take action against the Portland Power Plant. In support of the petition, NJDEP established an SO_2 monitoring station at the Columbia Wildlife Management Area in Knowlton Township, Warren County, in September 2010. The dramatic increase in the monitored SO_2 concentration in 2010 (shown in Figure 7-7) is the result of measurements taken at the Columbia site. In October 2011, USEPA finalized a rule to grant New Jersey's petition. This final rule required the Portland Power Plant to reduce its SO_2 emissions such that the plant's contribution to predicted air quality standard violations would be lowered within one year, and completely eliminated within three years. The power plant stopped operating in mid-2014. Recent monitoring data have shown that Warren County and its vicinity are now able to meet the 1-hour SO_2 NAAQS.

Figure 7-7 shows the trend in one-hour concentrations of SO_2 since 2000. The graph uses the 99^{th} percentile of the daily maximum 1-hour concentrations. Figure 7-8 shows the trend in the design value, the value that determines compliance with the NAAQS. The design value for the 1-hour NAAQS is the 3-year average of the 99^{th} percentile of the daily maximum 1-hour concentrations.

Figure 7-6
Sulfur Dioxide Concentrations in New Jersey, 1975-2016
Second-Highest 24-Hour Averages
Parts per Million (ppm)

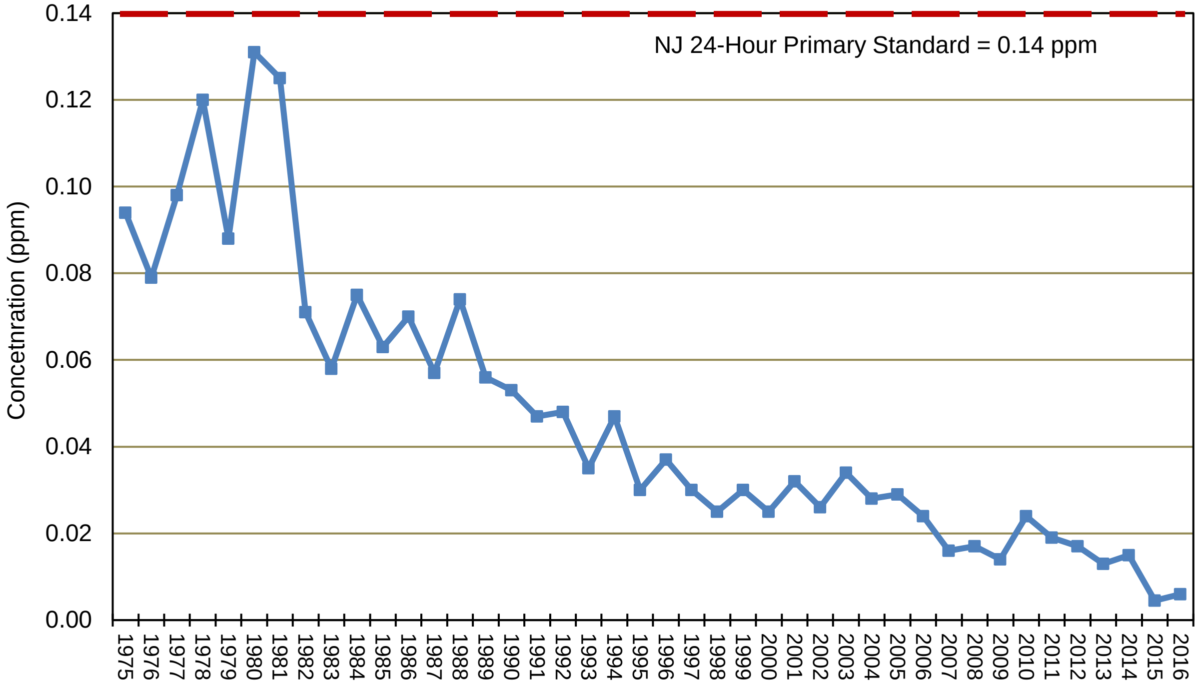


Figure 7-7
Sulfur Dioxide Concentrations in New Jersey, 2000-2016
99th Percentile of the Daily Maximum 1-Hour Concentrations
Parts per Million (ppm)

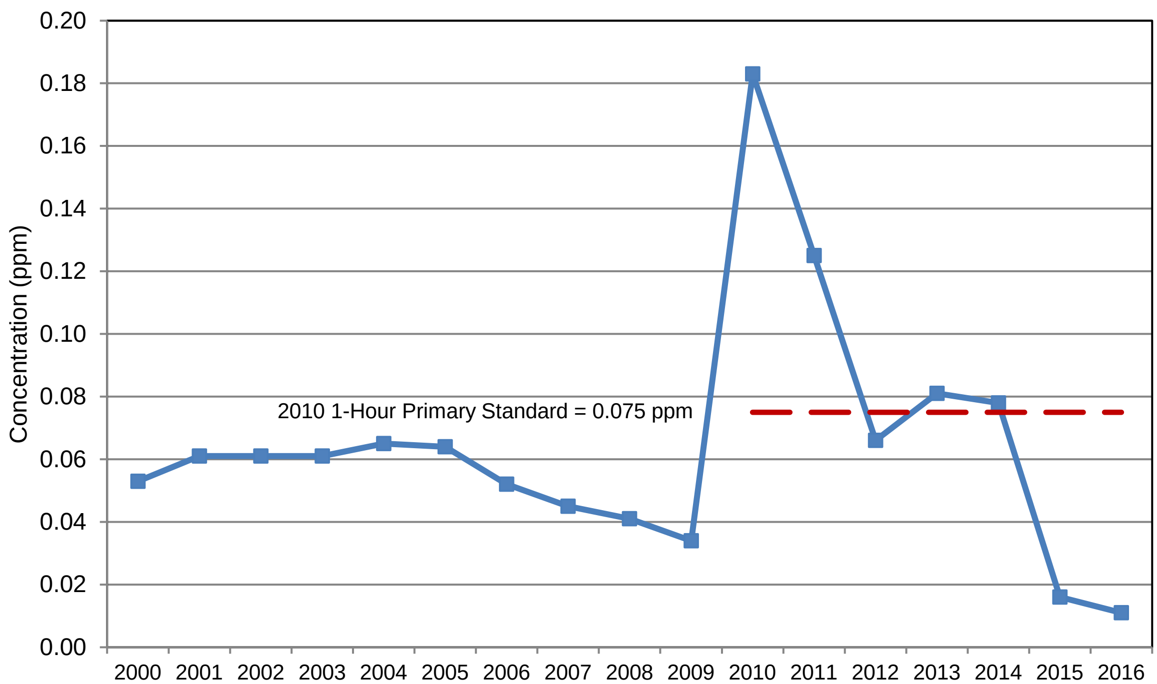
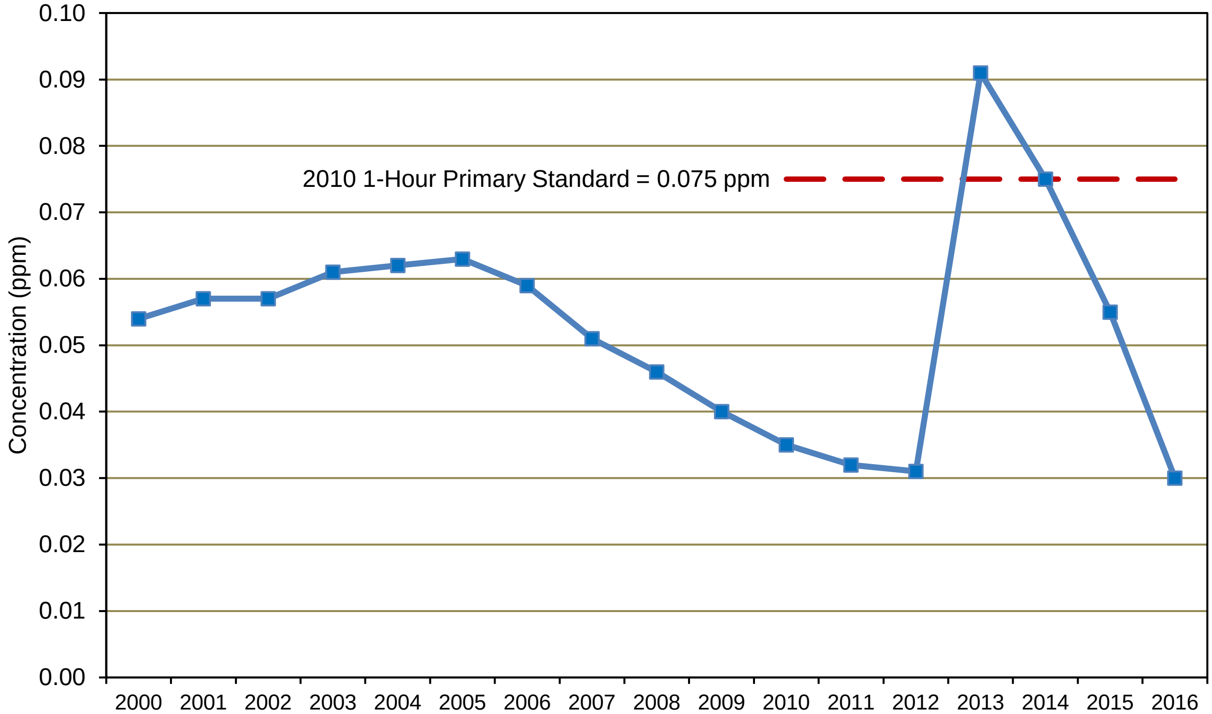


Figure 7-8
Sulfur Dioxide Design Value Trend in New Jersey, 2000-2016
3-Year Average of the 99th Percentile Daily Maximum 1-Hour Concentrations
Parts per Million (ppm)



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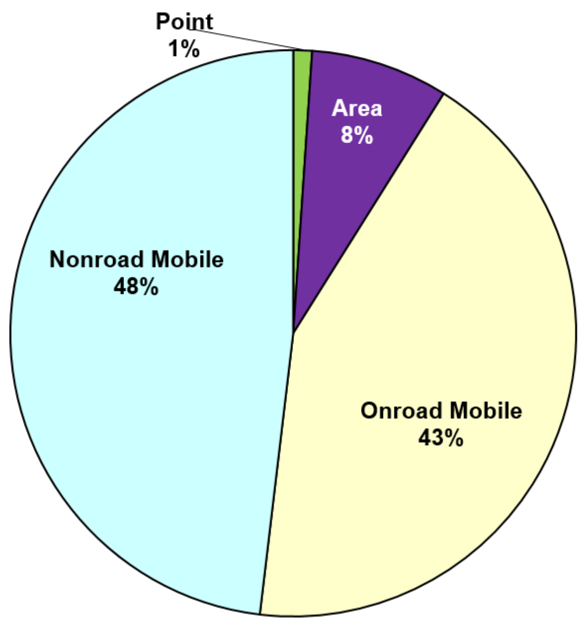
2016 Carbon Monoxide Summary

New Jersey Department of Environmental Protection

SOURCES

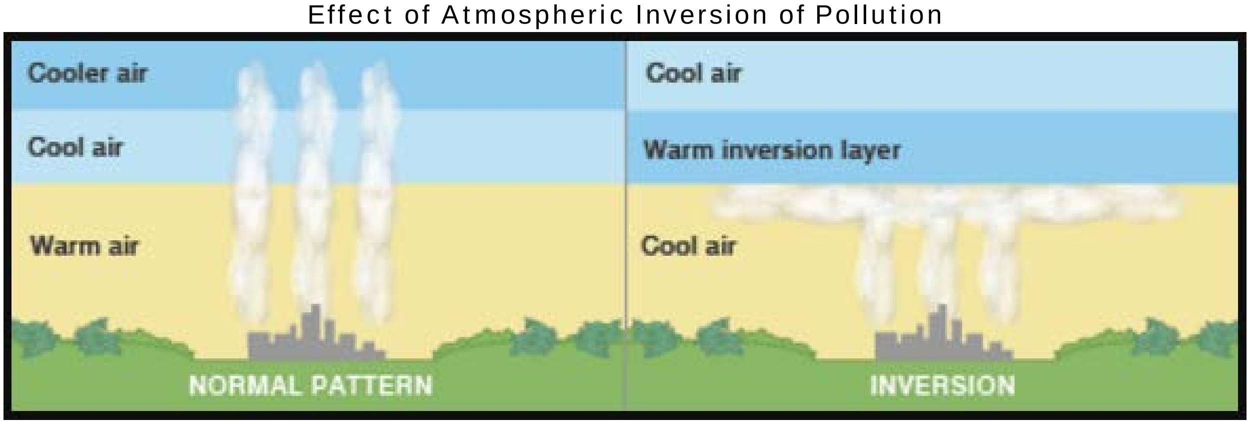
Carbon monoxide (CO) is a colorless, odorless gas formed when carbon in fuels is not burned completely. The main source of outdoor CO is exhaust from internal combustion engines, primarily on-road vehicles, as well as non-road vehicles, generators, construction equipment, boats and other types of mobile sources. 50% of all CO emissions nationwide are attributable to mobile sources, and over 90% in New Jersey. Significant amounts of CO are also emitted from fuel combustion in boilers and incinerators, natural sources such as forest fires, and various industrial processes. A pie chart summarizing the major sources of CO in New Jersey in 2017 is shown in Figure 8-1.

Figure 8-1
2017 New Jersey CO Projected Emissions



Inventory Source: MARAMA 2017 BETA2

Figure 8-2
Effect of Atmospheric Inversion of Pollution



https://kisialevelgeography.files.wordpress.com/2014/06/44875197_thermal_inversion466x135.gif

Outdoor concentrations of CO can rise during atmospheric inversions. This phenomenon occurs when cooler air is trapped beneath a layer of warmer air, which often occurs overnight. The inversion acts like a lid, preventing pollution from mixing in the atmosphere and effectively trapping it close to the ground (see Figure 8-2). This can allow CO to accumulate at ground-level. Figure 8-3 shows that CO concentrations are slightly higher in the winter, probably because inversions are more frequent during the winter months. Also, high CO levels often coincide with morning and afternoon rush hours; this diurnal variation is displayed in Figure 8-4.

Figure 8-3
2016 Carbon Monoxide Concentrations in New Jersey
Monthly Variation
Parts per Million (ppm)

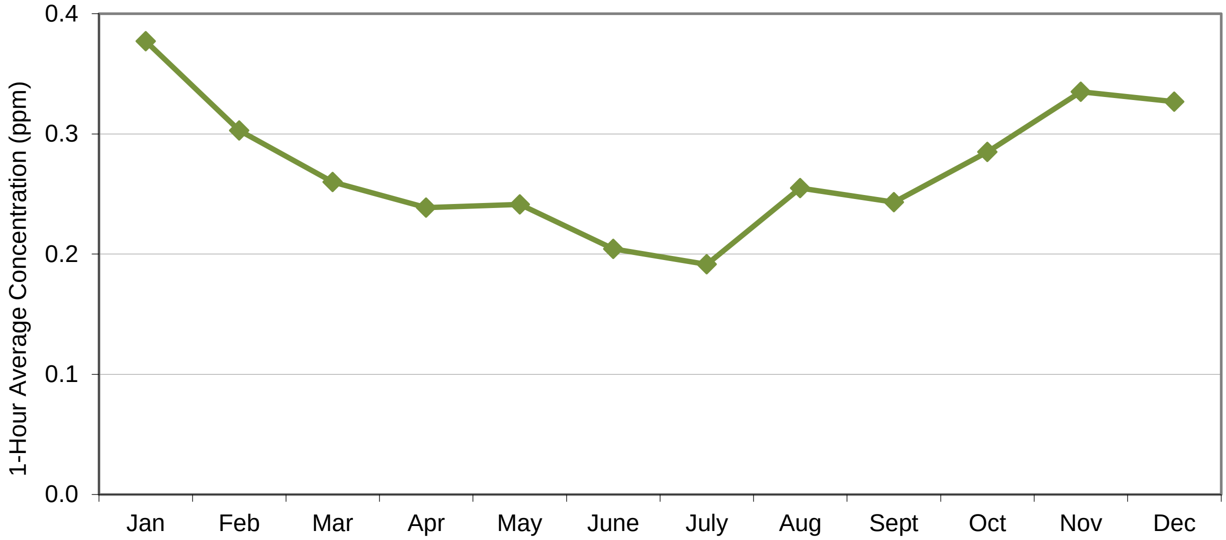
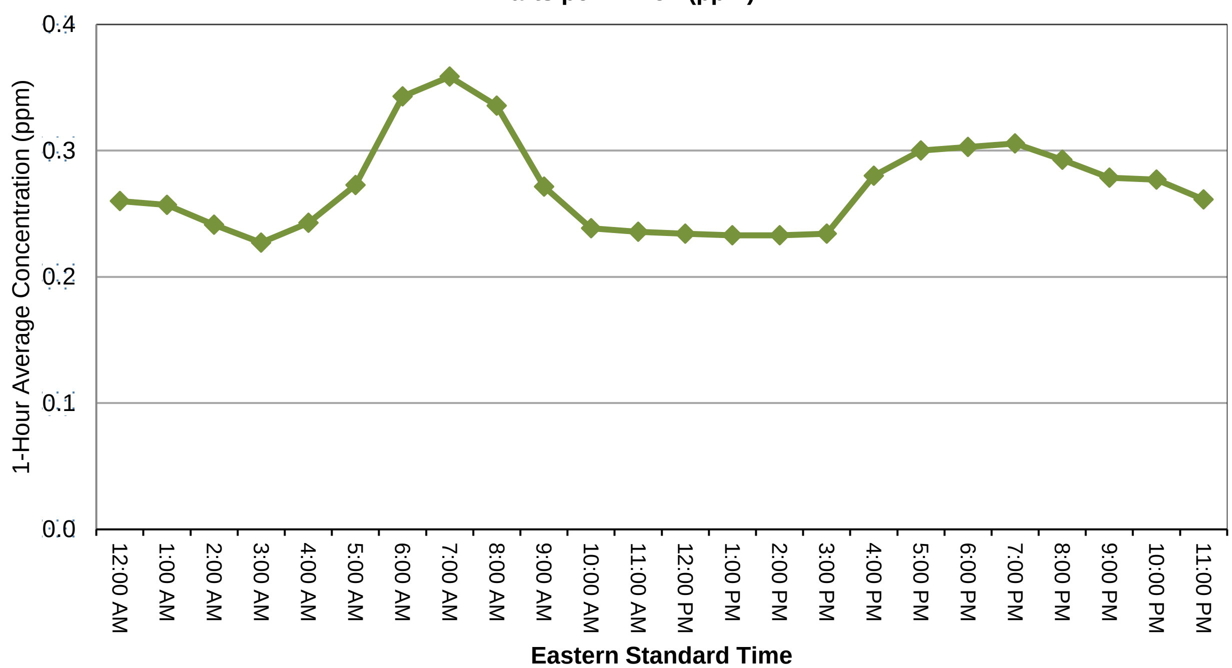


Figure 8-4
2016 Carbon Monoxide Concentrations in New Jersey
Hourly Variation
Parts per Million (ppm)



HEALTH EFFECTS

Carbon monoxide reduces the oxygen-carrying capacity of blood, therefore reducing the distribution of oxygen to organs like the heart and brain. The most common symptoms of exposure to high concentrations of carbon monoxide are headaches and nausea. Exposure to extremely high concentrations, usually resulting from combustion exhaust accumulating in enclosed indoor spaces, can be life-threatening. Such high levels of CO are not likely to occur outdoors. The health threat from exposure to outdoor CO is most serious for those who suffer from cardiovascular disease. For a person with heart disease, a single exposure to CO at low levels may reduce that individual's ability to exercise and may cause chest pain (angina).

AMBIENT AIR QUALITY STANDARDS

National Ambient Air Quality Standards (NAAQS) are established for the entire U.S. Primary standards are set to provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. For carbon monoxide, there are currently two primary, or health-based, NAAQS: a 1-hour standard of 35 parts per million (ppm), and an 8-hour standard of 9 ppm. These levels are not to be exceeded more than once in any calendar year. Therefore, the design value, or the actual statistical value that determines compliance with the NAAQS, is the second-highest 1-hour and 8-hour value in a given year. There are no national secondary, or welfare-based, standards for CO at this time. New Jersey also has standards for CO, and they are based on different units (milligrams per cubic meter as opposed to parts per million). The state standards are not to be exceeded more than once in any 12-month period. The state has set secondary standards for CO at the same level as the primary standards. The standards are all summarized in Table 8-1.

Table 8-1
National and New Jersey Ambient Air Quality Standards
for Carbon Monoxide
Parts per Million (ppm)
Milligrams per Cubic Meter (mg/m^3)

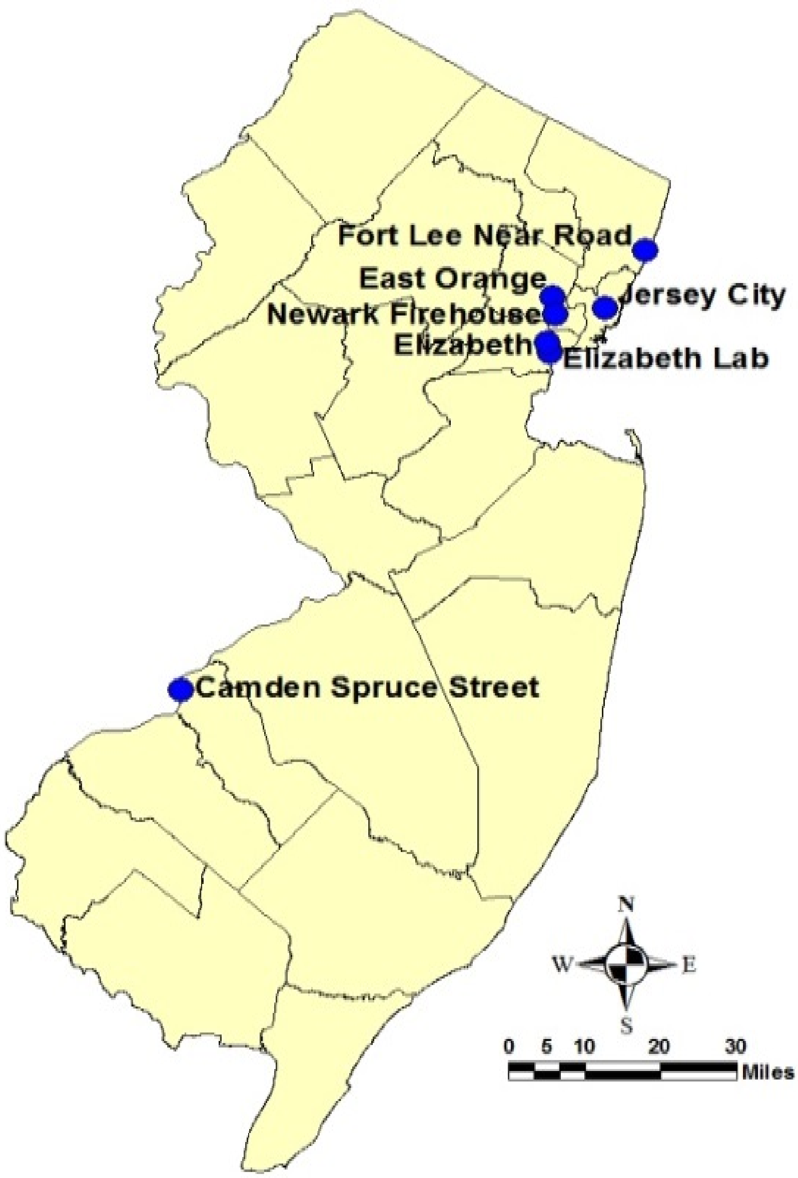
Averaging Period	Type	National [a]	New Jersey [b]
1-Hour	Primary	35 ppm	40 mg/m^3 (35 ppm)
1-Hour	Secondary	----	40 mg/m^3 (35 ppm)
8-Hours	Primary	9 ppm	10 mg/m^3 (9 ppm)
8-Hours	Secondary	----	10 mg/m^3 (9 ppm)

[a] Not to be exceeded more than once in a calendar year.
[b] Not to be exceeded more than once in any 12-month period.

CO MONITORING NETWORK

The New Jersey Department of Environmental Protection (NJDEP) operated seven CO monitoring stations in 2015. These sites are shown in the map in Figure 8-5. The Newark Firehouse station is part of the U.S. Environmental Protection Agency's (USEPA) National Core Multipollutant Monitoring Network (NCORE). It measures and reports CO concentrations at trace levels, down to a hundredth of a ppm (0.00 ppm). The East Orange site was shut down on July 2, 2016, because of duplication of efforts.

Figure 8-5
2016 Carbon Monoxide Monitoring Network



CO Levels in 2016

None of the New Jersey monitoring sites recorded exceedances of any CO standards during 2016. The maximum 1-hour average CO concentration recorded in 2016 was 5.4 ppm at the Elizabeth station. The highest 8-hour average CO concentration recorded was 3.3 ppm at the Elizabeth station. Summaries of the 2016 data are provided in Table 8-2, Figure 8-6 and Figure 8-7.

