2013 Air Quality Report
Introduction

New Jersey Department of Environmental Protection

SUMMARY

This report summarizes the New Jersey air quality monitoring data for 2013. It contains information on the Air Quality Index (AQI), concentrations of individual pollutants – carbon monoxide, nitrogen oxides, ozone, particulate matter, and sulfur dioxide. Data on acid precipitation, speciation of fine particulates, ozone precursors, toxic air contaminants, including mercury, and meteorological data are also provided.

INTRODUCTION

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 regulations, which are among the most stringent in the country, as well as regional and national air pollution reduction efforts.

Air quality problems still exist across the state. Ozone continues be to a significant problem in the summer months, and has been found to have serious health effects at lower levels than previously thought. The United States Environmental Protection Agency (USEPA) revised the National Ambient Air Quality Standards (NAAQS) for ozone in 2008 to account for this public health information and emission reduction strategies continue to be implemented to meet these standards.

In addition to ozone, sulfur dioxide (SO2) and nitrogen dioxides (NO2) have also been proven to have serious respiratory health problems with sensitive individuals, especially children, the elderly and people with asthma. In 2010, the USEPA revised the NAAQS for both SO2 and NO2 to account for this new public health concern. New Jersey continues to closely monitor these pollutants to keep them within the NAAQS.

Fine particles are also a problem that faces the state of New Jersey. Fine particles are defined as particles less than 2.5 micrometers in diameter and are referred to as PM2.5. These small particles have been found to have a greater impact on public health than larger particles, which were the focus of the previous standards. Monitoring data indicate PM2.5 levels could be a problem in some areas of New Jersey.

Additionally, there is an increasing concern about a class of air pollutants termed “air toxics”. These pollutants include substances known to cause cancer or other serious health problems. The list of potential air toxics is very large and includes many different types of compounds including heavy metals and toxic volatile organic compounds. New Jersey continues to use the results of an EPA air toxics study and other information to address this complex problem. More comprehensive monitoring of ozone, fine particles, and air toxics in New Jersey is being implemented and data from these programs are presented in this report.

Questions or comments concerning this report can be made by e-mailing us at bamweb@dep.state.nj.us , by phone at (609) 292-0138 or by writing to us at:

New Jersey Department of Environmental Protection
Bureau of Air Monitoring
P. O. Box 420
Mail Code: 401-07H
Trenton, New Jersey 08625

LIST OF CONTENTS

Available separately at www.njaqinow.net, under "Publications"

2013 Network Summary

New Jersey Department of Environmental Protection

NETWORK DESCRIPTION

Figure 1
Rider University Air Monitoring Station
Mercer County, New Jersey

In 2013, the New Jersey Department of Environmental Protection (NJDEP) operated 39 ambient air monitoring stations. The individual monitoring stations vary in terms of the number and type of measurements taken, and how the data collected from each site are used. Most of the monitoring program focuses on criteria pollutants which are pollutants for which National Ambient Air Quality Standards (NAAQS) have been established. Criteria pollutant monitoring is regulated by the United States Environmental Protection Agency (USEPA) which prescribes the minimum number of sites that must be operated, the monitoring methods to be used, the general locations in which they must be placed, and quality assurance protocols that must be followed. Data which meet USEPA requirements can then be used to determine if the area being monitored meets the NAAQS for the pollutants measured. There are six criteria air pollutants: Carbon Monoxide (CO), Lead (Pb), Nitrogen Dioxide (NO_2), Ozone (O_3), Particulate Matter, and Sulfur Dioxide (SO_2). In part 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 particles less than 10 microns (1 micron = one millionth of a meter) or PM_{10}, and for particles less than 2.5 microns ($PM_{2.5}$).

In New Jersey, most of the criteria air pollutants are measured using USEPA approved monitoring methods. Data retrieved from these contaminants are thus available in near real-time. The Bureau of Air Monitoring posts air quality updates to both its web site (www.njaqinow.net) and the USEPA's AirNow web site (www.airnow.gov) once every hour. The manually collected USEPA's approved $PM_{2.5}$ samplers pull air through a filter for 24-hours and the filters are weighed before and after sampling. The concentration of particles is then calculated. While this method is quite accurate, it takes several weeks to get results. In order to include $PM_{2.5}$ levels in the hourly updates provided, the NJDEP uses continuous $PM_{2.5}$ monitors. The Bureau has recently upgraded the $PM_{2.5}$ continuous network by replacing older continuous TEOM instruments with USEPA approved $PM_{2.5}$ Beta Attenuation analyzers.

In addition to monitoring criteria pollutants, several other types of measurements are made. Non-criteria pollutants are important for a variety of reasons. They may play a role in chemical reactions that take place in the atmosphere. The Photochemical Assessment Monitoring Station (PAMS) program, for example, measures 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 present of sunlight, it is important to know the levels of these “precursor” pollutants. The PAMS program is described in more detail in a separate section of this report. Other non-criteria monitoring instruments used throughout the network are the BTEX analyzer (which measures near real-time benzene, toluene, ethylbenzene, m,p-xylene, and o-xylene) and the aethalometer which collects real-time Black Carbon measurements at various urban air monitoring sites.

Figure 2
USEPA-approved $PM_{2.5}$ Sampler in
Toms River, Ocean County

Some sites in the monitoring network collect samples of particulate matter that are analyzed to determine the chemical makeup of the particles. These are termed “$PM_{2.5}$ Speciation Sites”. This data is used in helping to identify the primary sources of particles, and in assessing potential health effects.

At other locations samples are taken and analyzed for non-