Table 8-2
2016 Carbon Monoxide Concentrations in New Jersey
1-Hour and 8-Hour Averages
Parts per Million (ppm)

Monitoring Site	1-Hour Average Concentrations		8-Hour Average Concentrations	
	Highest	2nd-Highest	Highest	2nd-Highest (NOL*)
Camden Spruce St.	1.8	1.7	1.4	1.2
East Orange	3.0	2.7	1.9	1.6
Elizabeth	5.4	5.2	3.3	2.5
Elizabeth Lab	3.1	2.8	2.4	1.8
Fort Lee Near Rd.	1.1	1.0	0.8	0.7
Jersey City	2.0	1.9	1.6	1.4
Newark Firehouse	3.73	3.34	2.30	2.27

*NOL – Non-overlapping 8-hour periods

Figure 8-6
2016 Carbon Monoxide Concentrations in New Jersey
1-Hour Averages
Parts per Million (ppm)

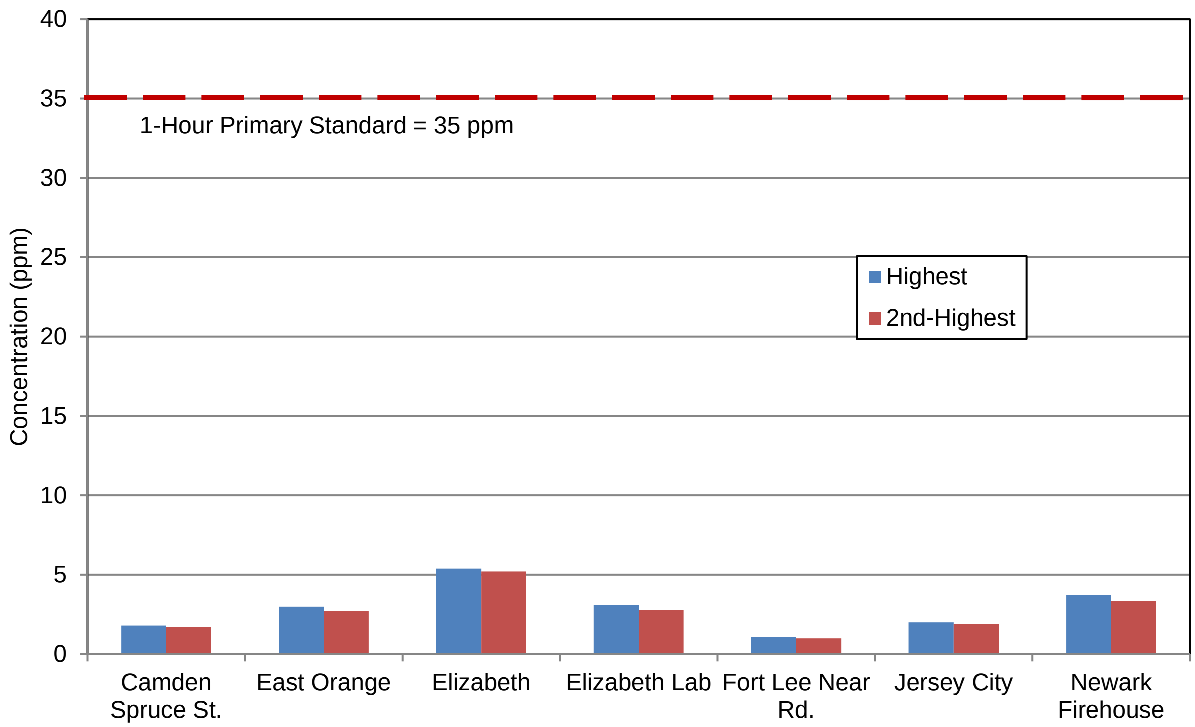
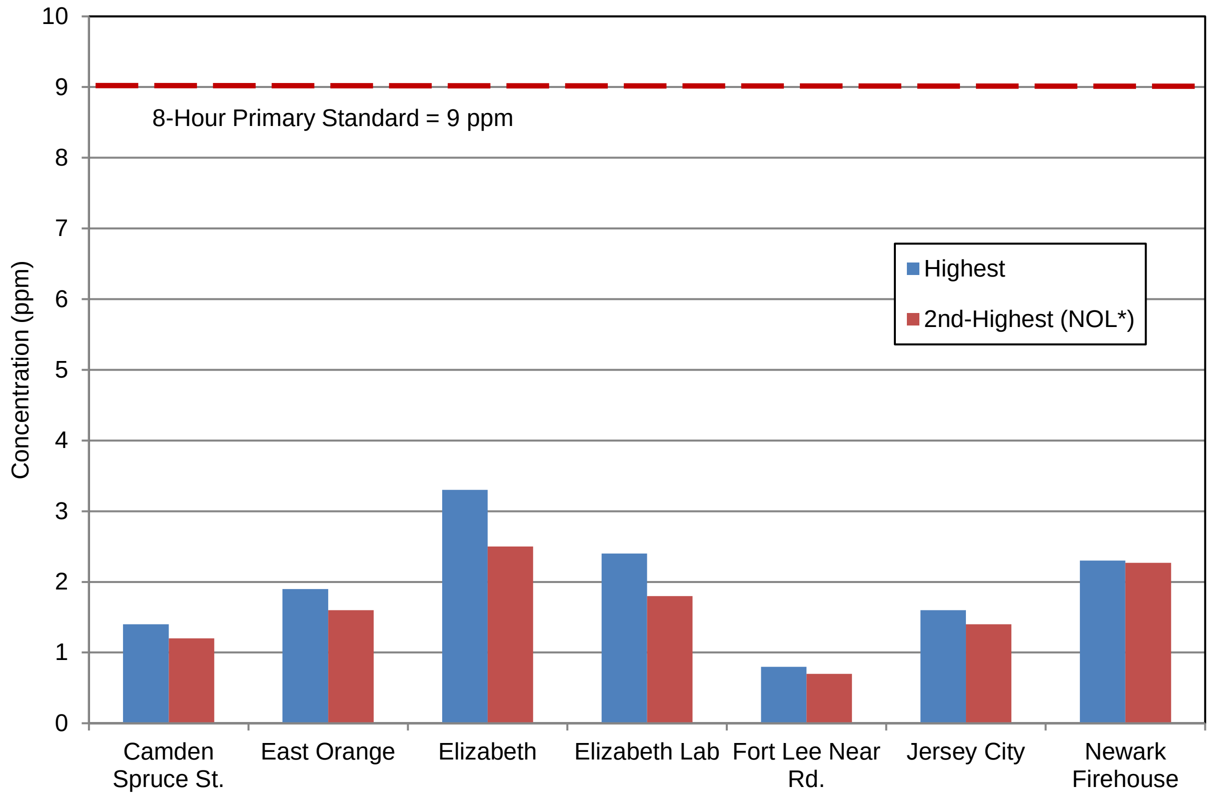


Figure 8-7
2016 Carbon Monoxide Concentrations in New Jersey
8-Hour Averages
Parts per Million (ppm)



CO Trends

Carbon monoxide levels have improved dramatically over the past two-and-a-half decades. Figures 8-8 and 8-9 present the trends in CO levels since 1990. The graphs actually show the second-highest 8-hour and 1-hour values recorded, because those are the design values that determine if the NAAQS are being met (one exceedance per site is allowed each year). The entire state was officially declared to have attained the CO standards as of August 23, 2002. At one time, unhealthy levels of CO were recorded on a regular basis. The reduction in CO levels is due primarily to cleaner-running cars, which are by far the largest source of this pollutant outdoors. The last violation of the 8-hour NAAQS was in 1994.

Figure 8-8
Carbon Monoxide Design Value Trend in New Jersey, 1990-2016
2nd-Highest 8-Hour Average Concentrations
Parts per Million (ppm)

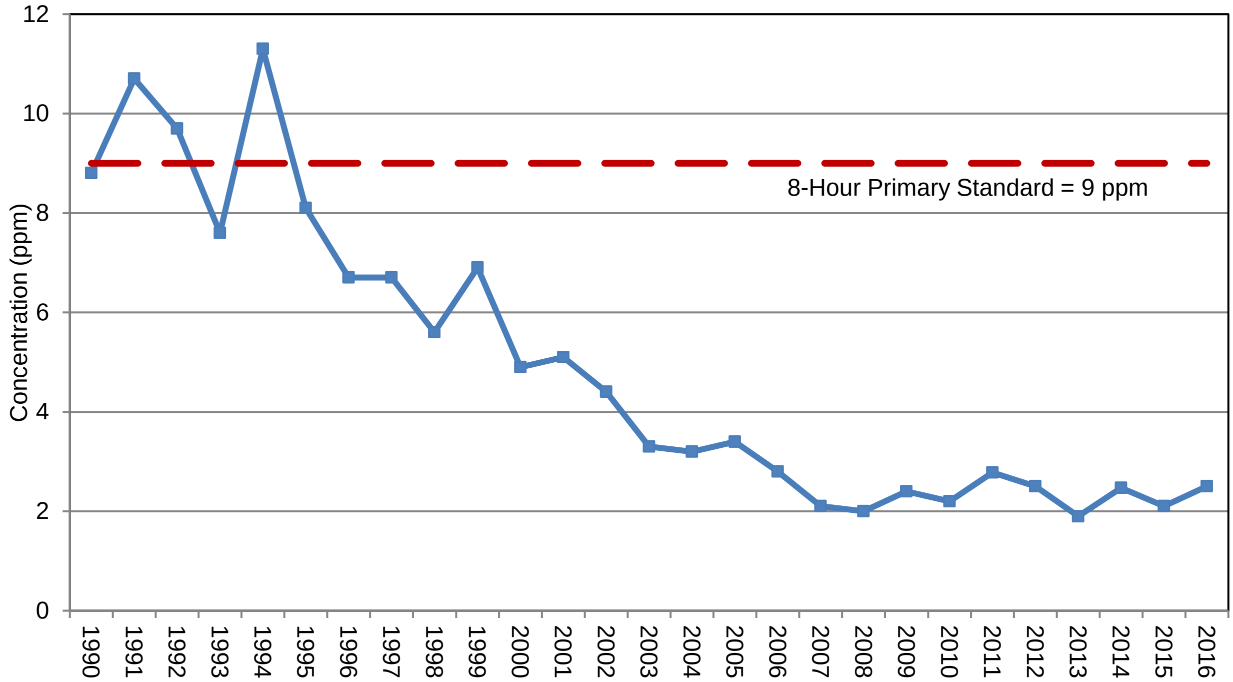
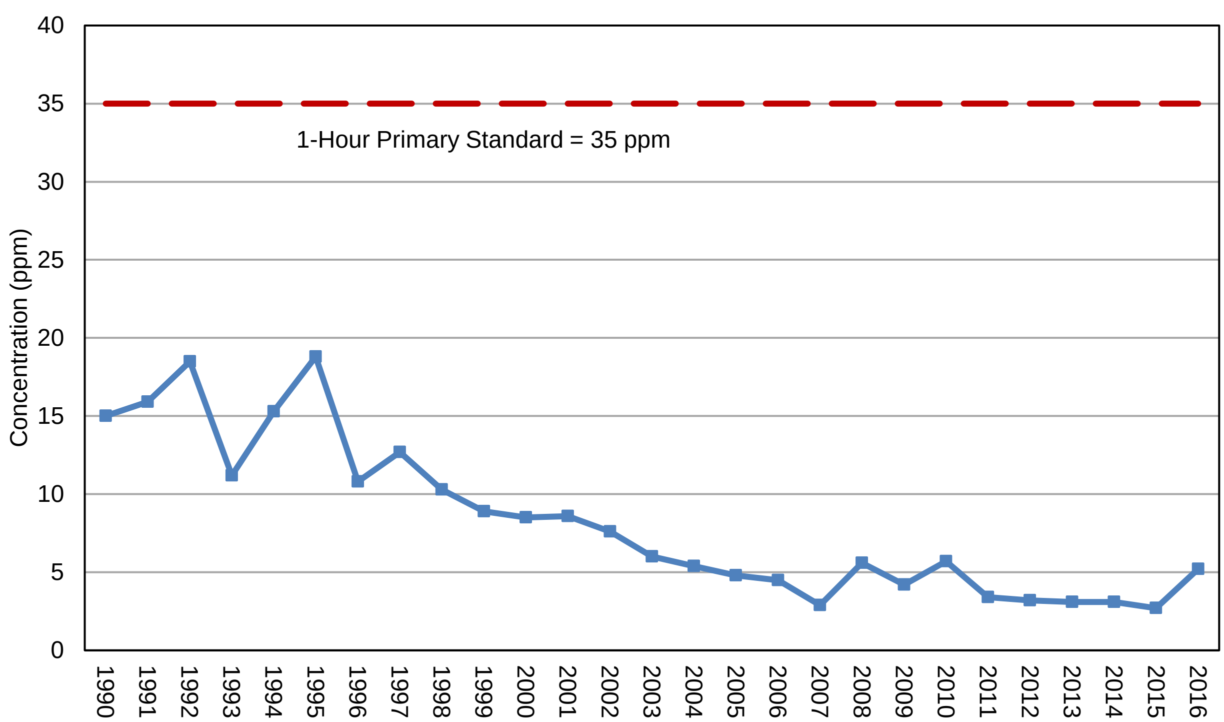


Figure 8-9
Carbon Monoxide Design Value Trend in New Jersey, 1990-2016
2nd-Highest 1-Hour Average Concentrations
Parts per Million (ppm)



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2016 Meteorology Summary

New Jersey Department of Environmental Protection

AIR POLLUTION AND METEOROLOGY

Meteorology plays an important role in the distribution of pollution throughout the troposphere, the layer of the atmosphere closest to the earth's surface. Atmospheric processes such as wind speed and wind direction affect the transport and dispersion of air pollution. Precipitation, solar radiation, and other weather phenomena influence chemical reactions and atmospheric transformations. By studying meteorological and air pollution data together, scientists and mathematicians have developed reasonably accurate models for predicting the fate of pollutants as they go through the stages of transport, dispersion, transformation, and removal.

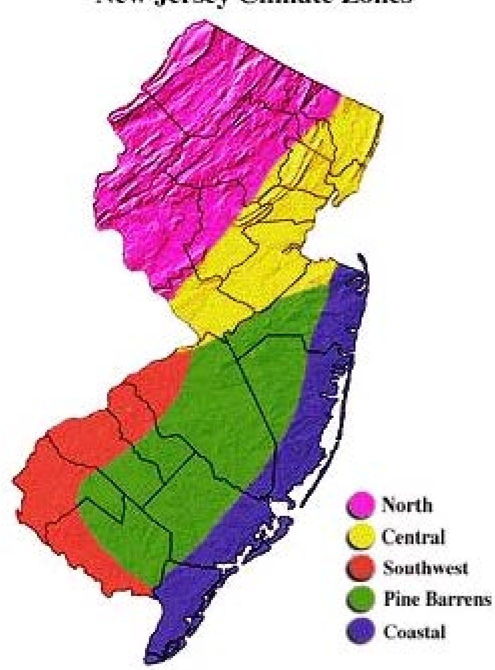
Scientists, engineers, and policy makers can use air pollution models as a screening tool, for comparing predicted pollutant concentrations to National Ambient Air Quality Standards (NAAQS), to determine the impacts of new and existing air pollution sources, and to design ambient air monitoring networks. The meteorological data collected by the New Jersey Department of Environmental Protection (NJDEP) can assist planners in preparing State Implementation Plans (SIPs) to reduce pollutant emissions; engineers in designing or evaluating air pollution permit applications; and scientists in siting air monitoring stations.

CLIMATOLOGY IN NEW JERSEY

New Jersey is located about halfway between the Equator and the North Pole, on the eastern coast of the United States. Its geographic location results in the state being influenced by different air streams at different times (wet, dry, hot, cold), making for daily weather that is highly variable.

Although New Jersey is one of the smallest states in the Union, with a land area of 7,836 square miles, it has five distinct climate zones, which are classified as the Northern, Central, Pine Barrens, Southwest, and Coastal Zones. The topography of the different zones, their distance from the Atlantic Ocean, and the prevailing atmospheric flow patterns affecting them produce distinct variations in the daily weather. These climate zones are shown in Figure 9-1.

Figure 9-1
New Jersey Climate Zones



Source: Office of the New Jersey State Climatologist

MONITORING LOCATIONS

NJDEP collected meteorological data at nine stations in its monitoring network in 2016, although monitoring was discontinued at East Orange mid-year. Not all meteorological parameters were measured at each site. The Elizabeth Trailer site has been collecting wind data for years; additional meteorological parameters were added in May 2016. Table 9-1 lists the parameters monitored at each station, and Figure 9-2 is a map of the 2016 meteorological monitoring network. In Tables 9-2 through 9-6, the 2016 meteorological data is summarized for temperature, rain, relative humidity, solar radiation, and barometric pressure. Figure 9-3 presents the average temperature for each monitoring site compared with the statewide 30-year average. Figure 9-4 shows the monthly precipitation at each site, as well as the statewide 30-year average.

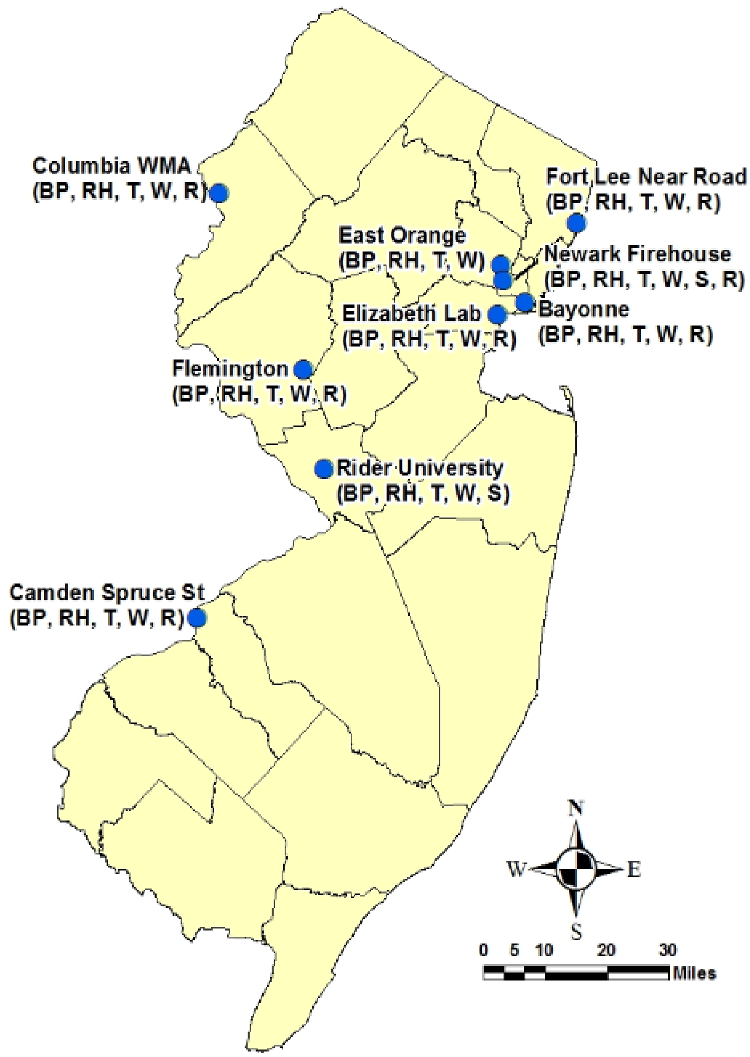
Figures 9-5 through 9-13 present annual wind roses for Bayonne, Camden Spruce Street, Columbia, Elizabeth Trailer, Flemington, Fort Lee Near Road, Newark Firehouse, and Rider University, respectively. Presented in a circular format, a wind rose shows the frequency of winds blowing *from* a specific direction for a specified period. The length of each "spoke" around the circle is related to the frequency that the wind blows from a particular direction per unit time. Each concentric circle represents a different frequency, starting with zero at the center and increasing frequencies at the outer circles. Each spoke is broken down into color-coded bands that show wind speed ranges.

Table 9-1
2016 New Jersey Meteorological Monitoring Network
Parameter Summary

	Site Name	Temperature	Relative Humidity	Wind Speed	Wind Direction	Barometric Pressure	Solar Radiation	Rain
1	Bayonne	X	X	X	X	X		X
2	Camden Spruce Street	X	X	X	X	X		X
3	Columbia	X	X	X	X	X		X
4	East Orange*	X	X	X	X	X		
5	Elizabeth Trailer	X	X	X	X	X		X
6	Flemington	X	X	X	X	X		X
7	Fort Lee Near Road	X	X	X	X	X		X
8	Newark Firehouse	X	X	X	X	X	X	X
9	Rider University	X	X	X	X	X	X	

*Monitoring discontinued 7/1/2016.

Figure 9-2
2016 Meteorological Monitoring Network



Legend

●	Meteorological Site
BP	Barometric Pressure
RH	Relative Humidity
S	Solar Radiation
T	Temperature
W	Wind Speed & Direction
R	Rain

Table 9-2
2016 Temperature Data (in Degrees Fahrenheit)
from NJ's Air Monitoring Sites

SITE		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Bayonne	Mean	33	36	46	51	60	71	77	78	70	58	48	37	55
	Minimum	11	1	26	26	41	53	65	64	53	39	34	16	1
	Maximum	63	62	76	78	91	86	92	95	89	83	69	57	95
Camden Spruce St.	Mean	33	38	49	53	62	73	79	80	72	59	49	38	57
	Minimum	12	8	27	30	43	55	67	64	52	39	34	16	8
	Maximum	64	65	80	82	89	91	95	97	94	85	72	63	97
Columbia	Mean	27	32	44	48	58	67	72	73	65	52	43	32	51
	Minimum	6	-2	22	22	37	46	54	55	40	29	25	6	-2
	Maximum	59	61	77	80	89	88	92	93	91	82	69	57	93
East Orange	Mean	32	35	47	51	61	71	ND	ND	ND	ND	ND	ND	*
	Minimum	9	0	27	25	39	51	ND	ND	ND	ND	ND	ND	*
	Maximum	62	61	78	79	91	89	ND	ND	ND	ND	ND	ND	*
Elizabeth Trailer	Mean	ND	ND	ND	ND	65	71	78	78	71	57	48	37	*
	Minimum	ND	ND	ND	ND	41	52	63	59	51	36	33	15	*
	Maximum	ND	ND	ND	ND	92	90	95	97	92	85	72	60	*
Flemington	Mean	29	33	45	49	59	69	75	74	66	54	45	34	53
	Minimum	7	2	22	19	37	46	56	52	39	24	22	10	2
	Maximum	62	64	78	80	89	90	94	94	92	84	71	59	94
Fort Lee Near Road	Mean	32	35	45	50	58	70	77	77	69	56	47	36	54
	Minimum	9	-2	24	24	40	52	63	61	52	36	33	15	-2
	Maximum	57	60	75	76	88	86	95	94	88	83	71	58	95
Newark Firehouse	Mean	32	36	46	51	61	71	77	77	70	56	48	36	55
	Minimum	10	0	25	25	39	52	63	61	52	37	33	15	0
	Maximum	62	61	78	78	90	88	94	95	90	83	71	59	95
Rider University	Mean	30	35	47	51	60	69	75	76	70	51	45	35	54
	Minimum	9	4	24	22	39	50	57	56	48	31	25	13	4
	Maximum	63	65	80	80	89	86	94	95	92	76	71	60	95

ND = no data
*Not enough data to determine an annual statistic.

Table 9-3
2016 Rain Data (Inches) from NJ's Air Monitoring Sites

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Bayonne	2.11	3.01	0.77	1.11	2.90	2.14	6.33	0.79	1.63	1.95	4.61	1.79	29.14
Camden Spruce St.	1.14	3.44	1.65	2.08	5.96	2.23	5.53	1.72	3.39	2.33	2.11	2.39	33.97
Columbia	1.12	3.92	0.96	1.82	3.64	3.22	3.84	3.58	3.00	1.12	2.75	1.82	30.79
Elizabeth Trailer	ND	ND	ND	ND	1.66	2.47	4.65	0.78	1.79	2.22	4.76	2.09	*
Flemington	ND	1.24	1.09	1.20	2.80	1.43	8.43	2.08	1.61	0.84	3.10	1.97	*
Fort Lee Near Road	2.50	2.96	0.95	2.20	1.73	3.27	4.29	1.54	2.16	2.29	5.73	2.30	31.92
Newark Firehouse	2.66	2.94	1.05	1.65	3.61	2.88	7.75	1.20	1.86	2.46	5.51	1.93	35.51

ND = no data
*Not able to determine an annual statistic because of missing data.

Table 9-4
2016 Relative Humidity Data (%) from NJ's Air Monitoring Sites

SITE		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Bayonne	Mean	56	59	55	50	60	56	62	61	62	65	58	58	58
	Minimum	23	29	22	11	23	22	27	29	21	27	24	31	11
	Maximum	89	91	89	87	90	88	89	86	88	89	89	90	91
Camden Spruce St	Mean	54	56	52	50	61	54	60	59	59	62	54	54	56
	Minimum	21	25	17	13	18	15	26	28	24	23	21	26	13
	Maximum	90	91	90	88	90	88	91	90	88	90	90	90	91
Columbia	Mean	59	59	55	53	67	66	72	75	72	71	64	63	65
	Minimum	21	25	18	13	18	25	30	33	25	26	20	28	13
	Maximum	92	92	91	90	92	92	92	93	92	92	92	91	93
East Orange	Mean	52	55	51	47	58	52	ND	ND	ND	ND	ND	ND	*
	Minimum	15	22	19	10	19	19	ND	ND	ND	ND	ND	ND	*
	Maximum	90	90	88	86	89	89	ND	ND	ND	ND	ND	ND	*
Elizabeth Trailer	Mean	ND	ND	ND	ND	55	55	62	61	61	64	57	56	*
	Minimum	ND	ND	ND	ND	18	20	27	30	21	22	20	22	18
	Maximum	ND	ND	ND	ND	93	92	92	89	91	91	91	92	93
Flemington	Mean	61	62	56	55	67	61	69	72	69	69	62	63	64
	Minimum	29	28	20	14	22	20	25	33	26	24	20	27	14
	Maximum	92	93	92	90	93	92	93	93	93	92	92	93	93
Fort Lee Near Road	Mean	54	56	53	50	57	53	60	59	61	65	56	57	57
	Minimum	20	22	21	9	18	18	23	30	24	33	18	23	9
	Maximum	92	93	91	89	92	92	90	88	90	91	90	91	93
Newark Firehouse	Mean	53	55	53	49	60	55	62	61	61	65	56	56	57
	Minimum	20	22	19	11	20	18	27	32	19	22	21	25	11
	Maximum	93	94	91	89	93	92	92	90	90	91	90	92	94
Rider University	Mean	63	66	58	56	70	68	72	67	63	67	67	64	65
	Minimum	20	25	17	13	20	27	28	34	27	43	25	24	13
	Maximum	99	100	99	97	99	98	95	94	88	95	96	95	100

ND = no data
* Not able to determine an annual statistic because of missing data.

Table 9-5
2016 Solar Radiation Data (in Langleys) from NJ's Air Monitoring Sites

SITE		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Newark Firehouse	Mean	0.110	0.133	0.225	0.293	0.265	0.368	0.337	0.326	0.238	0.151	0.116	0.081	0.220
	Maximum	0.737	0.929	1.188	1.324	1.391	1.421	1.375	1.345	1.255	0.976	0.749	0.639	1.421
Rider University	Mean	0.106	0.122	0.219	0.274	0.265	0.369	0.336	0.312	0.226	0.159	0.110	0.070	0.214
	Maximum	0.698	0.887	1.137	1.246	1.345	1.338	1.287	1.296	1.136	0.926	0.721	0.547	1.345

Table 9-6
2016 Average Barometric Pressure Data (in inches of Hg)
from NJ's Air Monitoring Sites

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Bayonne	29.97	29.98	30.00	30.00	29.94	29.90	29.92	30.01	30.06	30.07	30.01	30.08	30.00
Camden Spruce St	29.99	29.99	30.00	29.99	29.95	29.91	29.93	30.01	30.05	30.09	30.05	30.11	30.01
Columbia	29.46	29.46	29.48	29.48	29.44	29.42	29.45	29.51	29.57	29.58	29.52	29.56	29.49
East Orange	29.80	29.81	29.84	29.83	29.77	29.74	ND	ND	ND	ND	ND	ND	*
Elizabeth Trailer	ND	ND	ND	ND	29.97	29.89	29.91	30.00	30.05	30.07	30.00	30.08	*
Flemington	29.77	29.83	29.85	29.85	29.79	29.76	29.78	29.87	29.91	29.93	29.87	29.94	29.85
Fort Lee Near Road	29.64	29.66	29.68	29.68	29.62	29.59	29.62	29.71	29.76	29.74	29.69	29.75	29.68
Newark Firehouse	29.86	29.87	29.89	29.88	29.83	29.79	29.82	29.90	29.95	29.97	29.91	29.98	29.89
Rider University	30.23	30.23	30.25	30.25	30.19	29.99	29.83	29.92	29.96	29.93	29.92	29.99	30.06

ND = no data
* Not able to determine an annual statistic because of missing data.

Figure 9-3
2016 Average Temperatures at NJDEP Air Monitoring Sites
Compared to the Statewide 30-Year Average

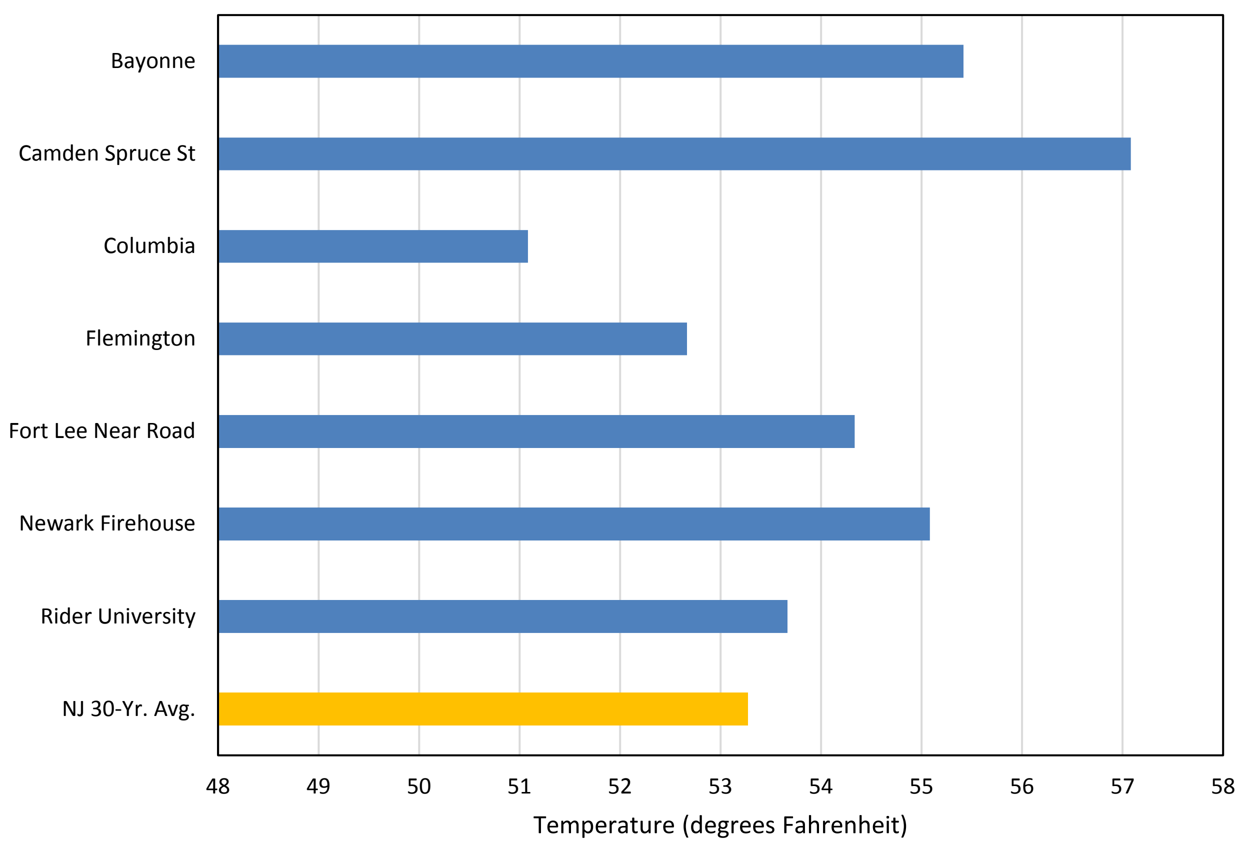
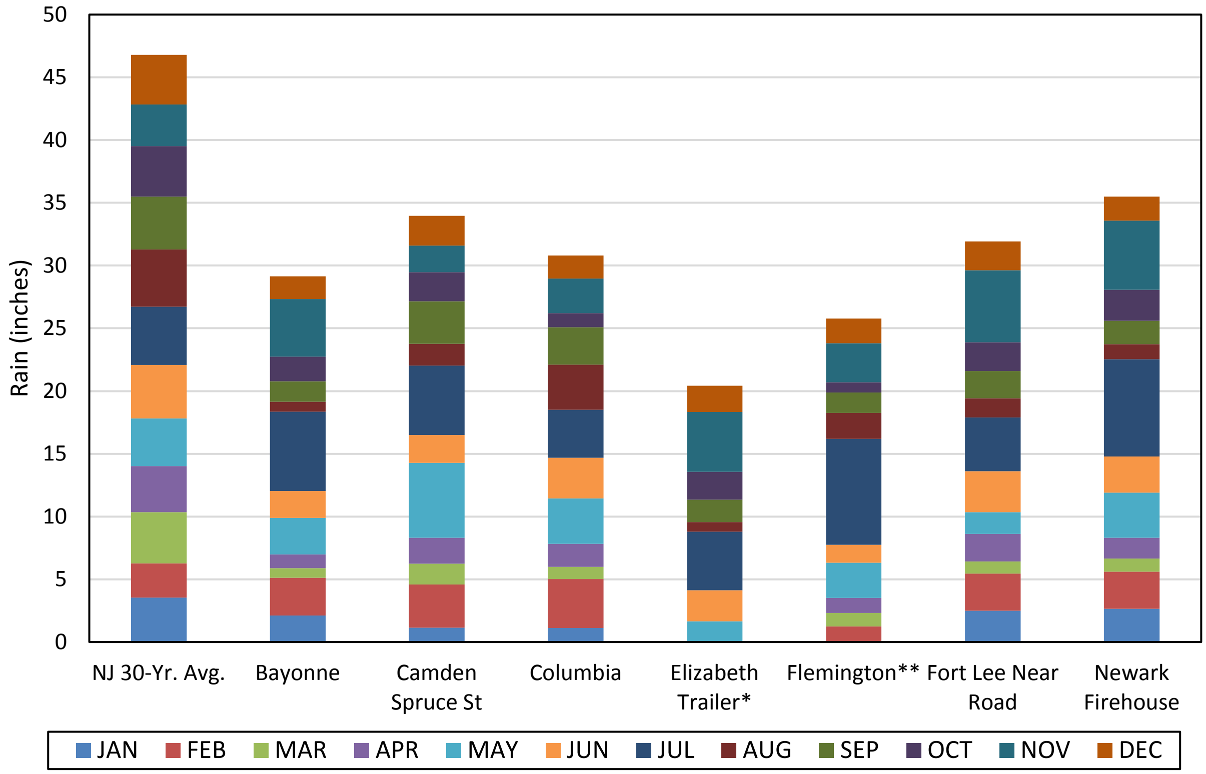


Figure 9-4
2016 Total Rainfall at NJDEP Air Monitoring Sites
Compared to the Statewide 30-Year Average



*Elizabeth Trailer missing data from January through April.
**Flemington missing January data.

Wind Roses - Distribution of Wind Speed & Wind Direction

Figure 9-5. 2016 Wind Rose for Bayonne

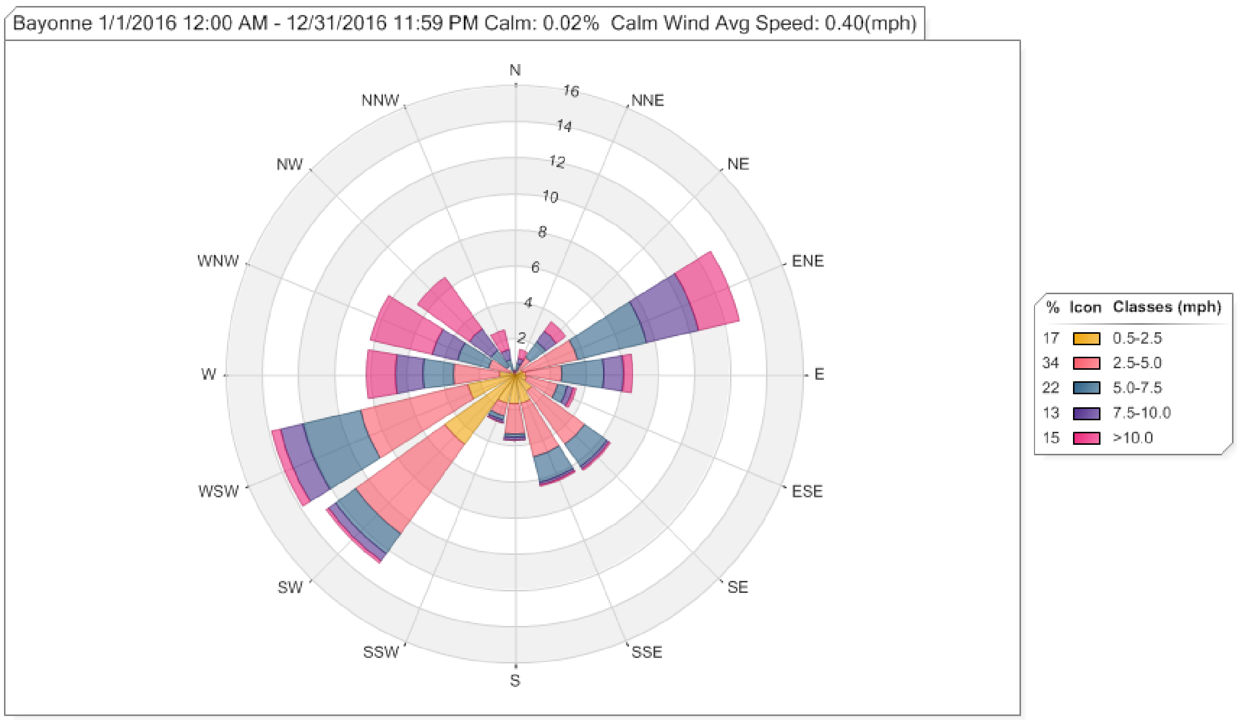


Figure 9-6. 2016 Wind Rose for Camden Spruce Street

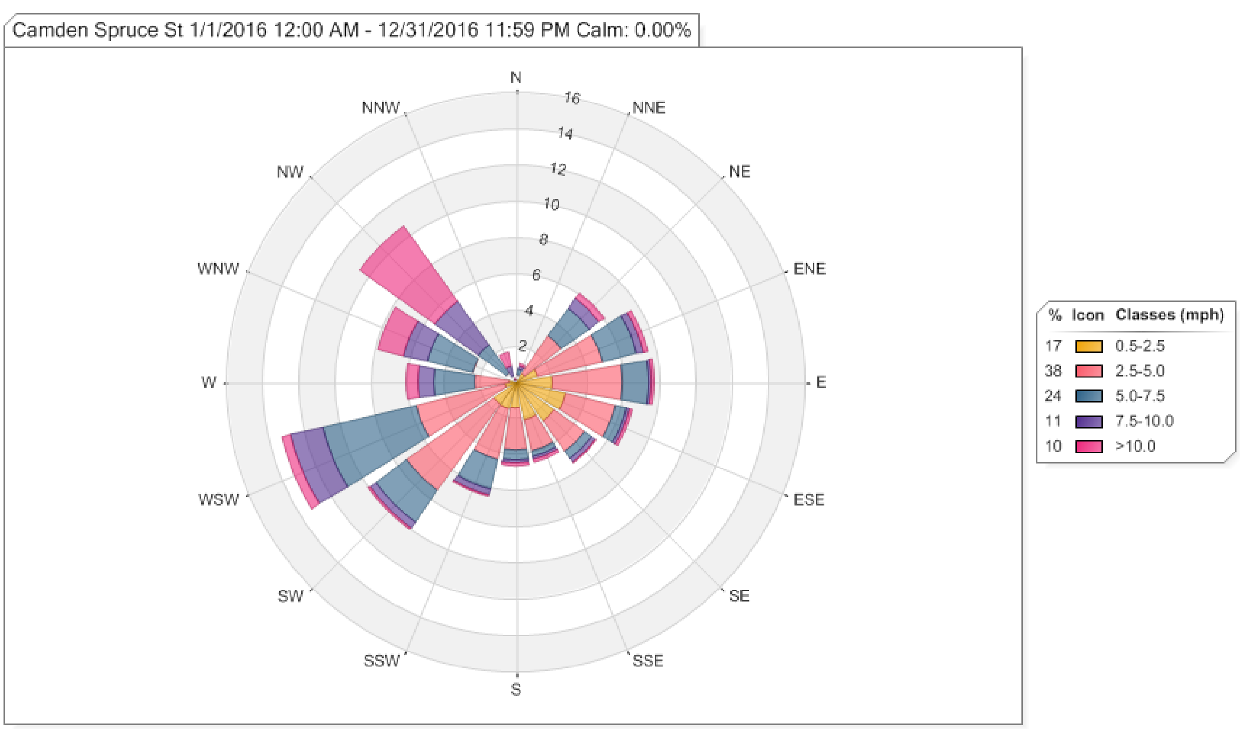


Figure 9-7. 2016 Wind Rose for Columbia

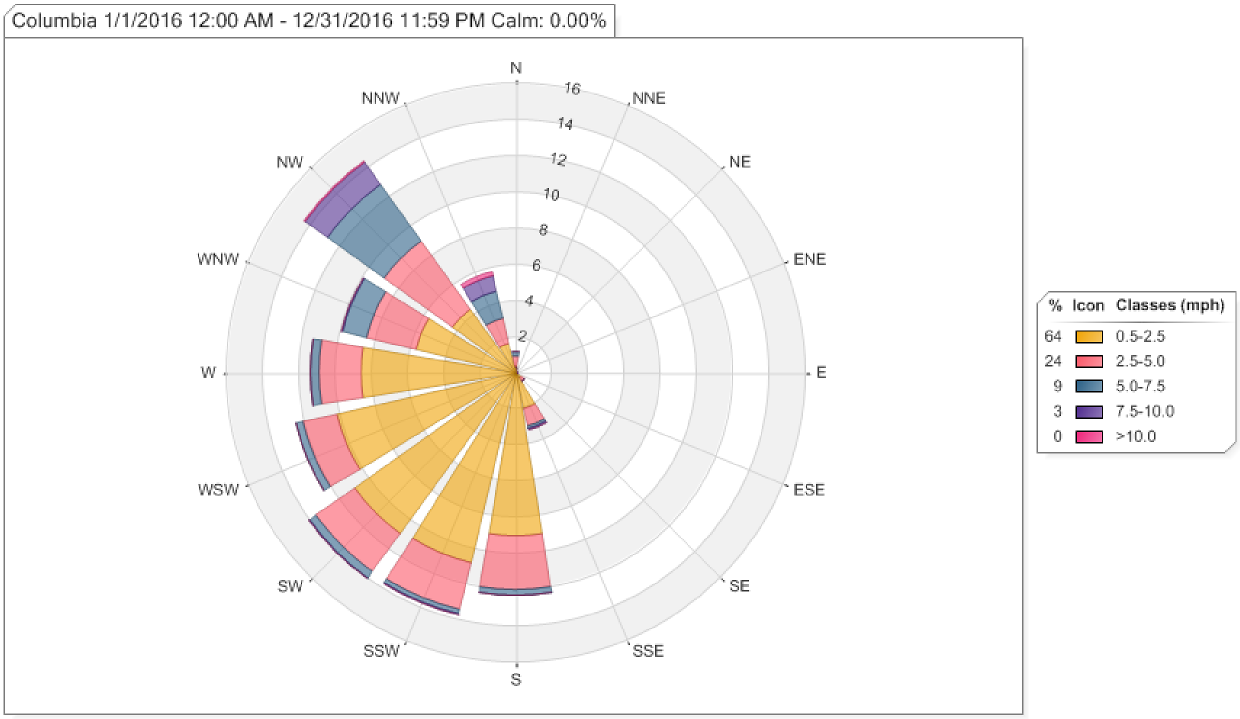


Figure 9-8. 2016 Wind Rose for Elizabeth Trailer

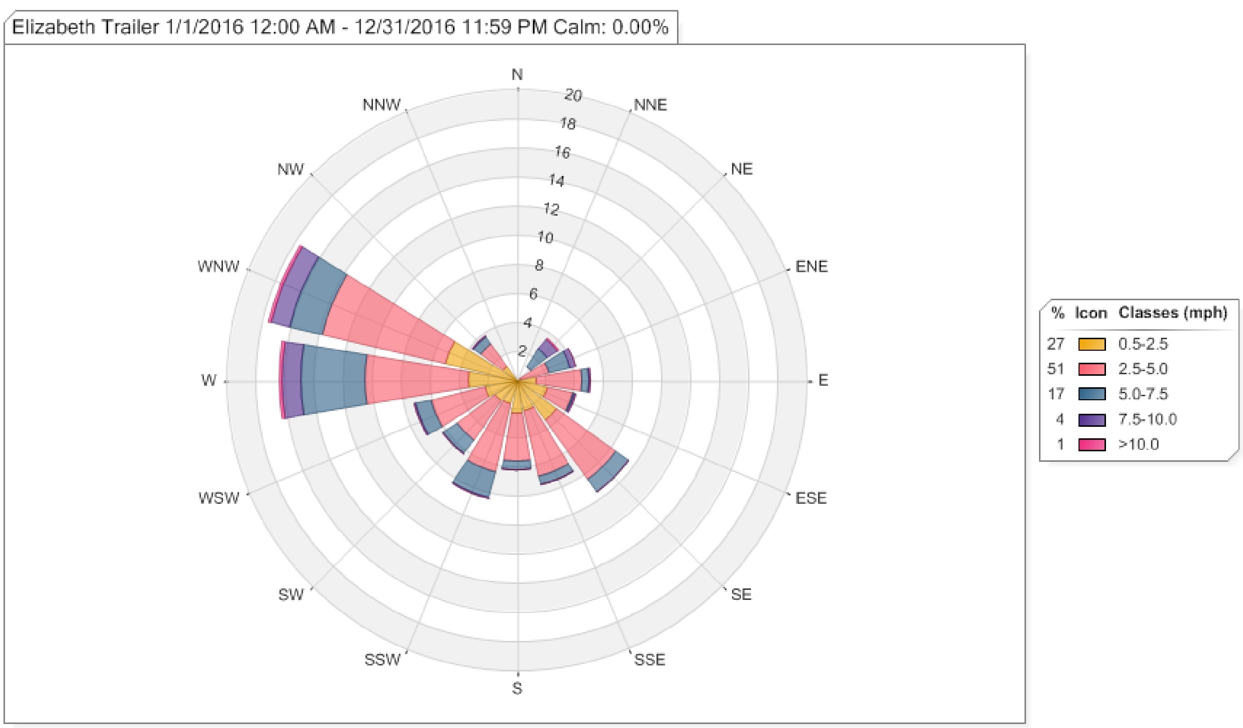


Figure 9-9. 2016 Wind Rose for Flemington

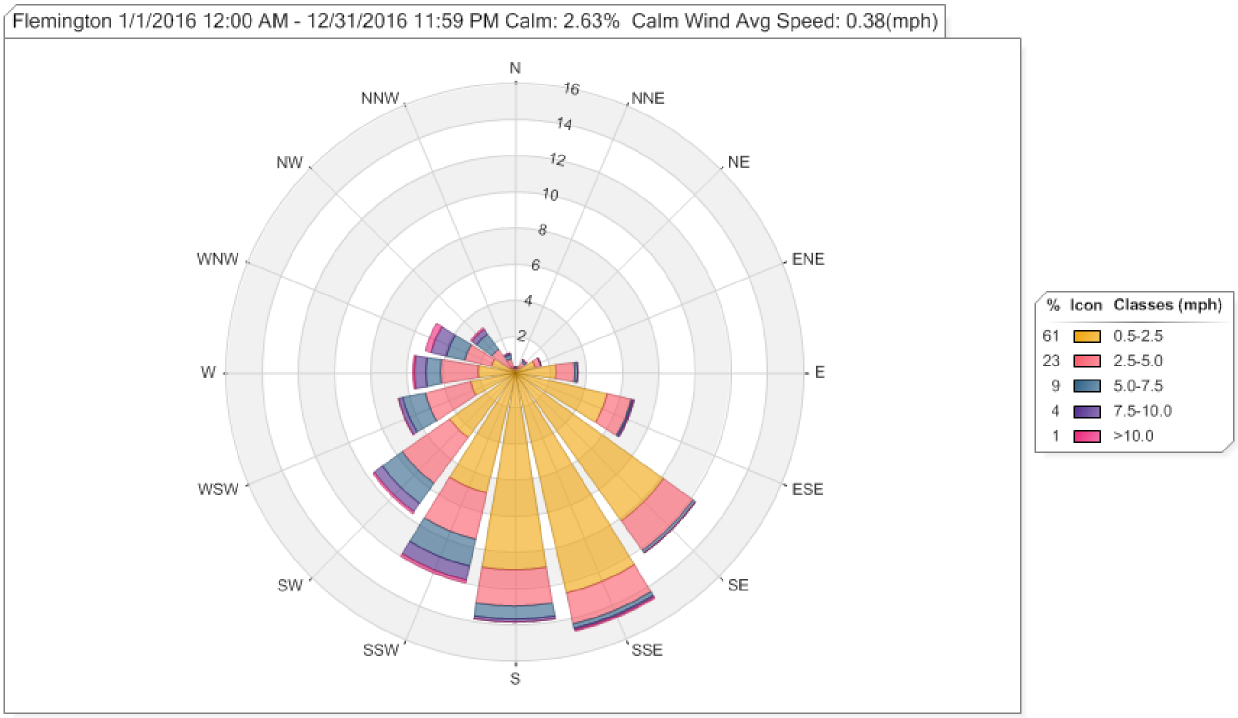


Figure 9-10. 2016 Wind Rose for Fort Lee Near Road

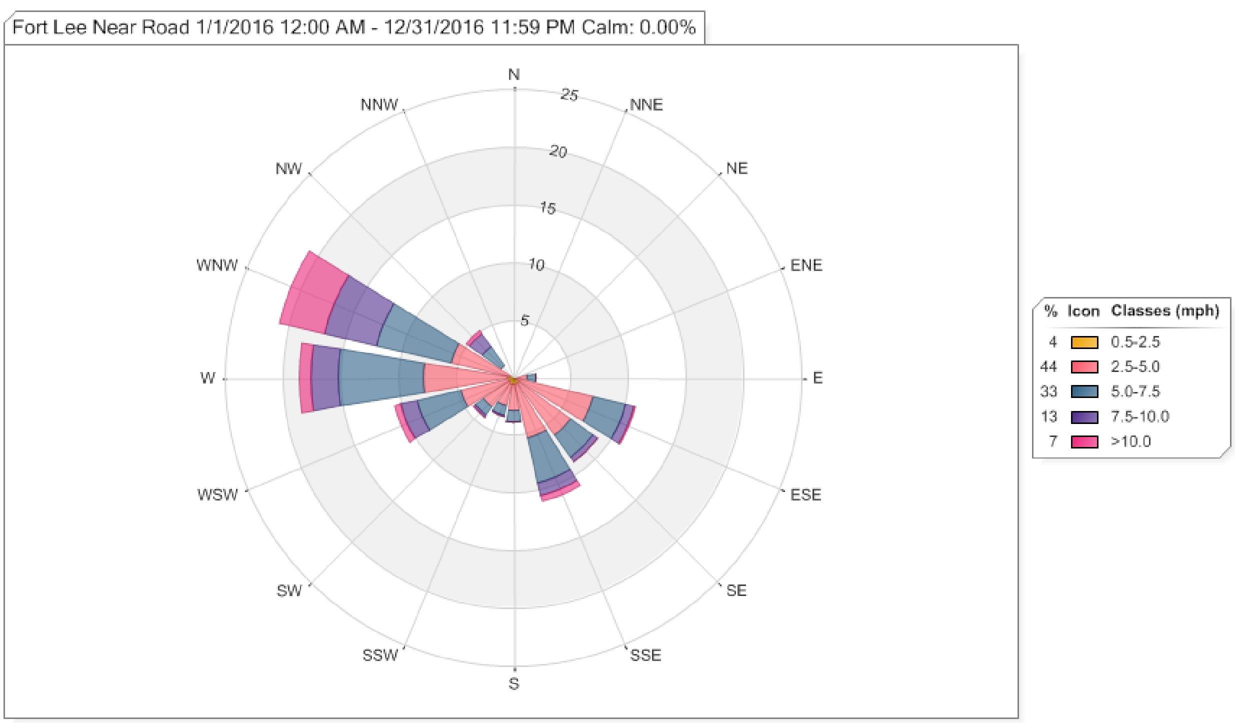


Figure 9-11. 2016 Wind Rose for Newark Firehouse

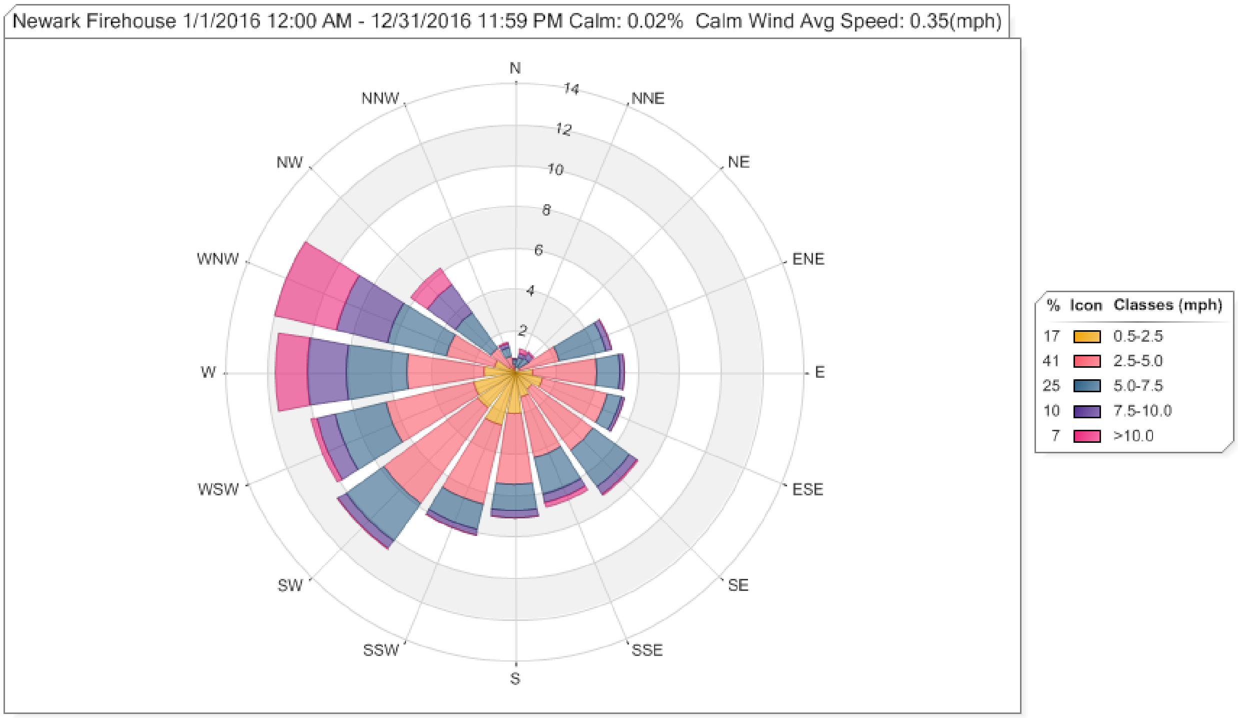
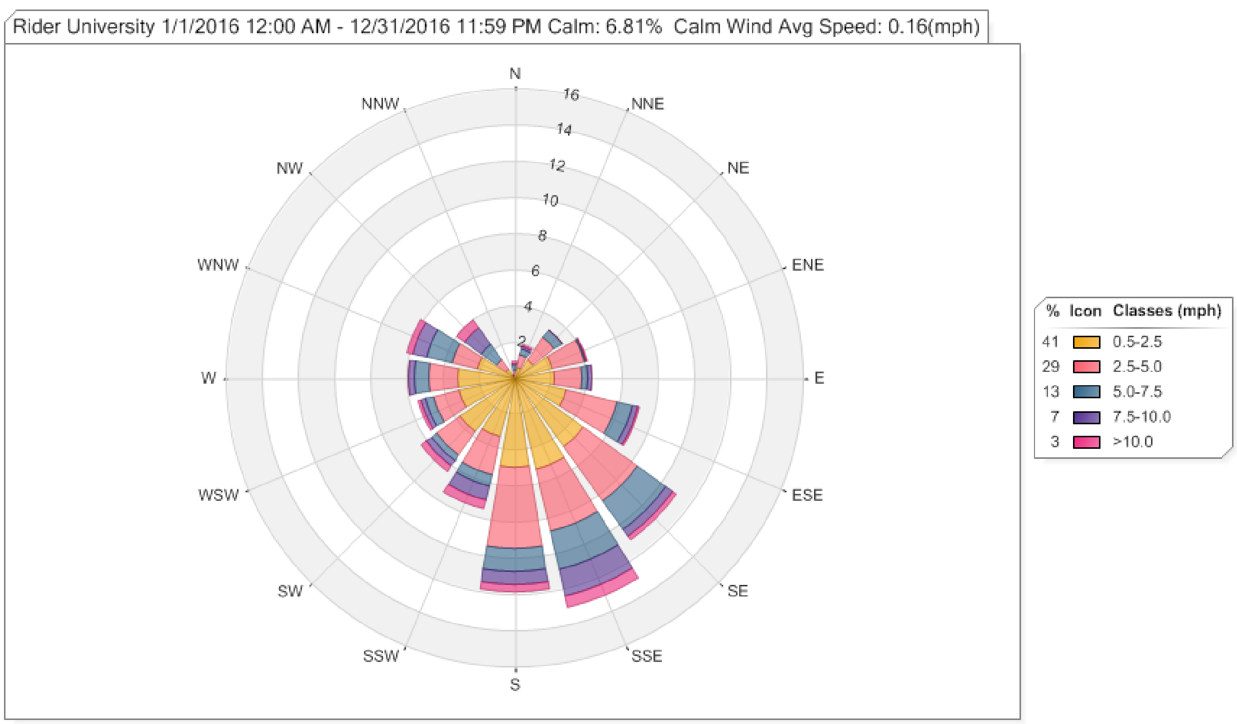


Figure 9-12. 2016 Wind Rose for Rider University



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2016 Air Toxics Summary

New Jersey Department of Environmental Protection

INTRODUCTION

Air pollutants can be generally divided into two categories: criteria pollutants (ozone, sulfur dioxide, carbon monoxide, nitrogen dioxide, particulate matter, and lead); and air toxics. The criteria pollutants have been addressed at the national level since the 1970s. The United States Environmental Protection Agency (USEPA) has set National Ambient Air Quality Standards (NAAQS) for them, and they are subject to a standard planning process that includes monitoring, reporting, and control requirements. Each of these pollutants is discussed in its own section of this New Jersey Department of Environmental Protection (NJDEP) 2016 Air Quality Report.

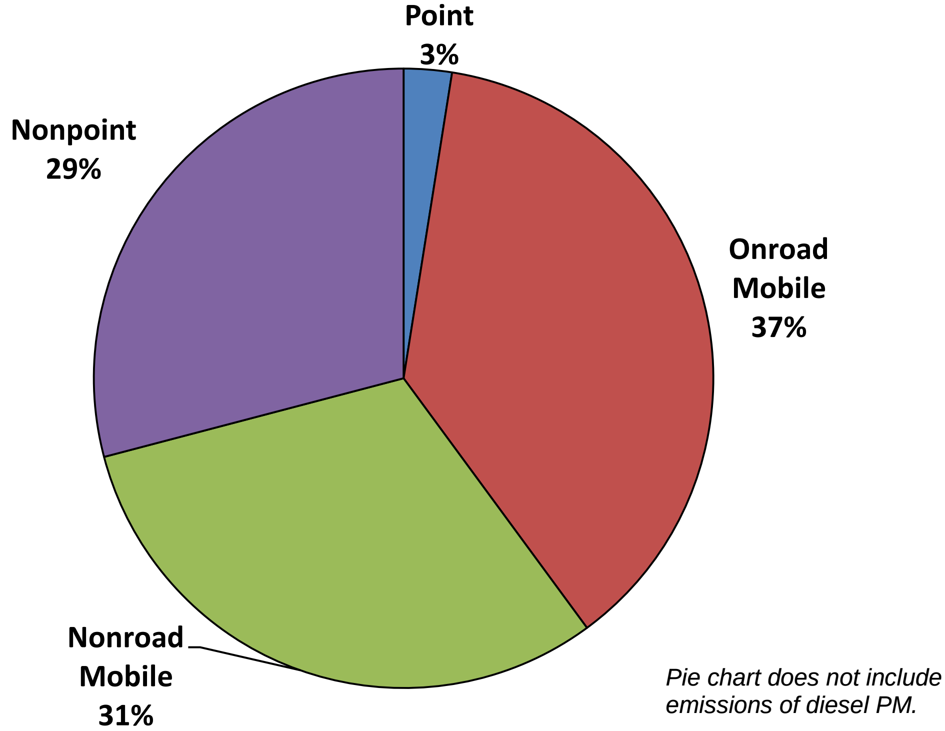
Air toxics are basically all the other chemicals released into the air that have the potential to cause adverse health effects in humans. These effects cover a wide range of conditions, from lung irritation to birth defects to cancer. There are no NAAQS for these pollutants, but in 1990 the U.S. Congress directed the USEPA to begin addressing a list of almost 200 air toxics by developing control technology standards for specific categories of sources that emit them. These air toxics are known as the Clean Air Act Hazardous Air Pollutants (HAPs). You can get more information about HAPs at the USEPA Air Toxics web site at www.epa.gov/ttn/atw. NJDEP also has several web pages dedicated to air toxics. They can be accessed at www.nj.gov/dep/airtoxics.

SOURCES OF AIR TOXICS

USEPA compiles a National Emissions Inventory (NEI) every three years. In addition to criteria pollutants and criteria precursors, it also collects information on emissions of hazardous air pollutants. This data is then used for the National-Scale Air Toxics Assessment (NATA), which combines emissions data and complex dispersion and exposure models to estimate the public's exposure to air toxics around the country. The pie chart in Figure 10-1, taken from the 2011 NEI, shows that mobile sources are the largest contributors of air toxics emissions in New Jersey. More information can be found at www.epa.gov/national-air-toxics-assessment.

In New Jersey, on-road mobile sources (cars and trucks) account for 37% of the air toxics emissions, and non-road mobile sources (airplanes, trains, construction equipment, lawnmowers, boats, dirt bikes, etc.) contribute an additional 31%. Nonpoint sources (residential, commercial, and small industrial sources) represent 29% of the inventory, and point sources (such as factories and power plants) account for the remaining 3%.

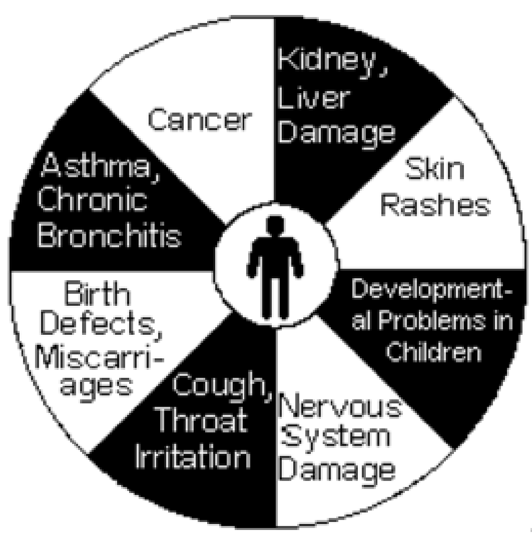
Figure 10-1
2011 Air Toxics Emissions Source Estimates for New Jersey



HEALTH EFFECTS

People exposed to significant amounts of air toxics may have an increased chance of developing cancer or experiencing other serious health effects. The noncancer health effects can range from respiratory, neurological, reproductive, developmental, or immune system damage, to irritation and effects on specific organs (see Figure 10-2). In addition to inhalation exposure, there can be risks from the deposition of toxic pollutants onto soil or surface water. There, they can be taken up by humans directly, or by consuming exposed plants and animals.

Figure 10-2
Potential Effects of Air Toxics

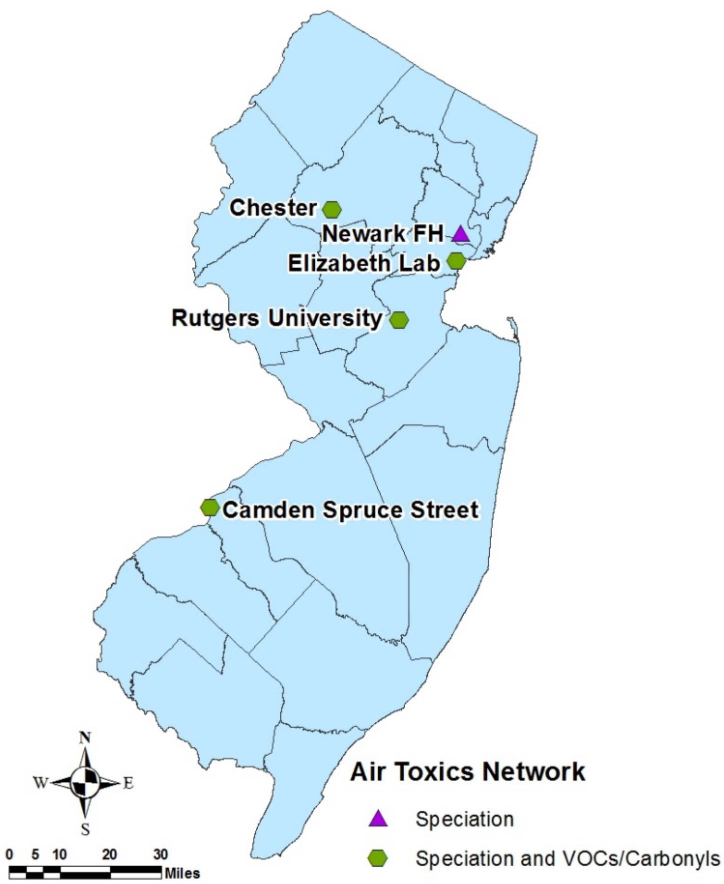


Source: www3.epa.gov/ttn/atw/3_90_024.html

MONITORING LOCATIONS

NJDEP has four air toxics monitoring sites that measure volatile organic compounds (VOCs) and carbonyls, a subset of VOCs that includes formaldehyde, acetaldehyde and other related compounds. As shown in Figure 10-3, they are located in Camden, Chester, Elizabeth, and at Rutgers University in East Brunswick. Toxic metals data are collected at the same four monitoring stations plus Newark Firehouse.

Figure 10-3
2016 Air Toxics Monitoring Network



The Chester monitoring site is in rural Morris County, away from known sources, and serves as kind of a "background" monitor. The Rutgers University monitoring station is in a suburban setting on Rutgers agricultural lands in East Brunswick. In 2016 both the VOC and metals monitors were relocated to the new Rutgers station from the New Brunswick monitoring site, about eight-tenths of a mile away. The Elizabeth Lab monitoring station sits next to the Exit 13 tollbooths on the New Jersey Turnpike. The Camden Spruce Street monitoring station is located in an industrial urban setting. The Newark Firehouse monitoring station is in an urban residential area. More information about the air monitoring sites can be found in the Air Monitoring Network section and Appendix A of the annual Air Quality Report.

A previous monitoring site in Camden (officially called the Camden Lab site) had been measuring toxic VOCs since 1989. It was shut down in 2008 when NJDEP lost access to the location. A new monitoring station, the Camden Spruce Street monitoring site, became operational in 2013. The Elizabeth Lab site began measuring VOCs in 2000, and the New Brunswick and Chester sites started in July 2001. The new Rutgers site began measuring VOCs in January 2016. New Jersey's VOC monitors are part of the Urban Air Toxics Monitoring Program (UATMP), sponsored by the USEPA. A 24-hour integrated air sample is collected in a canister every six days, and then sent to the USEPA contract laboratory (ERG, located in North Carolina) to be analyzed for VOCs and carbonyls.

Analysis of metals at Camden Spruce Street, Chester, Elizabeth Lab and New Brunswick also began in 2001 as part of USEPA's Chemical Speciation Network (CSN). The Newark Firehouse site was added in 2010. In July 2016 the CSN monitor was moved from the New Brunswick site to Rutgers. The CSN was established to characterize the metals, ions and carbon constituents of $PM_{2.5}$. Filters are collected every three or six days and sent to a national lab for analysis. In 2016, USEPA switched to a different laboratory for CSN analysis and initiated a state review process, resulting in a delay in processing and finalizing samples. This report does not include 2016 information for toxic metals because of this delay. When it is available, data from the CSN monitors will be published in Appendix B (Fine Particulate Speciation Summary) of the annual Air Quality Report.

NEW JERSEY AIR TOXICS MONITORING RESULTS FOR 2016

2016 air toxic monitoring results for VOCs and carbonyls are shown in Table 10-1. This table contains the annual average concentration for each air toxic measured at the four New Jersey monitoring sites. All values are in micrograms per cubic meter ($\mu g/m^3$). More detail can be found in Tables 10-4 through 10-7, including additional statistics, detection limit information, health benchmarks used by NJDEP, risk ratios, and concentrations in parts per billion by volume (ppbv). The ppbv units are more common in air monitoring, while $\mu g/m^3$ units are generally used in air dispersion modeling and health studies. A number of compounds that were analyzed were mostly below the detection limit of the method used (see Table 10-9). However, this does not mean they are not present in the air below the detection limit level.

For chemicals with less than 50% of the samples above the detection limit, there is significant uncertainty in the calculated averages. Median values (the value of the middle sample value when the results are ranked) are reported in Tables 10-4 through 10-7 along with the mean (average) concentrations because for some compounds only a single or very few high values were recorded. These high values will tend to increase the average concentrations, but would have less effect on the median value. In such cases, the median value may be a better indicator of long-term exposures.

USEPA has determined that the methods used to collect and analyze acrolein in ambient air are not producing reliable results. More information is available at http://archive.epa.gov/schoolair/web/html/acrolein.html. Although we are including the 2016 New Jersey acrolein data in this report, the concentrations are highly uncertain and should be viewed as such.

Table 10-1
2016 Summary of Toxic Volatile Organic Compounds Monitored in New Jersey

Annual Average Concentration
Micrograms per Cubic Meter (μg/m³)

	Pollutant	Synonym	HAP	CAS No.	Camden	Chester	Elizabeth	Rutgers
1	Acetaldehyde		*	75-07-0	2.467	0.938	2.018	1.323
2	Acetone			67-64-1	2.805	1.596	2.445	1.888
3	Acetonitrile		*	75-05-8	1.480	4.977	0.369	0.378
4	Acetylene			74-86-2	0.939	0.422	1.097	0.713
5	Acrolein[a]		*	107-02-8	0.853	0.737	0.841	0.886
6	Acrylonitrile		*	107-13-1	ND	ND	ND	ND
7	tert-Amyl Methyl Ether			994-05-8	*0.001*	*0.001*	*0.001*	*0.003*
8	Benzaldehyde			100-52-7	0.926	0.069	0.220	0.145
9	Benzene		*	71-43-2	0.742	0.344	0.828	0.515
10	Bromochloromethane			74-97-5	*0.011*	*0.012*	*0.008*	*0.011*
11	Bromodichloromethane			75-27-4	*0.013*	*0.011*	*0.001*	*0.018*
12	Bromoform		*	75-25-2	*0.011*	*0.008*	*0.006*	*0.019*
13	Bromomethane	Methyl bromide	*	74-83-9	0.407	0.070	0.074	0.080
14	1,3-Butadiene		*	106-99-0	0.082	0.017	0.124	0.059
15	Butyraldehyde			123-72-8	0.434	0.122	0.416	0.244
16	Carbon Disulfide		*	75-15-0	0.057	0.046	0.054	ND
17	Carbon Tetrachloride		*	56-23-5	0.629	0.612	0.620	0.619
18	Chlorobenzene		*	108-90-7	*0.006*	*0.009*	*0.005*	*0.017*
19	Chloroethane	Ethyl chloride	*	75-00-3	0.047	*0.024*	0.034	0.070
20	Chloroform		*	67-66-3	0.148	0.119	0.164	0.169
21	Chloromethane	Methyl chloride	*	74-87-3	1.212	1.173	1.184	1.208
22	Chloroprene	2-Chloro-1,3-butadiene	*	126-99-8	ND	ND	ND	ND
23	Crotonaldehyde			123-73-9	0.249	0.286	0.378	0.267
24	Dibromochloromethane	Chlorodibromomethane		124-48-1	*0.026*	*0.024*	*0.017*	0.033
25	1,2-Dibromoethane	Ethylene dibromide	*	106-93-4	ND	*0.002*	*0.001*	*0.005*
26	m-Dichlorobenzene	1,3-Dichlorobenzene		541-73-1	*0.002*	*0.002*	*0.001*	*0.009*
27	o-Dichlorobenzene	1,2-Dichlorobenzene		95-50-1	*0.003*	*0.003*	*0.001*	*0.009*
28	p-Dichlorobenzene	1,4-Dichlorobenzene	*	106-46-7	0.059	*0.009*	0.044	*0.035*
29	Dichlorodifluoromethane			75-71-8	2.724	2.577	2.701	2.600
30	1,1-Dichloroethane	Ethylidene dichloride	*	75-34-3	*0.001*	*0.002*	*0.001*	*0.006*
31	1,2-Dichloroethane	Ethylene dichloride	*	107-06-2	0.077	0.065	0.075	0.079
32	1,1-Dichloroethylene	Vinylidene chloride	*	75-35-4	*0.007*	*0.004*	*0.002*	*0.008*
33	cis-1,2-Dichloroethylene	cis-1,2-Dichloroethene		156-59-2	ND	ND	ND	ND

- *Values in **italics** indicate averages based on less than 50% of samples above the detection limit.*
- **ND** indicates that all samples were below the detection limit.
- HAP = Hazardous air pollutant as listed in the Clean Air Act.

[a] Acrolein concentrations are highly uncertain because of problems with collection and analysis methods.

Table 10-1 (continued)
2016 Summary of Toxic Volatile Organic Compounds Monitored in New Jersey

Annual Average Concentration
Micrograms per Cubic Meter (µg/m³)

	Pollutant	Synonym	HAP	CAS No.	Camden	Chester	Elizabeth	Rutgers
34	trans-1,2-Dichloroethylene	trans-1,2-Dichloroethene		156-60-5	*0.005*	*0.001*	*0.004*	*0.006*
35	Dichloromethane	Methylene chloride	*	75-09-2	0.444	0.328	0.530	0.458
36	1,2-Dichloropropane	Propylene dichloride	*	78-87-5	*0.005*	*0.004*	*0.004*	*0.006*
37	cis-1,3-Dichloropropene	cis-1,3-Dichloropropylene	*	542-75-6	ND	ND	ND	ND
38	trans-1,3-Dichloropropene	trans-1,3-Dichloropropylene	*	542-75-6	ND	ND	ND	ND
39	Dichlorotetrafluoroethane	Freon 114		76-14-2	0.130	0.130	0.122	0.132
40	2,5-Dimethylbenzaldehyde			5799-94-2	*0.292*	ND	*0.004*	*0.025*
41	Ethyl Acrylate		*	140-88-5	*0.0004*	*0.0005*	ND	ND
42	Ethyl tert-Butyl Ether	tert-Butyl ethyl ether		637-92-3	0.049	*0.003*	*0.006*	0.149
43	Ethylbenzene		*	100-41-4	0.468	0.073	0.320	0.283
44	Formaldehyde		*	50-00-0	3.221	1.802	3.516	2.116
45	Hexachloro-1,3-butadiene	Hexachlorobutadiene	*	87-68-3	*0.021*	*0.018*	*0.007*	*0.027*
46	Hexaldehyde	Hexanaldehyde		66-25-1	0.241	0.051	0.527	0.160
47	Isovaleraldehyde			590-86-3	*0.041*	*0.003*	*0.211*	*0.082*
48	Methyl Ethyl Ketone	MEK		78-93-3	0.698	0.266	0.575	0.481
49	Methyl Isobutyl Ketone	MIBK	*	108-10-1	0.242	0.095	0.163	0.135
50	Methyl Methacrylate		*	80-62-6	*0.044*	*0.005*	*0.020*	*0.030*
51	Methyl tert-Butyl Ether	MTBE	*	1634-04-4	*0.013*	*0.002*	*0.006*	0.044
52	n-Octane			111-65-9	0.259	0.086	0.318	0.141
53	Propionaldehyde		*	123-38-6	1.068	0.225	0.394	0.632
54	Propylene			115-07-1	1.025	0.271	3.74	0.572
55	Styrene		*	100-42-5	3.280	*0.020*	0.073	0.090
56	1,1,2,2-Tetrachloroethane		*	79-34-5	*0.007*	*0.007*	*0.005*	*0.012*
57	Tetrachloroethylene	Perchloroethylene	*	127-18-4	0.160	0.062	0.146	0.117
58	Tolualdehydes				0.254	0.065	0.109	0.093
59	Toluene		*	108-88-3	5.885	0.396	1.824	0.934
60	1,2,4-Trichlorobenzene		*	102-82-1	*0.004*	*0.001*	ND	*0.002*
61	1,1,1-Trichloroethane	Methyl chloroform	*	71-55-6	0.035	0.024	0.027	0.036
62	1,1,2-Trichloroethane		*	79-00-5	*0.001*	ND	ND	ND
63	Trichloroethylene		*	79-01-6	*0.057*	*0.003*	*0.022*	*0.022*
64	Trichlorofluoromethane			75-69-4	2.369	1.361	1.406	1.396
65	Trichlorotrifluoroethane	1,1,2-Trichloro-1,2,2-trifluoroethane		76-13-1	0.633	0.619	0.624	*0.026*
66	1,2,4-Trimethylbenzene			95-63-6	0.678	0.053	0.331	0.188
67	1,3,5-Trimethylbenzene			108-67-8	0.208	*0.024*	0.109	0.076
68	Valeraldehyde			110-62-3	0.159	0.046	0.175	0.453
69	Vinyl chloride		*	75-01-4	0.021	*0.006*	*0.0064*	0.009
70	m,p-Xylene		*	1330-20-7	1.008	0.147	0.839	0.530
71	o-Xylene		*	95-47-6	0.479	0.068	0.365	0.260

- *Values in **italics** indicate averages based on less than 50% of samples above the detection limit.*
- **ND** indicates that all samples were below the detection limit.
- HAP = Hazardous air pollutant as listed in the Clean Air Act.

ESTIMATING HEALTH RISK

The effects on human health resulting from exposure to specific air toxics can be estimated by using chemical-specific **health benchmarks**. These are based on toxicity values developed by the USEPA and other agencies, using chemical-specific animal or human health studies. For carcinogens, chemicals suspected of causing cancer, the health benchmark is the concentration of the pollutant that corresponds to a one-in-a-million increase in the risk of getting cancer if a person was to breathe that concentration over his or her entire lifetime. The health benchmark for a noncarcinogen is the air concentration at which no adverse health effect is expected to occur, even if a person is exposed to that concentration on a daily basis for a lifetime (this is also known as a reference concentration). Not all air toxics have health benchmarks, because of a lack of toxicity studies. Available health benchmarks for the VOCs and carbonyls monitored in New Jersey are listed in Tables 10-4 through 10-7.

If ambient air concentrations exceed health benchmarks, regulatory agencies can focus their efforts on reducing emissions or exposure to those chemicals. Dividing the air concentration of a chemical by its health benchmark gives us a number referred to as a **risk ratio**. If the risk ratio is less than one, the air concentration should not pose a health risk. If it is greater than one, it may be of concern. The risk ratio also indicates how much higher or lower the estimated air concentration is compared to the health benchmark.

The pollutants with risk ratios greater than one for at least one monitoring site are summarized in Table 10-3. Table 10-4 shows the different types of sources that contribute to the levels of those pollutants in the air. Formaldehyde showed the highest risk at all four monitoring sites. Risk ratios for formaldehyde at Camden and Elizabeth were almost double those at Chester and Rutgers.

Other pollutants above health benchmarks at all four sites were acetaldehyde, benzene, carbon tetrachloride, chloroform, chloromethane (methyl chloride), and 1,2-dichloroethane (ethylene dichloride). Risk ratios for ethylbenzene and styrene were of concern at the Camden site. 1,2-Dibromoethane had a risk ratio above one only at Rutgers, but most of the samples were below the detection limit. 1,3-Butadiene was above its health benchmark at all sites except Chester. To summarize, Camden had ten pollutants with annual average concentrations that exceeded their health benchmarks, Rutgers had nine, Elizabeth had eight, and Chester had seven.

Although the mean concentrations of **acrolein** exceeded the health benchmark at all sites (see Tables 10-4 through 10-7), risk ratios were not calculated because of problems with the sampling and analysis method, as previously mentioned. 61% of ambient acrolein in New Jersey is attributed to mobile sources, 13% to background or secondary formation, 11% to point sources, and 15% to nonpoint sources.

Table 10-2
Monitored Toxic Air Pollutants with Risk Ratios Greater Than One in NJ for 2016

Pollutant		CAS No.	Risk Ratio			
			Camden	Chester	Elizabeth	Rutgers
1	Acetaldehyde	75-07-0	5	2	4	3
2	Benzene	71-43-2	6	3	6	4
3	1,3-Butadiene	106-99-0	2		4	1.8
4	Carbon Tetrachloride	56-23-5	4	4	4	4
5	Chloroform	67-66-3	3	3	4	4
6	Chloromethane	74-87-3	2	2	2	2
7	*1,2-Dibromoethane*	106-93-4				*3*
8	1,2-Dichloroethane	107-06-2	2	1.7	2	2
9	Ethylbenzene	100-41-4	1.2			
10	Formaldehyde	50-00-0	42	23	46	27
11	Styrene	100-42-5	1.8			

NOTE: Values in italics are based on less than 50% of samples above the detection limit.

Table 10-3
Sources of Air Toxics with Risk Ratios >1 in NJ

Pollutant		% Contribution from				
		Point Sources	Nonpoint Sources	On-Road Mobile Sources	Nonroad Mobile Sources	Background & Secondary Formation
1	Acetaldehyde	<1%	2%	9%	4%	84%
2	Benzene	1%	17%	52%	29%	1%
3	1,3-Butadiene	2%	13%	56%	28%	1%
4	Carbon Tetrachloride	<1%	<1%			>99%
5	Chloroform	83%	17%			0%
6	Chloromethane	<1%				>99%
7	1,2-Dibromoethane	>99%	<1%			<1%
8	1,2-Dichloroethane	7%	93%			
9	Ethylbenzene	1%	13%	58%	24%	4%
10	Formaldehyde	1%	5%	9%	8%	77%
11	Styrene	7%	23%	44%	22%	4%

TRENDS AND COMPARISONS

Monitoring of air toxics in New Jersey has been going on since a UATMP site was established in Camden in 1989. Sampling and analysis methods continue to evolve, most notably with improvements in the ability to detect chemicals at lower concentrations. Figures 10-4 through 10-14 present data for some of the VOCs that have been sampled over the past decade. As mentioned previously, the first toxics monitoring site in Camden (Camden Lab) was shut down in 2008. It is identified in Figures 10-4 through 10-14 as "Camden 1." The new Camden site (Camden Spruce Street), located about two miles from the old site, is designated "Camden 2" in the trend graphs.

According to USEPA's National Air Toxics Assessment (NATA), **acetaldehyde** concentrations in New Jersey (Figure 10-4) are primarily influenced by secondary formation, a process in which chemicals in the air react with each other and are transformed into other chemicals. Mobile sources also contribute to ambient levels. In 2003, no data was collected in Camden after September, which could have had an influence on the low annual average for that year. In 2004, high levels of acetaldehyde were measured over a number of weeks at both Camden and New Brunswick.

Figures 10-5 and 10-6 show a general decrease in **benzene** and **1,3-butadiene** concentrations over the past decade. Over 50% of New Jersey's ambient benzene and 1,3-butadiene comes from on-road mobile sources, and about 30% comes from non-road mobile sources.

Carbon tetrachloride (Figure 10-7) was once used widely as a degreaser, household cleaner, propellant, refrigerant, and fumigant. It has been phased out of most production and use because of its toxicity and its ability to deplete stratospheric ozone. However, about 100 tons are still emitted annually by industry in the U.S., although no emissions have been reported in New Jersey for years. It degrades slowly in the environment, so it can be transported from other areas, and levels in the air can remain relatively steady for a long time.

Some of the increase in **chloroform** concentrations shown in Figure 10-8 is believed to be from improvements in the detection limit. The high annual average concentration for New Brunswick in 2014 is attributable to a period of high values in May and June. Nonpoint sources and background are the major contributors to ambient chloroform levels in New Jersey. Chloroform can be formed in small amounts by chlorination of water. It breaks down slowly in ambient air.

Chloromethane (also known as methyl chloride) levels are influenced almost entirely by background, since it also degrades very slowly in the air. Figure 10-9 shows that concentrations have remained relatively stable from year to year, and that all the sites show similar levels. It was once commonly used as a refrigerant and in the chemical industry, but was phased out because of its toxicity.

1,2-Dibromoethane (or ethylene dibromide) (Figure 10-10) is currently used as a pesticide in the treatment of felled logs for bark beetles and termites, and control of wax moths in beehives. It was once used as an additive to leaded gasoline and as a soil and grain fumigant, but those uses have been banned by USEPA. Most of the monitoring results fall below the detection limit, so the data in the graph is relatively uncertain.

1,2-Dichloroethane (also called ethylene dichloride) (Figure 10-11) is primarily used in the production of chemicals, as a solvent, dispersant and wetting and penetrating agent. The increase in concentrations after 2011 is related to an improvement in the detection limit, resulting in over 90% of samples having detectable levels of 1,2-dichloroethane. The most recent National Emissions Inventory (2011) estimates that 1.3 tons were emitted by point and area sources in New Jersey. Concentrations at monitors in New Jersey are comparable to levels elsewhere.

About 82% of **ethylbenzene** is emitted from mobile sources. Improvements in mobile source emissions controls have contributed to the downward trend in air concentrations. 2001 data for Chester and New Brunswick have been omitted from the graph because of technical problems encountered when sampling began that year (Figure 10-12).

Formaldehyde (Figure 10-13) is a ubiquitous pollutant that is often found at higher concentrations indoors rather than outdoors because of its use in many consumer goods. It is used in the production of fertilizer, paper, plywood, urea-formaldehyde resins, and many other products. In New Jersey the primary emitters of formaldehyde are mobile sources, although secondary formation and transport contribute the most to high outdoor levels. In 2014, concentrations at the New Brunswick site were consistently higher than at the other monitors, although they dropped in 2015.

Styrene is used in the production of polystyrene plastics and resins. A significant amount also comes from mobile sources. A possible source of the higher concentrations at the Camden Spruce Street monitor (see Figure 10-14) is being investigated but has not yet been identified.

Figure 10-4
ACETALDEHYDE – New Jersey Monitored Concentrations

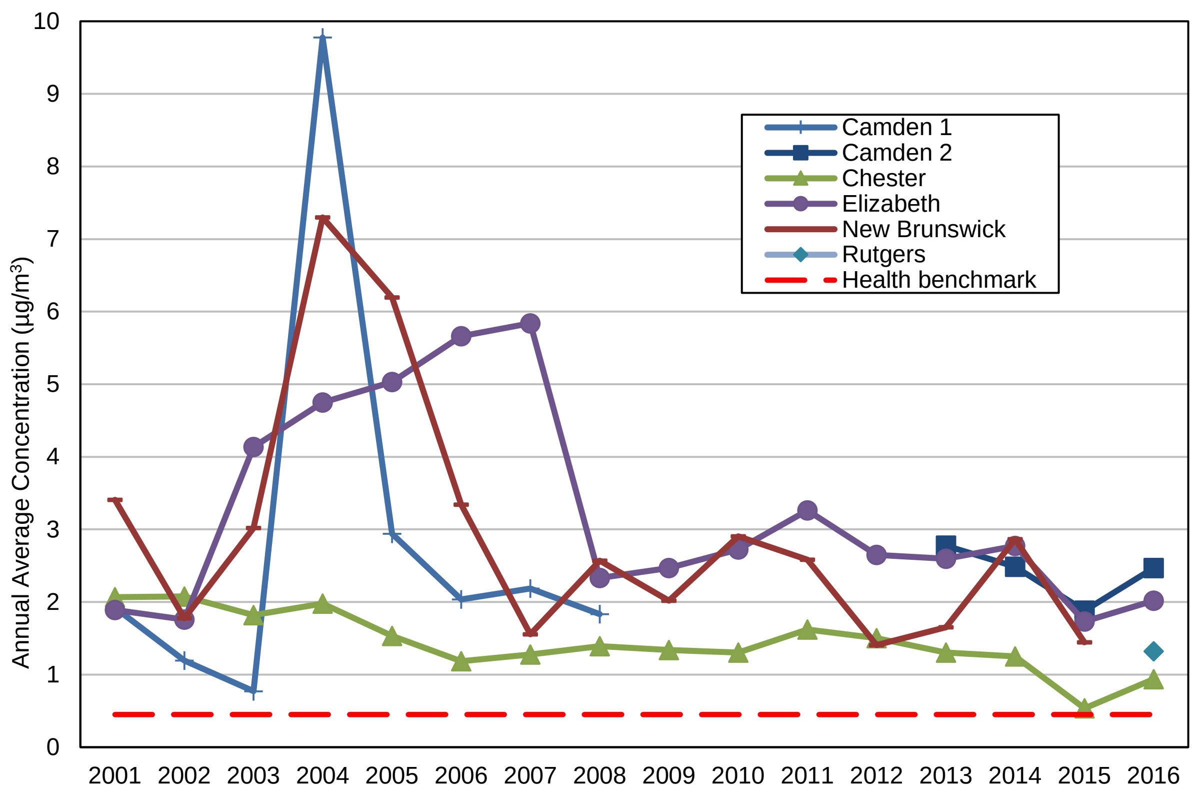


Figure 10-5
BENZENE – New Jersey Monitored Concentrations

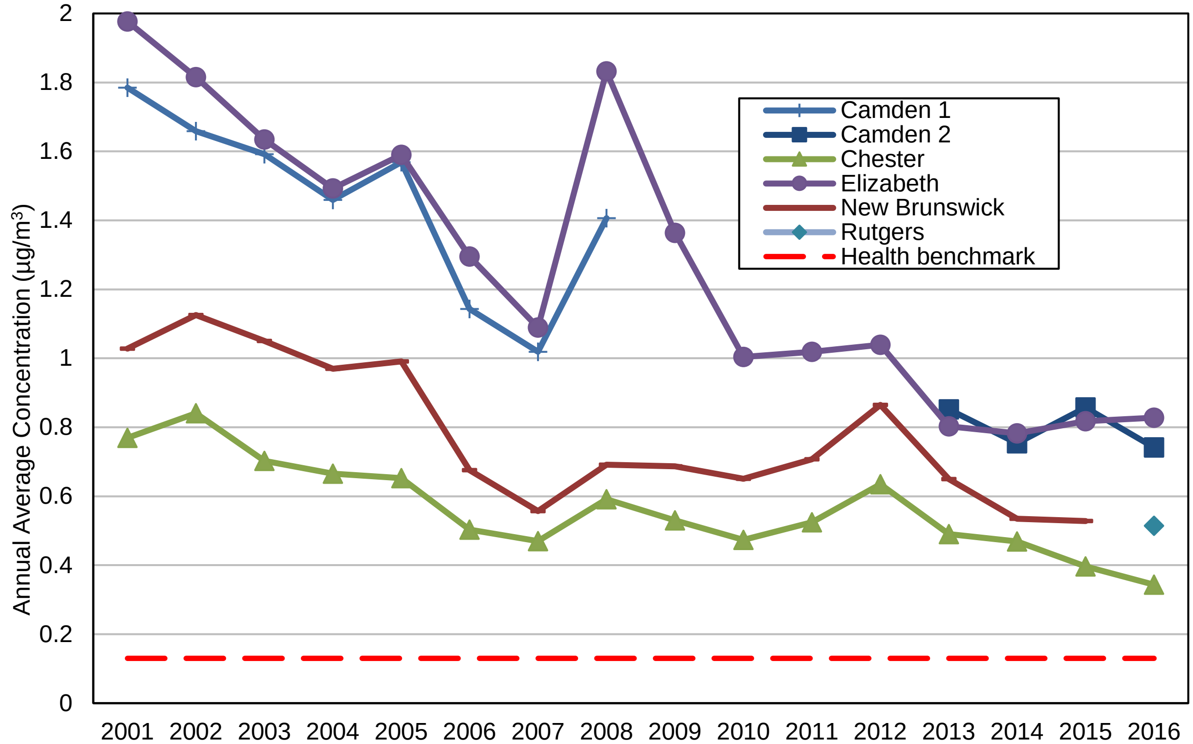


Figure 10-6
1,3-BUTADIENE – New Jersey Monitored Concentrations

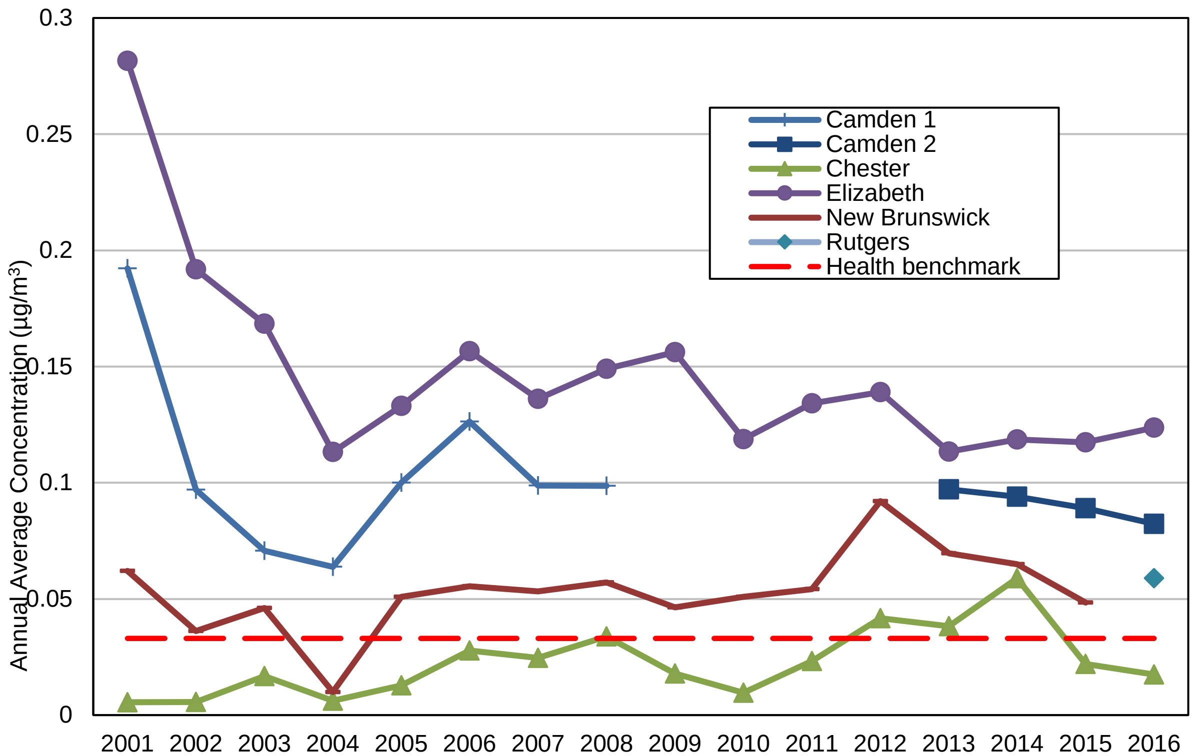


Figure 10-7

CARBON TETRACHLORIDE – New Jersey Monitored Concentrations

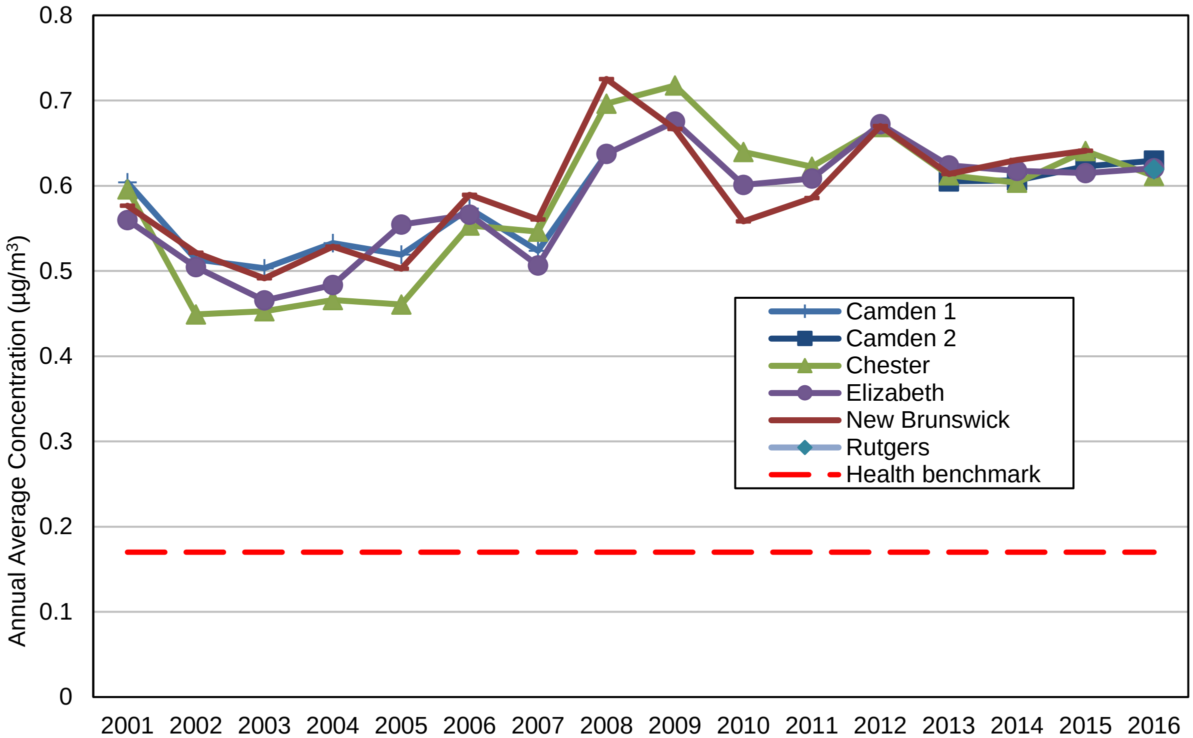


Figure 10-8

CHLOROFORM – New Jersey Monitored Concentrations

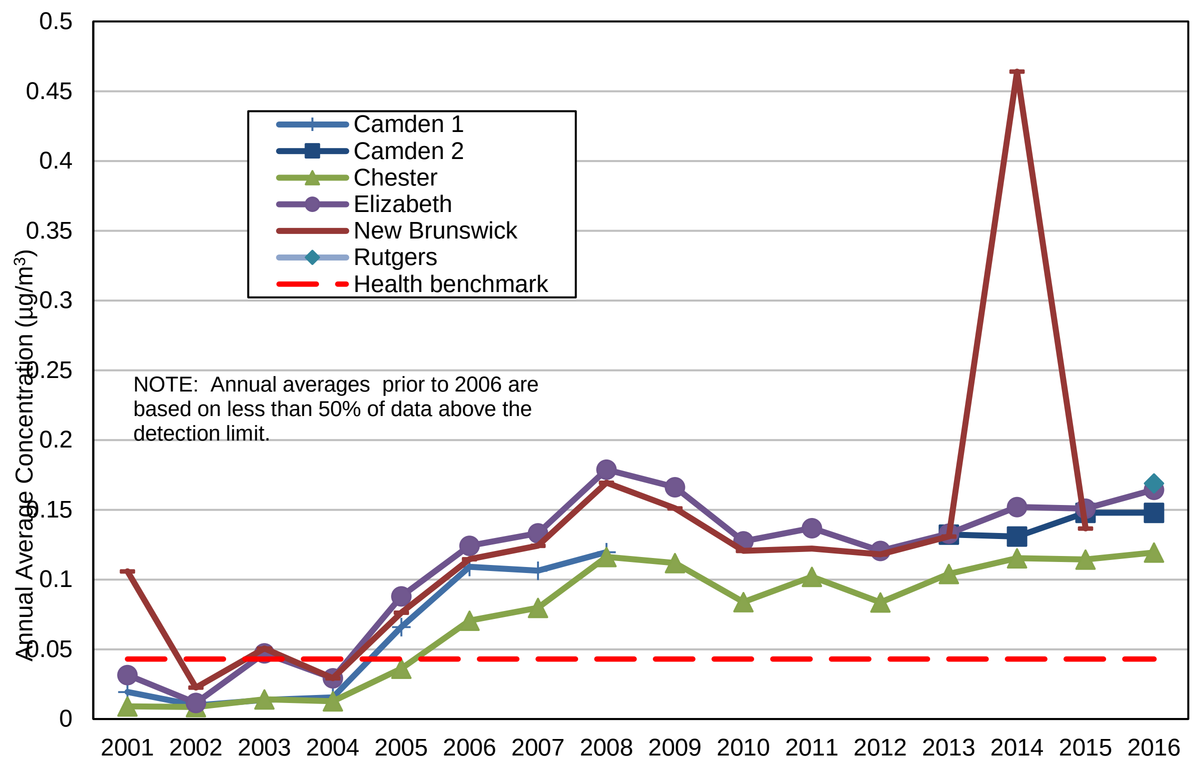


Figure 10-9

CHLOROMETHANE (Methyl Chloride) – New Jersey Monitored Concentrations

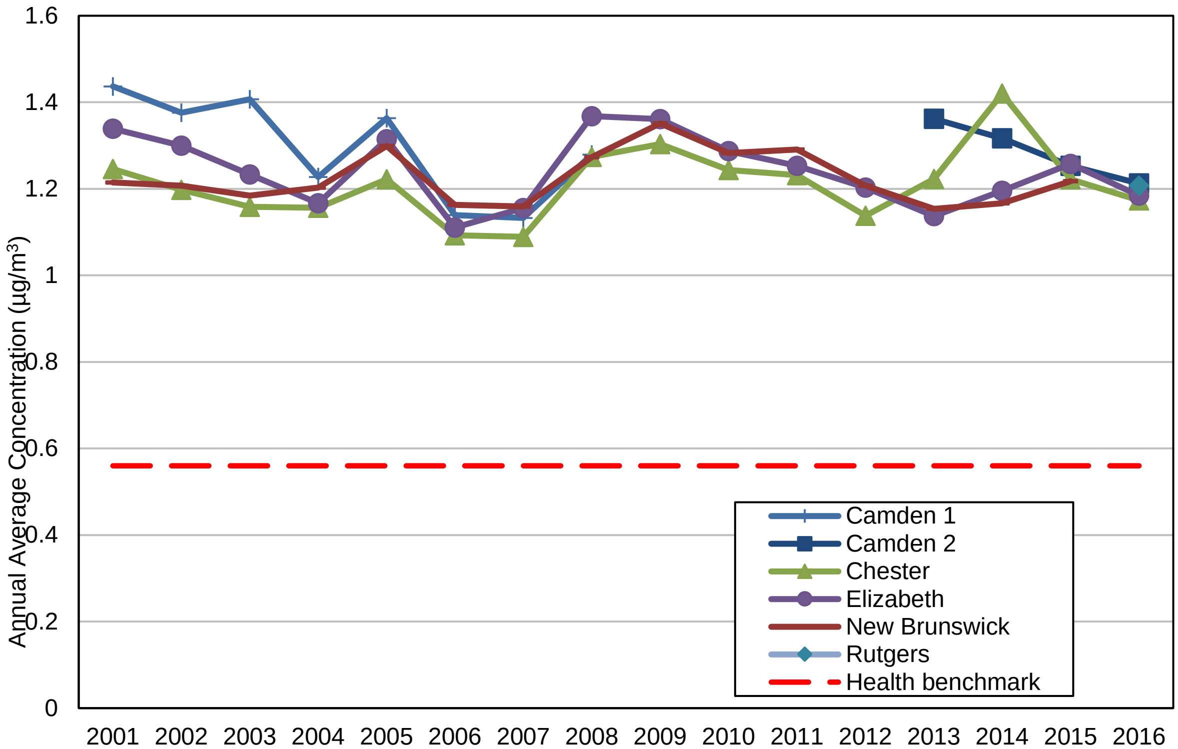


Figure 10-10

1,2-DIBROMOETHANE (Ethylene Dibromide) – New Jersey Monitored Concentrations

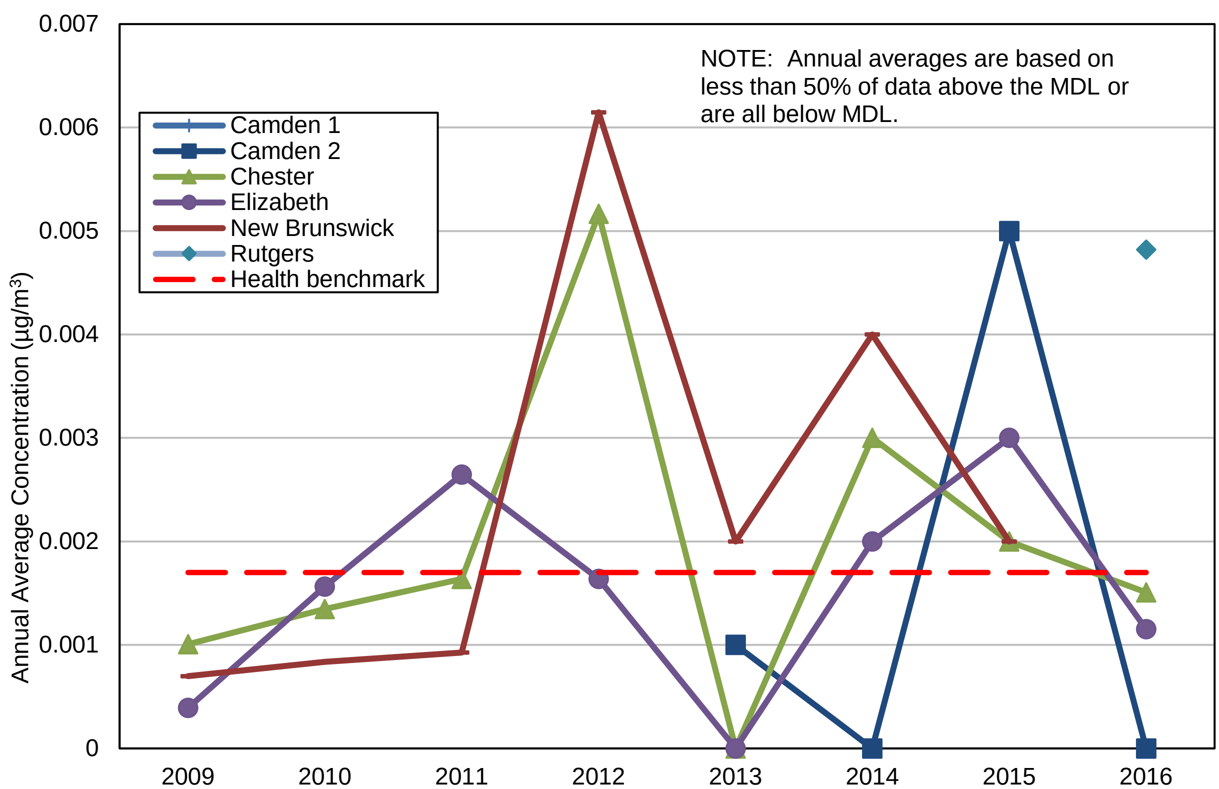


Figure 10-11

1,2-DICHLOROETHANE (Ethylene Dichloride) – New Jersey Monitored Concentrations

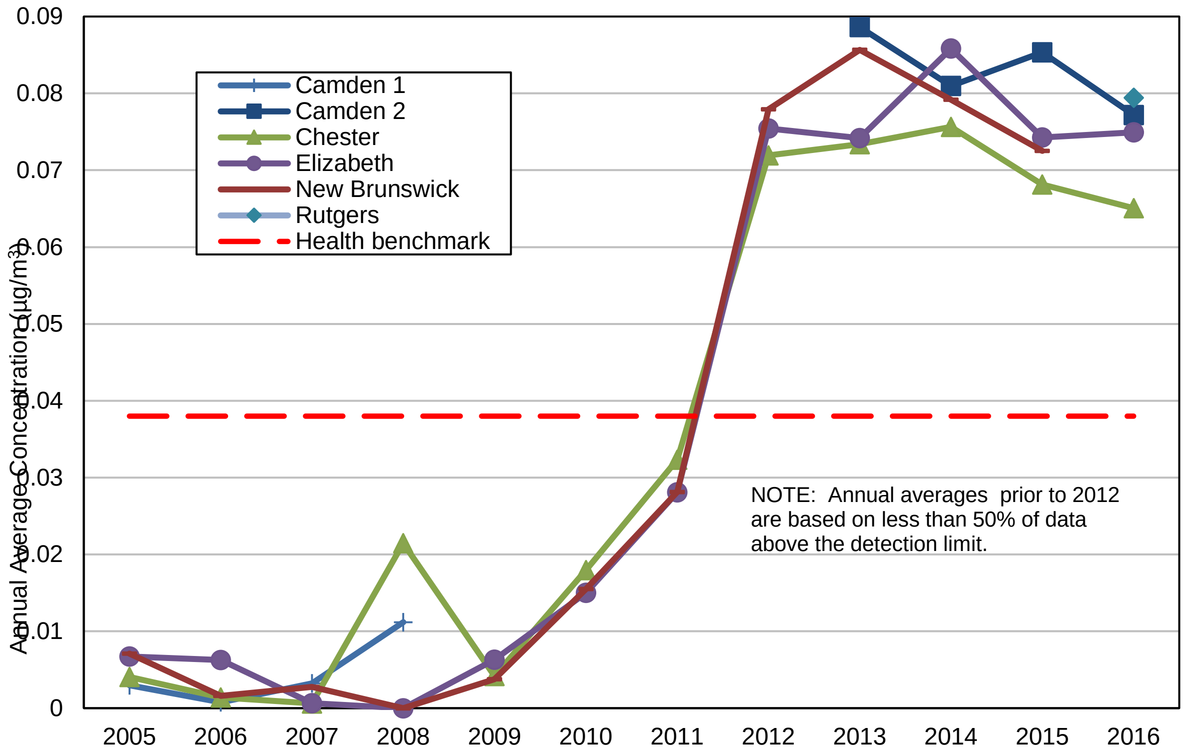


Figure 10-12

ETHYLBENZENE – New Jersey Monitored Concentrations

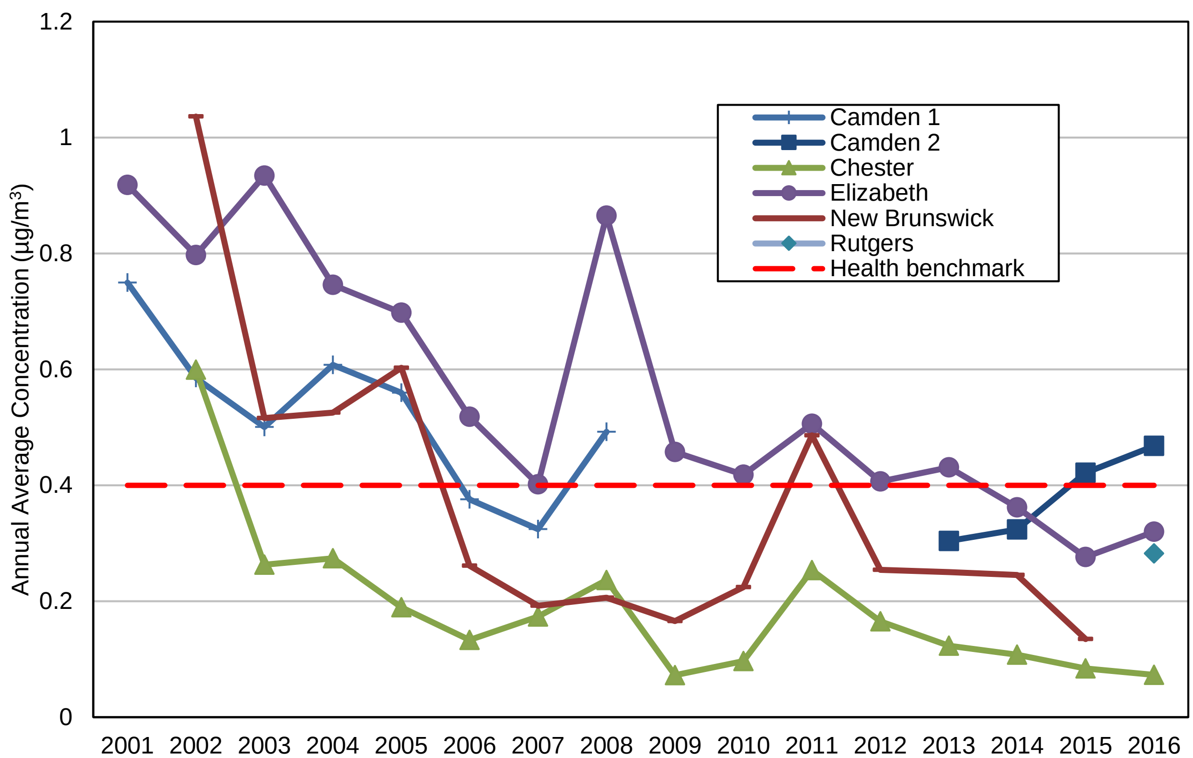


Figure 10-13

FORMALDEHYDE – New Jersey Monitored Concentrations

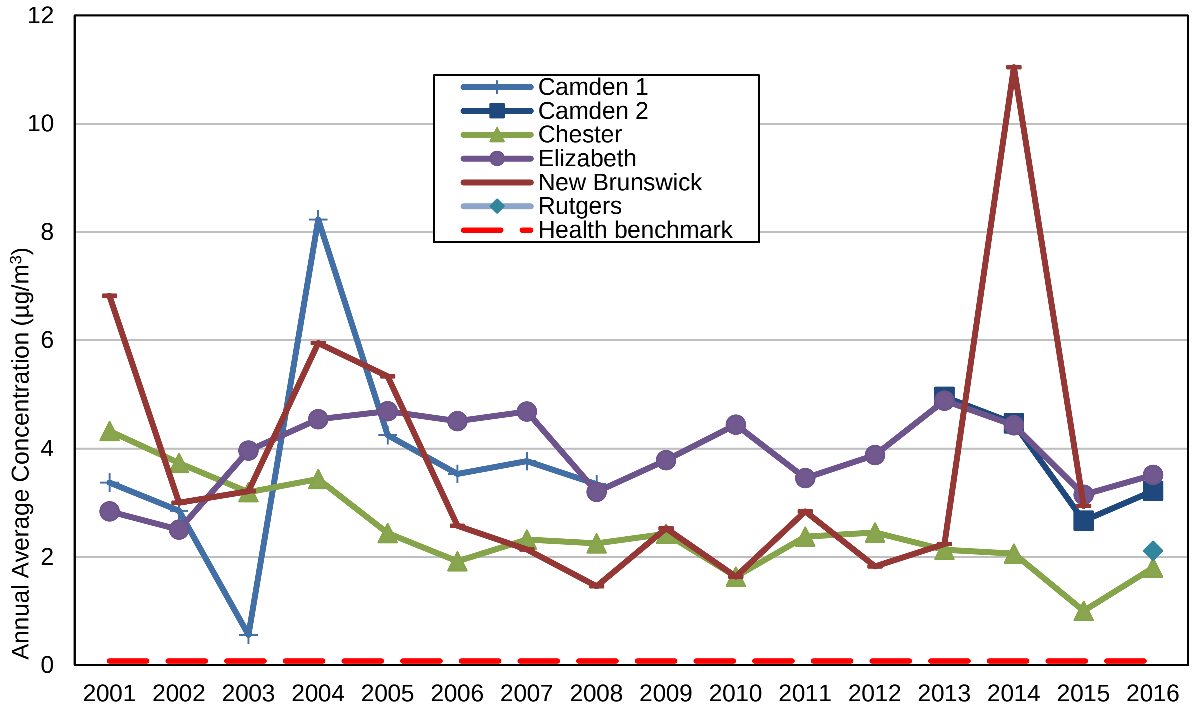


Figure 10-14

STYRENE – New Jersey Monitored Concentrations

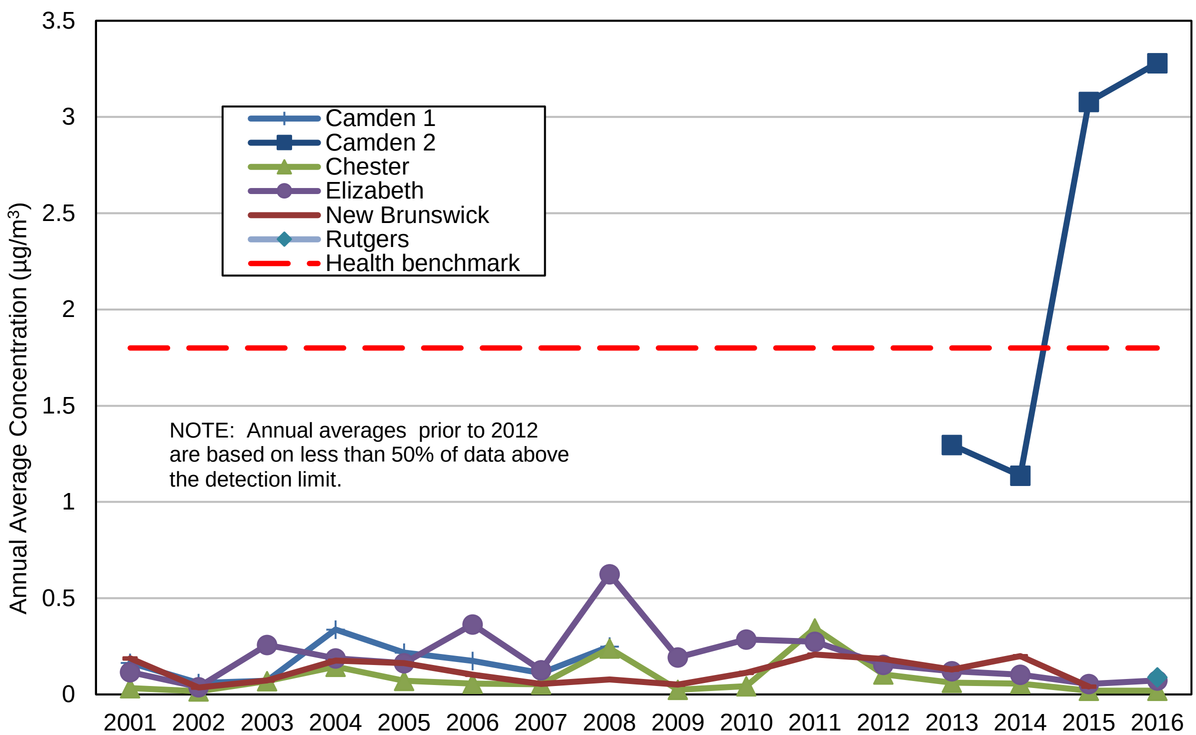


Table 10-4

CAMDEN SPRUCE STREET - 2016 NJ Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[d]	24-Hour Maximum (ppbv)	Annual Mean (µg/m³)[c,d]	Annual Median (µg/m³)[d]	24-Hour Maximum (µg/m³)	Health Bench-mark (µg/m³)[e]	Annual Mean Risk Ratio[f]	Detection Limit (µg/m³)	% Above Minimum Detection Limit
Acetaldehyde	75-07-0	1.369	1.20	4.53	2.47	2.16	8.16	0.45	**5**	0.005	100
Acetone	67-64-1	1.181	1.02	6.13	2.81	2.42	14.6	31000	0.0001	0.014	77
Acetonitrile	75-05-8	0.882	0.271	9.77	1.48	0.455	16.4	60	0.02	0.020	100
Acetylene	74-86-2	0.882	0.629	5.11	0.939	0.670	5.44			0.033	100
Acrolein	107-02-8	0.372	0.316	0.94	0.853	0.725	2.16	0.02		0.046	100
Acrylonitrile	107-13-1	ND	ND	ND	ND	ND	ND	0.015		0.065	0
tert-Amyl Methyl Ether	994-05-8	*0.0003*	0	0.011	*0.001*	0	0.046			0.033	4
Benzaldehyde	100-52-7	0.213	0.204	0.816	0.926	0.883	3.54			0.074	100
Benzene	71-43-2	0.232	0.189	0.705	0.742	0.604	2.25	0.13	**6**	0.010	100
Bromochloromethane	74-97-5	*0.002*	0	0.032	*0.011*	0	0.169	40	0.0003	0.206	11
Bromodichloromethane	75-27-4	*0.002*	0	0.015	*0.013*	0	0.101	0.027	0.5	0.101	20
Bromoform	75-25-2	*0.001*	0	0.011	*0.011*	0	0.114	0.91	0.01	0.186	13
Bromomethane	74-83-9	0.105	0.022	1.28	0.407	0.085	4.97	5	0.1	0.066	100
1,3-Butadiene	106-99-0	0.037	0.031	0.168	0.082	0.069	0.372	0.033	**2**	0.031	96
Butyraldehyde	123-72-8	0.147	0.135	0.473	0.434	0.398	1.39			0.027	100
Carbon Disulfide	75-15-0	0.018	0.016	0.046	0.057	0.050	0.143	700	0.0001	0.009	100
Carbon Tetrachloride	56-23-5	0.100	0.103	0.132	0.629	0.648	0.830	0.17	**4**	0.075	100
Chlorobenzene	108-90-7	*0.001*	0	0.013	*0.006*	0	0.060	1000	0.00001	0.046	16
Chloroethane	75-00-3	0.018	0.015	0.096	0.047	0.040	0.253	10000	0.000005	0.047	69
Chloroform	67-66-3	0.030	0.029	0.053	0.148	0.142	0.259	0.043	**3**	0.044	100
Chloromethane	74-87-3	0.587	0.598	0.76	1.21	1.23	1.57	0.56	**2**	0.033	100
Chloroprene	126-99-8	ND	ND	ND	ND	ND	ND	0.002		0.040	0
Crotonaldehyde	123-73-9	0.087	0.042	0.379	0.249	0.119	1.09			0.049	98
Dibromochloromethane	124-48-1	*0.003*	0	0.011	*0.026*	0.000	0.094	0.037	0.7	0.051	45
1,2-Dibromoethane	106-93-4	ND	ND	ND	ND	ND	ND	0.0017		0.138	0
m-Dichlorobenzene	541-73-1	*0.000*	0	0.007	*0.002*	0	0.042			0.168	7
o-Dichlorobenzene	95-50-1	*0.001*	0	0.008	*0.003*	0	0.048	200	0.00002	0.144	7
p-Dichlorobenzene	106-46-7	0.010	0.008	0.078	0.059	0.048	0.469	0.091	0.7	0.156	53
Dichlorodifluoromethane	75-71-8	0.551	0.543	0.758	2.72	2.69	3.75	100	0.03	0.064	100
1,1-Dichloroethane	75-34-3	*0.000*	0	0.013	*0.001*	0.000	0.053	0.63	0.002	0.061	2
1,2-Dichloroethane	107-06-2	0.019	0.02	0.038	0.077	0.081	0.154	0.038	**2**	0.053	89
1,1-Dichloroethene	75-35-4	*0.002*	0	0.008	*0.007*	0	0.032	200	0.00003	0.032	25
cis-1,2-Dichloroethylene	156-59-2	ND	ND	ND	ND	ND	ND			0.048	0
trans-1,2-Dichloroethylene	156-60-5	*0.001*	0	0.017	*0.005*	0	0.067			0.048	15
Dichloromethane	75-09-2	0.128	0.114	0.454	0.444	0.396	1.58	77	0.01	0.028	100

[a] See page 31 for footnotes.

Table 10-4 (continued)
CAMDEN SPRUCE STREET - 2016 NJ Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[d]	24-Hour Maximum (ppbv)	Annual Mean (μg/m³)[c,d]	Annual Median (μg/m³)[d]	24-Hour Maximum (μg/m³)	Health Bench-mark (μg/m³)[e]	Annual Mean Risk Ratio[f]	Detection Limit (μg/m³)	% Above Minimum Detection Limit
1,2-Dichloropropane	78-87-5	*0.001*	0	0.015	*0.005*	0	0.069	0.1	0.1	0.079	9
cis-1,3-Dichloropropene	542-75-6	ND	ND	ND	ND	ND	ND	0.25		0.064	0
trans-1,3-Dichloropropene	542-75-6	ND	ND	ND	ND	ND	ND			0.095	0
Dichlorotetrafluoroethane	76-14-2	0.019	0.02	0.033	0.130	0.140	0.231			0.133	100
2,5-Dimethylbenzaldehyde	5799-94-2	*0.053*	0	0.403	*0.292*	0	2.21			0.011	25
Ethyl Acrylate	140-88-5	*0.000*	0	0.005	*0.0004*	0	0.020	8	0.00005	0.033	2
Ethyl tert-Butyl Ether	637-92-3	0.012	0.010	0.084	0.049	0.042	0.351			0.046	82
Ethylbenzene	100-41-4	0.108	0.080	0.383	0.468	0.347	1.66		**1.2**	0.035	100
Formaldehyde	50-00-0	2.623	2.68	7.16	3.22	3.29	8.79	0.077	**42**	0.023	100
Hexachloro-1,3-butadiene	87-68-3	*0.002*	0	0.011	*0.021*	0	0.117	0.045	0.5	0.117	25
Hexaldehyde	66-25-1	0.059	0.057	0.306	0.241	0.231	1.25			0.139	82
Isovaleraldehyde	590-86-3	*0.012*	0	0.127	*0.041*	0	0.447			0.007	25
Methyl Ethyl Ketone	78-93-3	0.237	0.249	0.77	0.698	0.732	2.27	5000	0.0001	0.074	87
Methyl Isobutyl Ketone	108-10-1	0.059	0.046	0.212	0.242	0.188	0.868	3000	0.0001	0.057	98
Methyl Methacrylate	80-62-6	*0.011*	0	0.049	*0.044*	0	0.201	700	0.0001	0.115	45
Methyl tert-Butyl Ether	1634-04-4	*0.004*	0	0.034	*0.013*	0	0.123	3.8	0.003	0.050	29
n-Octane	111-65-9	0.055	0.044	0.18	0.259	0.206	0.841			0.079	100
Propionaldehyde	123-38-6	0.450	0.207	4.86	1.07	0.491	11.5	8	0.1	0.007	100
Propylene	115-07-1	0.595	0.367	3.25	1.02	0.632	5.59	3000	0.0003	0.055	100
Styrene	100-42-5	0.770	0.124	4.72	3.28	0.528	20.1	1.8	**1.8**	0.068	100
1,1,2,2-Tetrachloroethane	79-34-5	*0.001*	0	0.011	*0.007*	0	0.076	0.017	0.4	0.124	13
Tetrachloroethylene	127-18-4	0.024	0.02	0.088	0.160	0.136	0.597	0.17	0.9	0.095	96
Tolualdehydes		0.052	0.032	0.307	0.254	0.157	1.51			0.020	100
Toluene	108-88-3	1.562	0.693	10.6	5.89	2.61	39.9	5000	0.001	0.068	100
1,2,4-Trichlorobenzene	102-82-1	*0.001*	0	0.019	*0.004*	0	0.141	2	0.002	0.371	4
1,1,1-Trichloroethane	71-55-6	0.006	0.006	0.02	0.035	0.033	0.109	1000	0.00004	0.071	78
1,1,2-Trichloroethane	79-00-5	*0.0002*	0	0.009	*0.001*	0	0.049	0.063	0.01	0.093	2
Trichloroethylene	79-01-6	*0.011*	0	0.198	*0.057*	0	1.06	0.2	0.3	0.091	38
Trichlorofluoromethane	75-69-4	0.422	0.315	1.19	2.37	1.77	6.69	700	0.003	0.045	100
Trichlorotrifluoroethane	76-13-1	0.083	0.082	0.101	0.633	0.628	0.774	30000	0.00002	0.069	100
1,2,4-Trimethylbenzene	95-63-6	0.138	0.09	0.608	0.678	0.442	2.99	7	0.1	0.103	100
1,3,5-Trimethylbenzene	108-67-8	0.042	0.031	0.176	0.208	0.152	0.865			0.103	100
Valeraldehyde	110-62-3	0.045	0.047	0.154	0.159	0.164	0.543			0.007	77
Vinyl chloride	75-01-4	0.008	0.007	0.057	0.021	0.018	0.146	0.11	0.2	0.020	69
m,p-Xylene	1330-20-7	0.232	0.197	0.8	1.01	0.855	3.47	100	0.01	0.017	100
o-Xylene	95-47-6	0.110	0.092	0.322	0.479	0.399	1.40	100	0.005	0.069	100

[a] See page 31 for footnotes.

Table 10-5

CHESTER - 2016 NJ Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[d]	24-Hour Maximum (ppbv)	Annual Mean (µg/m³)[c,d]	Annual Median (µg/m³)[d]	24-Hour Maximum (µg/m³)	Health Bench-mark (µg/m³)[e]	Annual Mean Risk Ratio[f]	Detection Limit (µg/m³)	% Above Minimum Detection Limit
Acetaldehyde	75-07-0	0.521	0.492	1.83	0.938	0.886	3.30	0.45	**2**	0.005	74
Acetone	67-64-1	0.672	0.696	2.38	1.60	1.65	5.65	31000	0.0001	0.014	74
Acetonitrile	75-05-8	2.96	0.156	153	4.98	0.262	257	60	0.1	0.020	100
Acetylene	74-86-2	0.397	0.356	1.00	0.422	0.379	1.06			0.033	100
Acrolein	107-02-8	0.321	0.245	0.842	0.737	0.562	1.93	0.02		0.046	100
Acrylonitrile	107-13-1	ND	ND	ND	ND	ND	ND	0.015		0.065	0
tert-Amyl Methyl Ether	994-05-8	*0.0003*	0	0.008	*0.001*	0	0.033			0.033	4
Benzaldehyde	100-52-7	0.016	0.014	0.060	0.069	0.061	0.260			0.074	72
Benzene	71-43-2	0.108	0.094	0.228	0.344	0.300	0.728	0.13	**3**	0.010	100
Bromochloromethane	74-97-5	*0.002*	0	0.033	*0.012*	0	0.175	40	0.0003	0.206	13
Bromodichloromethane	75-27-4	*0.002*	0	0.011	*0.011*	0	0.074	0.027	0.4	0.101	20
Bromoform	75-25-2	*0.001*	0	0.013	*0.008*	0	0.134	0.91	0.01	0.186	7
Bromomethane	74-83-9	0.018	0.018	0.025	0.070	0.070	0.097	5	0.01	0.066	100
1,3-Butadiene	106-99-0	0.008	0.005	0.031	0.017	0.011	0.069	0.033	0.5	0.031	59
Butyraldehyde	123-72-8	0.041	0.043	0.109	0.122	0.127	0.321			0.027	82
Carbon Disulfide	75-15-0	0.015	0.014	0.031	0.046	0.044	0.097	700	0.0001	0.009	100
Carbon Tetrachloride	56-23-5	0.097	0.099	0.135	0.612	0.623	0.849	0.17	**4**	0.075	100
Chlorobenzene	108-90-7	*0.002*	0	0.017	*0.009*	0	0.078	1000	0.00001	0.046	21
Chloroethane	75-00-3	*0.009*	0	0.051	*0.024*	0.000	0.135	10000	0.000002	0.047	43
Chloroform	67-66-3	0.024	0.024	0.040	0.119	0.117	0.195	0.043	**3**	0.044	100
Chloromethane	74-87-3	0.568	0.575	0.800	1.17	1.19	1.65	0.56	**2**	0.033	100
Chloroprene	126-99-8	ND	ND	ND	ND	ND	ND	0.002		0.040	0
Crotonaldehyde	123-73-9	0.100	0.021	0.767	0.286	0.060	2.20			0.049	72
Dibromochloromethane	124-48-1	*0.003*	0	0.011	*0.024*	0	0.094	0.037	0.6	0.051	45
1,2-Dibromoethane	106-93-4	*0.0002*	0	0.011	*0.002*	0	0.085	0.0017	0.9	0.138	2
m-Dichlorobenzene	541-73-1	*0.0004*	0	0.009	*0.002*	0	0.054			0.168	5
o-Dichlorobenzene	95-50-1	*0.0005*	0	0.012	*0.003*	0	0.072	200	0.00001	0.144	5
p-Dichlorobenzene	106-46-7	*0.002*	0	0.012	*0.009*	0	0.072	0.091	0.1	0.156	16
Dichlorodifluoromethane	75-71-8	0.521	0.517	0.652	2.58	2.56	3.22	100	0.03	0.064	100
1,1-Dichloroethane	75-34-3	*0.0005*	0	0.013	*0.002*	0	0.053	0.63	0.003	0.061	5
1,2-Dichloroethane	107-06-2	0.016	0.018	0.027	0.065	0.073	0.109	0.038	**1.7**	0.053	86
1,1-Dichloroethene	75-35-4	*0.001*	0	0.010	*0.004*	0	0.040	200	0.00002	0.032	14
cis-1,2-Dichloroethylene	156-59-2	ND	ND	ND	ND	ND	ND			0.048	0
trans-1,2-Dichloroethylene	156-60-5	*0.0003*	0	0.007	*0.001*	0	0.028			0.048	4
Dichloromethane	75-09-2	0.095	0.092	0.164	0.328	0.320	0.570	77	0.004	0.028	100

[a] See page 31 for footnotes.

Table 10-5 (continued)

CHESTER - 2016 NJ Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[d]	24-Hour Maximum (ppbv)	Annual Mean (µg/m³)[c,d]	Annual Median (µg/m³)[d]	24-Hour Maximum (µg/m³)	Health Bench-mark (µg/m³)[e]	Annual Mean Risk Ratio[f]	Detection Limit (µg/m³)	% Above Minimum Detection Limit
1,2-Dichloropropane	78-87-5	*0.001*	0	0.016	*0.004*	0	0.074	0.1	0.04	0.079	7
cis-1,3-Dichloropropene	542-75-6	0	0	0	0	0	0	0.25		0.064	0
trans-1,3-Dichloropropene	542-75-6	0	0	0	0	0	0			0.095	0
Dichlorotetrafluoroethane	76-14-2	0.019	0.019	0.034	0.130	0.133	0.238			0.133	100
2,5-Dimethylbenzaldehyde	5799-94-2	0	0	0	0	0	0			0.011	0
Ethyl Acrylate	140-88-5	*0.0001*	0	0.007	*0.0005*	0	0.029	8	0.0001	0.033	2
Ethyl tert-Butyl Ether	637-92-3	*0.001*	0	0.010	*0.003*	0	0.042			0.046	9
Ethylbenzene	100-41-4	0.017	0.017	0.040	0.073	0.072	0.174	0.4	0.2	0.035	95
Formaldehyde	50-00-0	1.47	1.2	5.91	1.80	1.47	7.26	0.077	**23**	0.023	100
Hexachloro-1,3-butadiene	87-68-3	*0.002*	0	0.012	*0.018*	0	0.128	0.045	0.4	0.117	18
Hexaldehyde	66-25-1	0.012	0.011	0.060	0.051	0.045	0.246			0.139	79
Isovaleraldehyde	590-86-3	*0.001*	0	0.008	*0.003*	0	0.028			0.007	12
Methyl Ethyl Ketone	78-93-3	0.090	0.096	0.271	0.266	0.283	0.799	5000	0.0001	0.074	91
Methyl Isobutyl Ketone	108-10-1	0.023	0.021	0.080	0.095	0.084	0.328	3000	0.00003	0.057	89
Methyl Methacrylate	80-62-6	*0.001*	0	0.014	*0.005*	0	0.057	700	0.00001	0.115	13
Methyl tert-Butyl Ether	1634-04-4	*0.001*	0	0.012	*0.002*	0	0.043	3.8	0.001	0.050	7
n-Octane	111-65-9	0.018	0.017	0.066	0.086	0.079	0.308			0.079	95
Propionaldehyde	123-38-6	0.095	0.086	0.233	0.225	0.204	0.553	8	0.03	0.007	100
Propylene	115-07-1	0.158	0.1415	0.434	0.271	0.244	0.747	3000	0.0001	0.055	100
Styrene	100-42-5	*0.005*	0	0.039	*0.020*	0	0.166	1.8	0.01	0.068	27
1,1,2,2-Tetrachloroethane	79-34-5	*0.001*	0	0.013	*0.007*	0	0.089	0.017	0.4	0.124	11
Tetrachloroethylene	127-18-4	0.009	0.010	0.024	0.062	0.068	0.163	0.17	0.4	0.095	75
Tolualdehydes		0.013	0.010	0.059	0.065	0.049	0.290			0.020	68
Toluene	108-88-3	0.105	0.100	0.309	0.396	0.375	1.16	5000	0.0001	0.068	100
1,2,4-Trichlorobenzene	102-82-1	*0.0001*	0	0.008	*0.001*	0	0.059	2	0.001	0.371	2
1,1,1-Trichloroethane	71-55-6	0.004	0.005	0.014	0.024	0.027	0.076	1000	0.00002	0.071	57
1,1,2-Trichloroethane	79-00-5	ND	ND	ND	ND	ND	ND	0.063		0.093	0
Trichloroethylene	79-01-6	*0.0005*	0	0.010	*0.003*	0	0.054	0.2	0.01	0.091	5
Trichlorofluoromethane	75-69-4	0.242	0.244	0.315	1.36	1.37	1.77	700	0.002	0.045	100
Trichlorotrifluoroethane	76-13-1	0.081	0.082	0.104	0.619	0.628	0.797	30000	0.00002	0.069	100
1,2,4-Trimethylbenzene	95-63-6	0.011	0.012	0.033	0.053	0.059	0.162	7	0.01	0.103	73
1,3,5-Trimethylbenzene	108-67-8	*0.005*	0	0.026	*0.024*	0	0.128			0.103	48
Valeraldehyde	110-62-3	0.013	0.012	0.045	0.046	0.042	0.159			0.007	79
Vinyl chloride	75-01-4	*0.002*	0	0.012	*0.006*	0	0.031	0.11	0.1	0.020	34
m,p-Xylene	1330-20-7	0.034	0.036	0.074	0.147	0.156	0.321	100	0.001	0.017	96
o-Xylene	95-47-6	0.016	0.017	0.040	0.068	0.072	0.174	100	0.001	0.069	89

[a] See page 31 for footnotes.

Table 10-6

ELIZABETH LAB - 2016 NJ Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[d]	24-Hour Maximum (ppbv)	Annual Mean (µg/m³)[c,d]	Annual Median (µg/m³)[d]	24-Hour Maximum (µg/m³)	Health Bench-mark (µg/m³)[e]	Annual Mean Risk Ratio[f]	Detection Limit (µg/m³)	% Above Minimum Detection Limit
Acetaldehyde	75-07-0	1.12	1.23	2.75	2.02	2.22	4.95	0.45	**4**	0.005	75
Acetone	67-64-1	1.03	0.838	4.17	2.45	1.99	9.91	31000	0.0001	0.014	100
Acetonitrile	75-05-8	0.220	0.193	0.909	0.369	0.323	1.53	60	0.01	0.020	100
Acetylene	74-86-2	1.03	0.767	4.21	1.10	0.816	4.48			0.033	100
Acrolein	107-02-8	0.367	0.335	0.981	0.841	0.767	2.25	0.02		0.046	100
Acrylonitrile	107-13-1	ND	ND	ND	ND	ND	ND	0.015		0.065	0
tert-Amyl Methyl Ether	994-05-8	*0.0001*	0	0.008	*0.0006*	0	0.033			0.033	2
Benzaldehyde	100-52-7	0.051	0.036	0.55	0.220	0.156	2.39			0.074	100
Benzene	71-43-2	0.259	0.236	0.643	0.828	0.752	2.05	0.13	**6**	0.010	100
Bromochloromethane	74-97-5	*0.002*	0	0.027	*0.008*	0	0.143	40	0.0002	0.206	10
Bromodichloromethane	75-27-4	*0.0002*	0	0.012	*0.001*	0	0.080	0.027	0.05	0.101	2
Bromoform	75-25-2	*0.0005*	0	0.013	*0.006*	0	0.134	0.91	0.01	0.186	5
Bromomethane	74-83-9	0.019	0.018	0.108	0.074	0.070	0.419	5	0.01	0.066	100
1,3-Butadiene	106-99-0	0.056	0.052	0.198	0.124	0.115	0.438	0.033	**4**	0.031	100
Butyraldehyde	123-72-8	0.141	0.125	0.364	0.416	0.369	1.07			0.027	100
Carbon Disulfide	75-15-0	0.017	0.016	0.052	0.054	0.048	0.162	700	0.0001	0.009	100
Carbon Tetrachloride	56-23-5	0.099	0.102	0.138	0.620	0.639	0.868	0.17	**4**	0.075	100
Chlorobenzene	108-90-7	*0.001*	0	0.012	*0.005*	0	0.055	1000	0.000005	0.046	12
Chloroethane	75-00-3	0.013	0.008	0.075	0.034	0.020	0.198	10000	0.000003	0.047	55
Chloroform	67-66-3	0.034	0.031	0.076	0.164	0.149	0.371	0.043	**4**	0.044	100
Chloromethane	74-87-3	0.574	0.590	0.801	1.18	1.22	1.65	0.56	**2**	0.033	100
Chloroprene	126-99-8	ND	ND	ND	ND	ND	ND	0.002		0.040	0
Crotonaldehyde	123-73-9	0.132	0.068	0.815	0.378	0.194	2.34			0.049	100
Dibromochloromethane	124-48-1	*0.002*	0	0.01	*0.017*	0	0.085	0.037	0.5	0.051	35
1,2-Dibromoethane	106-93-4	*0.0002*	0	0.009	*0.001*	0	0.069	0.0017	0.7	0.138	2
m-Dichlorobenzene	541-73-1	*0.0002*	0	0.008	*0.001*	0	0.048			0.168	3
o-Dichlorobenzene	95-50-1	*0.0002*	0	0.008	*0.001*	0	0.048	200	0.00001	0.144	3
p-Dichlorobenzene	106-46-7	0.007	0.006	0.034	0.044	0.036	0.204	0.091	0.5	0.156	52
Dichlorodifluoromethane	75-71-8	0.546	0.530	1.36	2.70	2.62	6.73	100	0.03	0.064	100
1,1-Dichloroethane	75-34-3	*0.0003*	0	0.01	*0.001*	0	0.040	0.63	0.002	0.061	3
1,2-Dichloroethane	107-06-2	0.019	0.020	0.028	0.075	0.081	0.113	0.038	**2**	0.053	92
1,1-Dichloroethene	75-35-4	*0.0006*	0	0.007	*0.002*	0	0.028	200	0.00001	0.032	10
cis-1,2-Dichloroethylene	156-59-2	ND	ND	ND	ND	ND	ND			0.048	0
trans-1,2-Dichloroethylene	156-60-5	*0.001*	0	0.02	*0.004*	0	0.079			0.048	10
Dichloromethane	75-09-2	0.152	0.131	0.666	0.530	0.455	2.31	77	0.01	0.028	100

[a] See page 31 for footnotes.

Table 10-6 (continued)

ELIZABETH LAB - 2016 NJ Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[d]	24-Hour Maximum (ppbv)	Annual Mean (µg/m^3)[c,d]	Annual Median (µg/m^3)[d]	24-Hour Maximum (µg/m^3)	Health Bench-mark (µg/m^3)[e]	Annual Mean Risk Ratio[f]	Detection Limit (µg/m^3)	% Above Minimum Detection Limit
1,2-Dichloropropane	78-87-5	*0.001*	0	0.015	*0.004*	0	0.069	0.1	0.04	0.079	7
cis-1,3-Dichloropropene	542-75-6	ND	ND	ND	ND	ND	ND	0.25		0.064	0
trans-1,3-Dichloropropene	542-75-6	ND	ND	ND	ND	ND	ND			0.095	0
Dichlorotetrafluoroethane	76-14-2	0.017	0.018	0.03	0.122	0.126	0.210			0.133	100
2,5-Dimethylbenzaldehyde	5799-94-2	*0.001*	0	0.013	*0.004*	0	0.071			0.011	8
Ethyl Acrylate	140-88-5	ND	ND	ND	ND	ND	ND	8		0.033	0
Ethyl tert-Butyl Ether	637-92-3	*0.002*	0	0.065	*0.006*	0	0.272			0.046	7
Ethylbenzene	100-41-4	0.074	0.066	0.228	0.320	0.284	0.990	0.4	0.8	0.035	100
Formaldehyde	50-00-0	2.86	3.15	6.84	3.52	3.87	8.40	0.077	**46**	0.023	75
Hexachloro-1,3-butadiene	87-68-3	*0.001*	0	0.01	*0.007*	0	0.107	0.045	0.2	0.117	8
Hexaldehyde	66-25-1	0.129	0.053	0.855	0.527	0.217	3.50			0.139	100
Isovaleraldehyde	590-86-3	*0.060*	0	0.565	*0.211*	0	1.99			0.007	25
Methyl Ethyl Ketone	78-93-3	0.195	0.167	0.636	0.575	0.492	1.87	5000	0.0001	0.074	100
Methyl Isobutyl Ketone	108-10-1	0.040	0.037	0.108	0.163	0.152	0.442	3000	0.0001	0.057	93
Methyl Methacrylate	80-62-6	*0.005*	0	0.04	*0.020*	0	0.164	700	0.00003	0.115	25
Methyl tert-Butyl Ether	1634-04-4	*0.002*	0	0.022	*0.006*	0	0.079	3.8	0.002	0.050	15
n-Octane	111-65-9	0.068	0.055	0.219	0.318	0.255	1.02			0.079	100
Propionaldehyde	123-38-6	0.166	0.171	0.405	0.394	0.406	0.962	8	0.05	0.007	82
Propylene	115-07-1	2.17	0.858	14.5	3.74	1.48	25.0	3000	0.001	0.055	100
Styrene	100-42-5	0.017	0.017	0.059	0.073	0.070	0.251	1.8	0.04	0.068	80
1,1,2,2-Tetrachloroethane	79-34-5	*0.001*	0	0.01	*0.005*	0	0.069	0.017	0.3	0.124	8
Tetrachloroethylene	127-18-4	0.022	0.018	0.061	0.146	0.122	0.414	0.17	0.9	0.095	92
Tolualdehydes		0.022	0.022	0.075	0.109	0.108	0.369			0.020	75
Toluene	108-88-3	0.484	0.431	1.4	1.82	1.62	5.28	5000	0.0004	0.068	100
1,2,4-Trichlorobenzene	102-82-1	ND	ND	ND	ND	ND	ND	2		0.371	0
1,1,1-Trichloroethane	71-55-6	0.005	0.005	0.014	0.027	0.027	0.076	1000	0.00003	0.071	72
1,1,2-Trichloroethane	79-00-5	ND	ND	ND	ND	ND	ND	0.063		0.093	0
Trichloroethylene	79-01-6	*0.004*	0	0.029	*0.022*	0	0.156	0.2	0.1	0.091	30
Trichlorofluoromethane	75-69-4	0.250	0.254	0.314	1.41	1.42	1.76	700	0.002	0.045	100
Trichlorotrifluoroethane	76-13-1	0.081	0.082	0.098	0.624	0.628	0.751	30000	0.00002	0.069	100
1,2,4-Trimethylbenzene	95-63-6	0.0673	0.059	0.3	0.331	0.290	1.47	7	0.05	0.103	98
1,3,5-Trimethylbenzene	108-67-8	0.0222	0.020	0.088	0.109	0.098	0.433			0.103	95
Valeraldehyde	110-62-3	0.050	0.043	0.155	0.175	0.151	0.546			0.007	100
Vinyl chloride	75-01-4	*0.003*	0	0.017	*0.0064*	0	0.043	0.11	0.1	0.020	33
m,p-Xylene	1330-20-7	0.193	0.170	0.626	0.839	0.738	2.72	100	0.01	0.017	98
o-Xylene	95-47-6	0.084	0.078	0.27	0.365	0.337	1.17	100	0.004	0.069	98

[a] See page 31 for footnotes.

Table 10-7

RUTGERS - 2016 NJ Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[,d]	24-Hour Maximum (ppbv)	Annual Mean ($\mu g/m^3$)[c,d]	Annual Median ($\mu g/m^3$)[,d]	24-Hour Maximum ($\mu g/m^3$)	Health Bench-mark ($\mu g/m^3$)[e]	Annual Mean Risk Ratio[f]	Detection Limit ($\mu g/m^3$)	% Above Minimum Detection Limit
Acetaldehyde	75-07-0	0.734	0.729	1.98	1.32	1.31	3.57	0.45	**3**	0.005	75
Acetone	67-64-1	0.795	0.840	2.94	1.89	2.00	6.98	31000	0.0001	0.014	76
Acetonitrile	75-05-8	0.225	0.200	0.763	0.378	0.336	1.28	60	0.01	0.020	100
Acetylene	74-86-2	0.670	0.491	2.57	0.713	0.523	2.74			0.033	100
Acrolein	107-02-8	0.386	0.320	0.958	0.886	0.734	2.20	0.02		0.046	100
Acrylonitrile	107-13-1	ND	ND	ND	ND	ND	ND	0.015		0.065	0
tert-Amyl Methyl Ether	994-05-8	*0.001*	0	0.01	*0.003*	0	0.042			0.033	12
Benzaldehyde	100-52-7	0.033	0.028	0.069	0.145	0.122	0.299			0.074	100
Benzene	71-43-2	0.161	0.145	0.482	0.515	0.463	1.54	0.13	**4**	0.010	100
Bromochloromethane	74-97-5	*0.002*	0	0.03	*0.011*	0	0.159	40	0.0003	0.206	12
Bromodichloromethane	75-27-4	*0.003*	0	0.014	*0.018*	0	0.094	0.027	0.7	0.101	27
Bromoform	75-25-2	*0.002*	0	0.015	*0.019*	0	0.155	0.91	0.02	0.186	17
Bromomethane	74-83-9	0.021	0.020	0.058	0.080	0.078	0.225	5	0.02	0.066	100
1,3-Butadiene	106-99-0	0.027	0.021	0.103	0.059	0.046	0.228	0.033	**1.8**	0.031	86
Butyraldehyde	123-72-8	0.083	0.078	0.172	0.244	0.230	0.507			0.027	100
Carbon Disulfide	75-15-0	ND	ND	ND	ND	ND	ND	700		0.009	0
Carbon Tetrachloride	56-23-5	0.098	0.102	0.135	0.619	0.642	0.849	0.17	**4**	0.075	100
Chlorobenzene	108-90-7	*0.004*	0	0.015	*0.017*	0	0.069	1000	0.00002	0.046	37
Chloroethane	75-00-3	0.027	0.023	0.146	0.070	0.061	0.385	10000	0.00001	0.047	78
Chloroform	67-66-3	0.035	0.031	0.077	0.169	0.151	0.376	0.043	**4**	0.044	100
Chloromethane	74-87-3	0.585	0.603	0.823	1.21	1.25	1.70	0.56	**2**	0.033	100
Chloroprene	126-99-8	ND	ND	ND	ND	ND	ND	0.002		0.040	0
Crotonaldehyde	123-73-9	0.093	0.040	0.409	0.267	0.115	1.17			0.049	88
Dibromochloromethane	124-48-1	0.004	0.004	0.012	0.033	0.034	0.102	0.037	0.9	0.051	56
1,2-Dibromoethane	106-93-4	*0.001*	0	0.01	*0.005*	0	0.077	0.0017	**3**	0.138	7
m-Dichlorobenzene	541-73-1	*0.001*	0	0.015	*0.009*	0	0.090			0.168	15
o-Dichlorobenzene	95-50-1	*0.001*	0	0.014	*0.009*	0	0.084	200	0.00004	0.144	15
p-Dichlorobenzene	106-46-7	*0.006*	0	0.021	*0.035*	0	0.126	0.091	0.4	0.156	49
Dichlorodifluoromethane	75-71-8	0.526	0.536	0.655	2.60	2.65	3.24	100	0.03	0.064	100
1,1-Dichloroethane	75-34-3	*0.001*	0	0.014	*0.006*	0	0.057	0.63	0.01	0.061	14
1,2-Dichloroethane	107-06-2	0.020	0.020	0.029	0.079	0.081	0.117	0.038	**2**	0.053	95
1,1-Dichloroethene	75-35-4	*0.002*	0	0.01	*0.008*	0	0.040	200	0.00004	0.032	29
cis-1,2-Dichloroethylene	156-59-2	ND	ND	ND	ND	ND	ND			0.048	0
trans-1,2-Dichloroethylene	156-60-5	*0.002*	0	0.014	*0.006*	0	0.056			0.048	17
Dichloromethane	75-09-2	0.132	0.127	0.258	0.458	0.441	0.896	77	0.01	0.028	100

[a] See page 31 for footnotes.

Table 10-7 (continued)

RUTGERS - 2016 NJ Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[,d]	24-Hour Maximum (ppbv)	Annual Mean (µg/m³)[c,d]	Annual Median (µg/m³)[,d]	24-Hour Maximum (µg/m³)	Health Bench-mark (µg/m³)[e]	Annual Mean Risk Ratio[f]	Detection Limit (µg/m³)	% Above Minimum Detection Limit
1,2-Dichloropropane	78-87-5	*0.001*	0	0.015	*0.006*	0	0.069	0.1	0.1	0.079	10
cis-1,3-Dichloropropene	542-75-6	ND	ND	ND	ND	ND	ND	0.25		0.064	0
trans-1,3-Dichloropropene	542-75-6	ND	ND	ND	ND	ND	ND			0.095	0
Dichlorotetrafluoroethane	76-14-2	0.019	0.019	0.037	0.132	0.133	0.259			0.133	100
2,5-Dimethylbenzaldehyde	5799-94-2	*0.005*	0	0.044	*0.025*	0	0.241			0.011	24
Ethyl Acrylate	140-88-5	ND	ND	ND	ND	ND	ND	8		0.033	0
Ethyl tert-Butyl Ether	637-92-3	0.036	0.036	0.085	0.149	0.150	0.355			0.046	98
Ethylbenzene	100-41-4	0.065	0.054	0.437	0.283	0.234	1.90	0.4	0.7	0.035	100
Formaldehyde	50-00-0	1.72	1.60	4.27	2.12	1.96	5.24	0.077	**27**	0.023	100
Hexachloro-1,3-butadiene	87-68-3	*0.003*	0	0.012	*0.027*	0	0.128	0.045	0.6	0.117	29
Hexaldehyde	66-25-1	0.039	0.026	0.169	0.160	0.107	0.692			0.139	78
Isovaleraldehyde	590-86-3	*0.023*	0	0.123	*0.082*	0	0.433			0.007	25
Methyl Ethyl Ketone	78-93-3	0.163	0.164	0.499	0.481	0.483	1.47	5000	0.0001	0.074	95
Methyl Isobutyl Ketone	108-10-1	0.033	0.028	0.086	0.135	0.115	0.352	3000	0.00004	0.057	98
Methyl Methacrylate	80-62-6	*0.007*	0	0.042	*0.030*	0	0.172	700	0.00004	0.115	47
Methyl tert-Butyl Ether	1634-04-4	0.012	0.014	0.036	0.044	0.050	0.130	3.8	0.01	0.050	63
n-Octane	111-65-9	0.030	0.029	0.079	0.141	0.135	0.369			0.079	98
Propionaldehyde	123-38-6	0.266	0.169	0.693	0.632	0.401	1.65	8	0.1	0.007	100
Propylene	115-07-1	0.332	0.271	1.19	0.572	0.466	2.05	3000	0.0002	0.055	100
Styrene	100-42-5	0.021	0.019	0.126	0.090	0.081	0.537	1.8	0.1	0.068	92
1,1,2,2-Tetrachloroethane	79-34-5	*0.002*	0	0.011	*0.012*	0	0.076	0.017	0.7	0.124	20
Tetrachloroethylene	127-18-4	0.017	0.016	0.062	0.117	0.109	0.421	0.17	0.7	0.095	92
Tolualdehydes		0.019	0.019	0.059	0.093	0.093	0.290			0.020	76
Toluene	108-88-3	0.248	0.214	0.696	0.934	0.806	2.62	5000	0.0002	0.068	100
1,2,4-Trichlorobenzene	102-82-1	*0.0002*	0	0.013	*0.002*	0	0.096	2	0.0008	0.371	2
1,1,1-Trichloroethane	71-55-6	0.007	0.007	0.015	0.036	0.038	0.082	1000	0.00004	0.071	83
1,1,2-Trichloroethane	79-00-5	ND	ND	ND	ND	ND	ND	0.063		0.093	0
Trichloroethylene	79-01-6	*0.004*	0	0.030	*0.022*	0	0.161	0.2	0.1	0.091	32
Trichlorofluoromethane	75-69-4	0.248	0.258	0.315	1.40	1.45	1.77	700	0.002	0.045	100
Trichlorotrifluoroethane	76-13-1	*0.003*	0	0.1	*0.026*	0	0.766	30000	0.000001	0.069	3
1,2,4-Trimethylbenzene	95-63-6	0.038	0.035	0.165	0.188	0.172	0.811	7	0.03	0.103	100
1,3,5-Trimethylbenzene	108-67-8	0.016	0.014	0.050	0.076	0.069	0.246			0.103	97
Valeraldehyde	110-62-3	0.129	0.038	0.834	0.453	0.134	2.94			0.007	100
Vinyl chloride	75-01-4	0.004	0	0.016	0.009	0.000	0.041	0.11	0.1	0.020	42
m,p-Xylene	1330-20-7	0.122	0.102	0.549	0.530	0.443	2.38	100	0.01	0.017	100
o-Xylene	95-47-6	0.060	0.055	0.309	0.260	0.239	1.34	100	0.003	0.069	100

[a] See page 31 for footnotes.

Footnotes for Tables 10-4 through 10-7

[b] Analytes in bold text had annual means above the long-term health benchmark.

[c] Numbers in italics are arithmetic means (or averages) based on less than 50% of the samples above the detection limit.

[d] For a valid 24-hour sampling event, when the analyzing laboratory reports the term “Not Detected” for a particular pollutant, the concentration of 0.0 ppbv is assigned to that pollutant. These zero concentrations were included in the calculation of annual averages and medians for each pollutant regardless of percent detection.

[e] A health benchmark is defined as the chemical-specific air concentration above which there may be human health concerns. For a carcinogen (cancer-causing chemical), the health benchmark is set at the air concentration that would cause no more than a one-in-a-million increase in the likelihood of getting cancer, even after a lifetime of exposure. For a non-carcinogen, the health benchmark is the maximum air concentration to which exposure is likely to cause no harm, even if that exposure occurs on a daily basis for a lifetime. These toxicity values are not available for all chemicals. For more information, go to www.nj.gov/dep/aqpp/risk.html.

[f] A risk ratio for a chemical is a comparison of the annual mean air concentration to the long-term health benchmark. If the annual mean is 0, then the annual mean risk ratio is not calculated.

[g] Acrolein concentrations are highly uncertain because of problems with collection and analysis methods.

ND indicates that all samples were below the detection limit.

Table 10-8
Analytes with 100% Non-Detects in 2016

	Pollutant	CAS No.	Camden	Chester	Elizabeth	Rutgers
1	Acrylonitrile	107-13-1	X	X	X	X
2	Carbon Disulfide	75-15-0				X
3	Chloroprene	126-99-8	X	X	X	X
4	1,2-Dibromoethane	106-93-4	X			
5	cis-1,2-Dichloroethylene	156-59-2	X	X	X	X
6	cis-1,3-Dichloropropene	542-75-6	X	X	X	X
7	trans-1,3-Dichloropropene	542-75-6	X	X	X	X
8	2,5-Dimethylbenzaldehyde	5799-94-2		X		
9	1,2,4-Trichlorobenzene	102-82-1			X	
10	1,1,2-Trichloroethane	79-00-5		X	X	X

In 2016, samples of the chemicals in Table 10-8 were never above the detection limit at the specific monitoring location. However, these pollutants may be present in the air below the detection limit level. Chemical-specific detection limits can be found in Tables 10-4 through 10-7.

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Appendix A
2016 Air Monitoring Sites

New Jersey Department of Environmental Protection

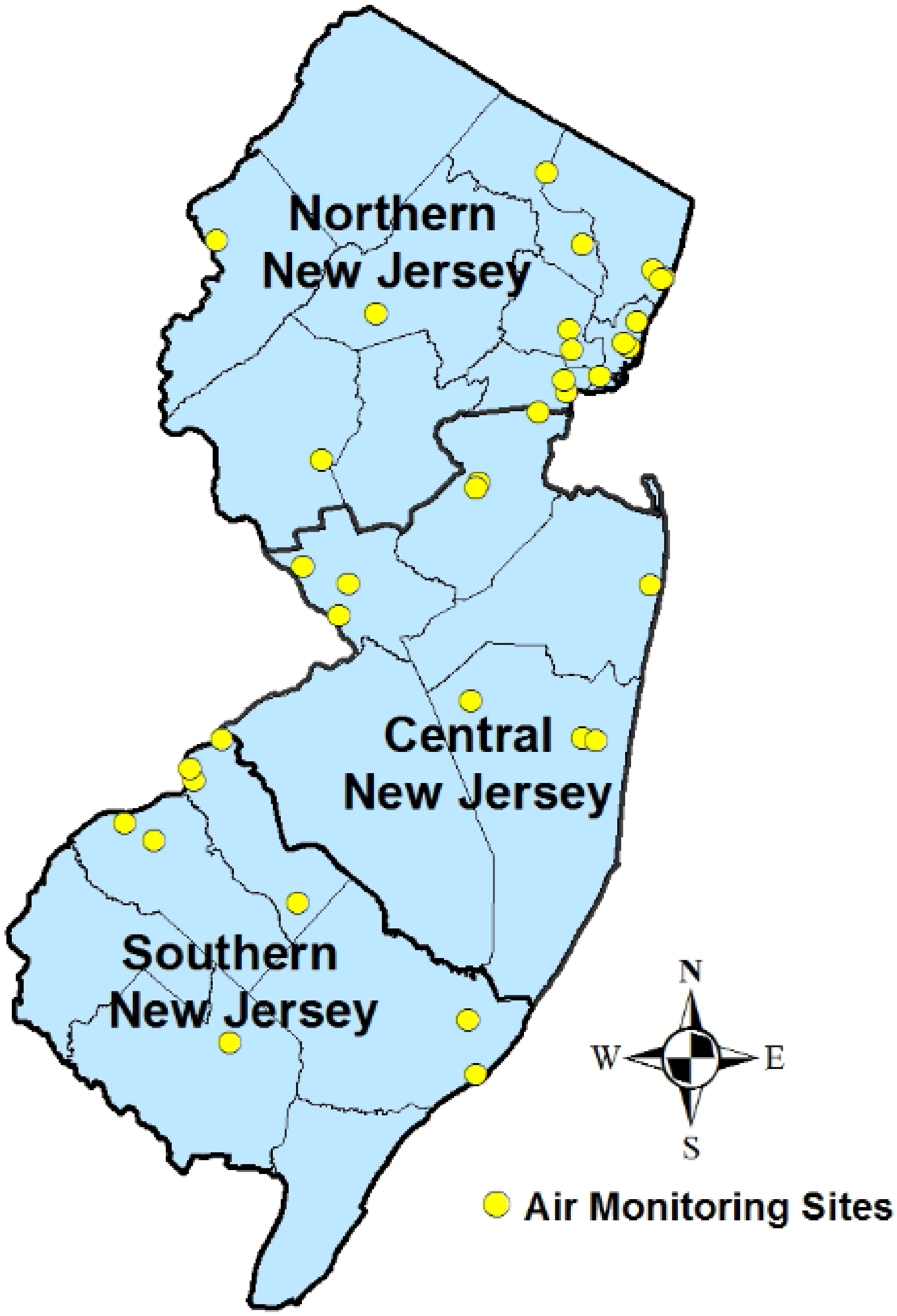

FIGURE A-1
NORTHERN NEW JERSEY
AIR MONITORING SITES

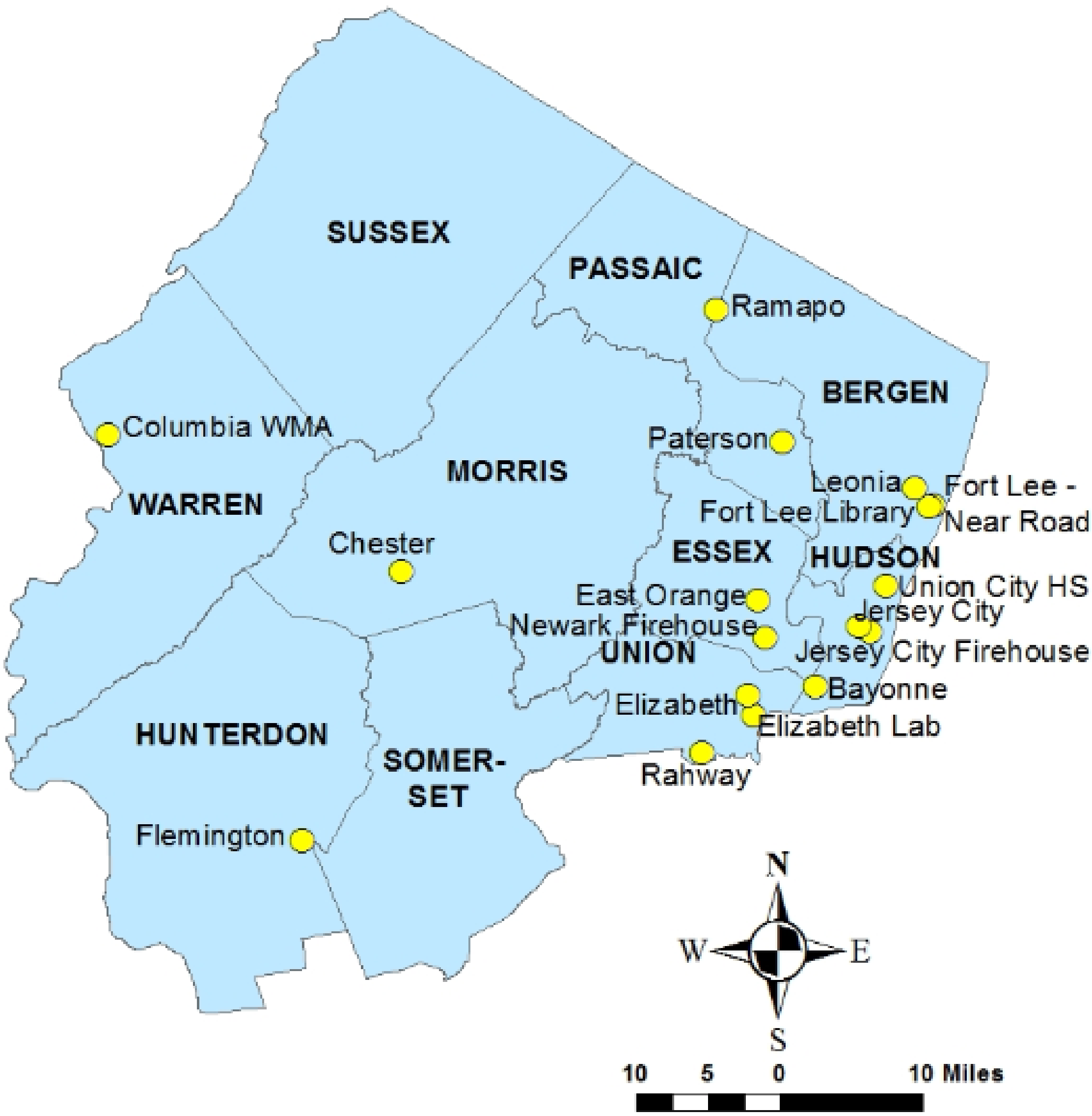

Table A-1
Northern New Jersey Air Monitoring Sites

County	Monitoring Site	AIRS Code	Parameter(s) Measured[1]	Coordinates (Decimal degrees)		Address
				Latitude	Longitude	
BERGEN	Fort Lee Library	34 003 0003	$PM_{2.5}$	40.852256	- 73.973314	320 Main Street
	Fort Lee Near Road	34 003 0010	CO, NO_x, Beta, BTEX, BC, Met	40.853550	-73.966180	2047 Central Ave.
	Leonia	34 003 0006	O_3	40.870436	-73.991994	Overpeck Park, 40 Fort Lee Road
ESSEX	East Orange	34 013 1003	CO, NO_X, Met	40.757501	- 74.200500	Engine No. 2, Main Street and Greenwood Avenue
	Newark Firehouse	34 013 0003	CO, O_3 ,SO_2, $PM_{2.5}$, Spec, NOy, NO_X, BTEX, Pb, Beta, BC, Met, PM_{coarse}	40.720989	-74.192892	Engine 10, 360 Clinton Avenue
HUDSON	Bayonne	34 017 0006	NO_X, O_3, SO_2, BTEX, BC, Met	40.670250	- 74.126081	Park Rd at end of W. 25th St.
	Jersey City	34 017 1002	CO, NO_x, SO_2	40.731645	- 74.066308	2828 John F. Kennedy Boulevard
	Jersey City Firehouse	34 017 1003	$PM_{2.5}$, PM_{10}, Beta	40.725454	- 74.052290	Engine 6, 355 Newark Avenue
	Union City High School	34 017 0008	$PM_{2.5}$	40.770908	-74.036218	2500 John F. Kennedy Blvd.
HUNTERDON	Flemington	34 019 0001	O_3, Met, Beta	40.515262	-74.806671	Raritan Twp. Municipal Utilities Authority, 365 Old York Road
MORRIS	Chester	34 027 3001	NO_X, O_3, SO_2, $PM_{2.5}$, Toxics, Hg, Spec	40.787628	- 74.676301	Bldg. #1, Department of Public Works, (DPW), 50 North Road
PASSAIC	Paterson	34 031 0005	$PM_{2.5}$	40.918381	-74.168092	Health Department, 176 Broadway
	Ramapo	34 031 5001	O_3	41.058617	- 74.255544	Ramapo Mountain State Forest, Access Road, off Skyline Drive, Wanaque
UNION	Elizabeth	34 039 0003	CO, SO_2	40.662493	- 74.214800	7 Broad Street
	Elizabeth Lab	34 039 0004	CO, NO_X, SO_2, Met, $PM_{2.5}$, Toxics, Hg, Spec, BTEX, BC, Beta	40.641440	- 74.208365	Interchange 13 Toll Plaza, New Jersey Turnpike
	Rahway	34 039 2003	$PM_{2.5}$, TEOM	40.603943	- 74.276174	Fire Dept. Headquarters, 1300 Main Street
WARREN	Columbia WMA	34 041 0007	NO_X, O_3, SO_2, $PM_{2.5}$, Met, Beta	40.924580	-75.067815	Columbia Wildlife Management Area, 105 Delaware Road, Knowlton Twp.

[1] See Parameter Codes, Table 4 (page 8)

FIGURE A-2
CENTRAL NEW JERSEY
AIR MONITORING SITES

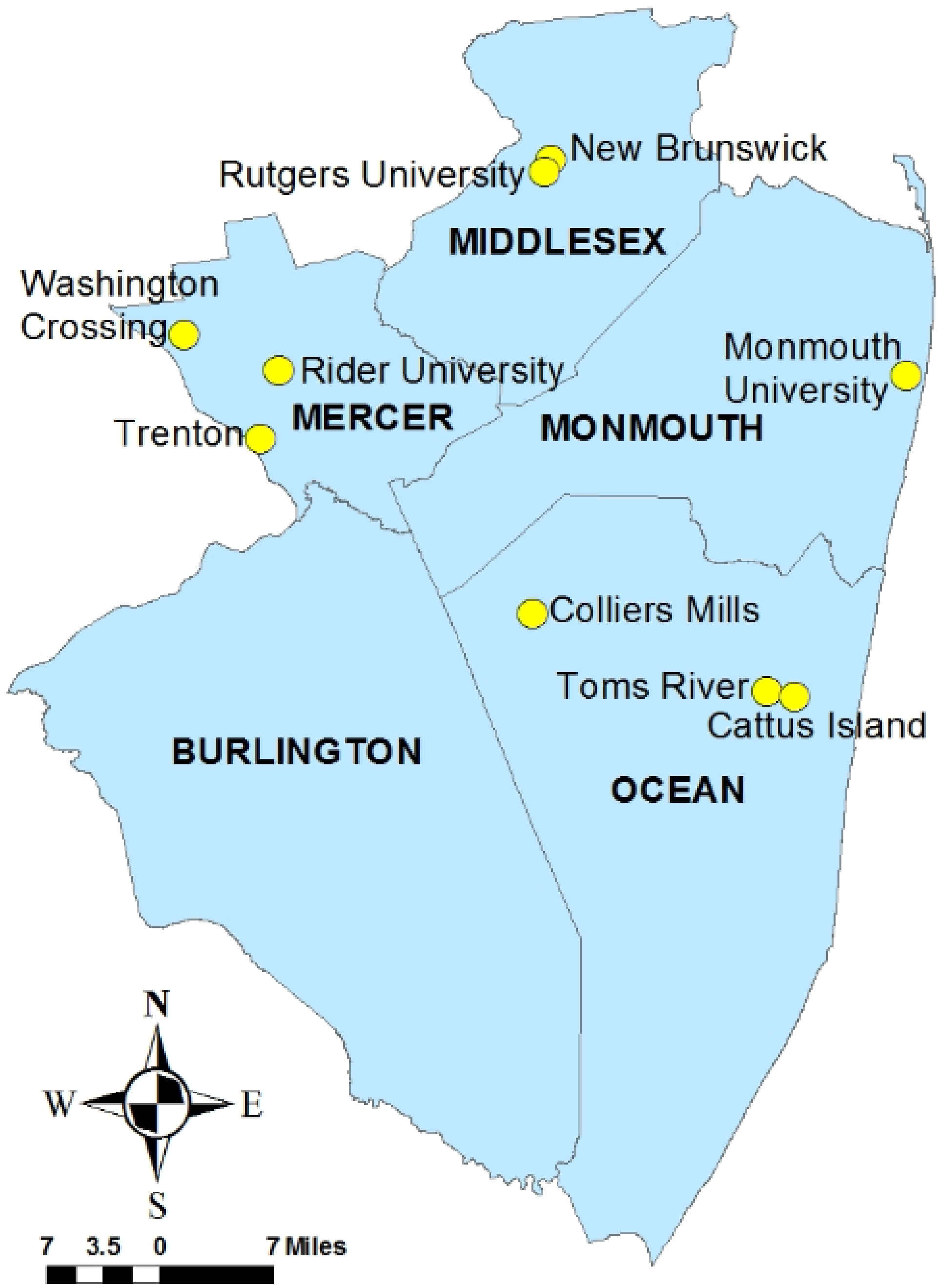

Table A-2
Central New Jersey Air Monitoring Sites

County	Monitoring Site	AIRS Code	Parameter(s) Measured[1]	Coordinates (Decimal degrees)		Address
				Latitude	Longitude	
MERCER	Rider University	34 021 0005	O_3, Met, Beta	40.283092	-74.742644	2083 Lawrenceville Rd, Athletic Fields, Lawrence Twp.
	Trenton	34 021 0008	$PM_{2.5}$	40.222411	-74.763167	Trenton Public Library, 120 Academy Street
	Washington Crossing	N/A	ACID	40.315359	-74.853613	1240 Bear Tavern Road, Washington Crossing State Park, Titusville
MIDDLESEX	New Brunswick	34 023 0006	Spec	40.472825	- 74.422403	Log Cabin Road near Horticulture Lab
	Rutgers University	34 023 0011	NO_X, O_3, Met[2], PAMS, Beta, $PM_{2.5}$, Toxics, Spec	40.462182	- 74.429439	Horticultural Farm #3, 67 Ryders Lane, East Brunswick
MONMOUTH	Monmouth University	34 025 0005	O_3	40.277647	- 74.005100	Edison Science Bldg., 400 Cedar Avenue, West Long Branch
OCEAN	Cattus Island	N/A	ACID[3]	39.989636	-74.134132	Cattus Island County Park, end of Bandon Road, Toms River
	Colliers Mills	34 029 0006	O_3	40.064830	-74.444050	Colliers Mills Wildlife Management Area, Success Rd. near Hawkin Rd., Jackson Twp.
	Toms River	34 029 2002	$PM_{2.5}$	39.994908	-74.170447	Hooper Avenue Elementary School, 1517 Hooper Avenue

[1] See Parameter Codes, Table 4 (page 8)
[2] Meteorological measurements at the site are collected by Rutgers University
[3] United States Fish and Wildlife Service-Air Quality Branch (USFWS-AQB) is responsible for sample collection.

FIGURE A-3
SOUTHERN NEW JERSEY
AIR MONITORING SITES

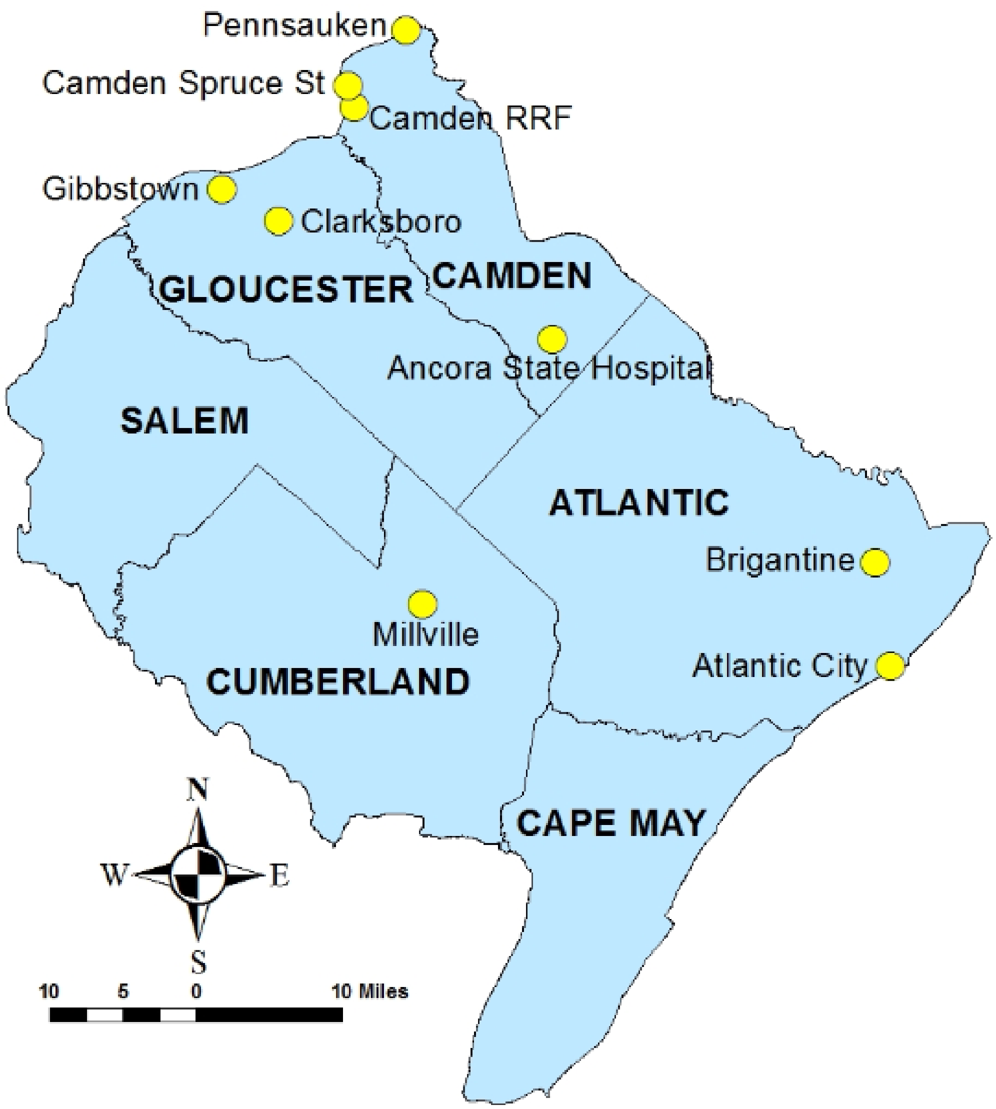

Table A-3
Southern New Jersey Air Monitoring Sites

County	Monitoring Site	AIRS Code	Parameter(s) Measured[1]	Coordinates (Decimal degrees)		Address
				Latitude	Longitude	
ATLANTIC	Atlantic City	34 001 1006	$PM_{2.5}$	39.363260	-74.431000	Atlantic Cape Community College, 1535 Bacharach Boulevard
	Brigantine	34 001 0006	Visibility, O_3, SO_2, Beta, $PM_{2.5}$, Hg, ACID[2]	39.464872	-74.448736	Edwin B. Forsythe National Wildlife Refuge Visitor Center, 800 Great Creek Road, Galloway
CAMDEN	Ancora State Hospital	34 007 1001	O_3	39.684250	- 74.861491	301 Spring Garden Road, Hammonton
	Camden RRF	34 007 0009	PM_{10}	39.912431	- 75.116864	600 Morgan Street
	Camden Spruce Street	34 007 0002	CO, NO_X, O_3, SO_2, $PM_{2.5}$, Spec, BTEX, BC, Toxics, Met, Beta	39.934446	-75.125291	226-298 Spruce Street
	Pennsauken	34 007 1007	$PM_{2.5}$	39.989036	-75.050008	Morris-Delair Water Treatment Plant, 8999 Zimmerman Ave.
CUMBERLAND	Millville	34 011 0007	NO_X, O_3, Beta	39.422273	- 75.025204	Next to 4425 South Main Road
GLOUCESTER	Clarksboro	34 015 0002	O_3	39.800339	-75.212119	Shady Lane Complex, 256 County House Road
	Gibbstown	34 015 0004	$PM_{2.5}$	39.830837	-75.284682	Municipal Maintenance Yard, 61 North School Street

[1] See Parameter Codes, Table 4 (page 8)

[2] United States Fish and Wildlife Service-Air Quality Branch (USFWS-AQB) is responsible for sample collection.

Table A-4
Parameter Codes

ACID	Acid Deposition	Pb	Lead
BC	Black carbon measured by aethalometer	$PM_{2.5}$	Fine particles (2.5 microns or less) collected by a Federal Reference Method $PM_{2.5}$ sampler
Beta	Real-time $PM_{2.5}$ analyzer	PM_{10}	Coarse particles (10 microns or less) collected by a Federal Reference Method PM_{10} sampler
BTEX	Measures benzene, toluene, ethylbenzene and xylenes	PM_{coarse}	Difference between PM_{10} and $PM_{2.5}$ measurements
CO	Carbon monoxide	SO_2	Sulfur dioxide
Hg	Mercury	Spec	Speciated fine particles (2.5 microns or less)
Met	Meteorological parameters	SS	Smoke shade
NO_X	Nitrogen dioxide and nitric oxide	TEOM	Real-time $PM_{2.5}$ analyzer
NOy	Total reactive oxides of nitrogen	Toxics	Air toxics
O_3	Ozone	Visibility	Measured by nephelometer
PAMS	Photochemical Assessment Monitoring Station, measures ozone precursors		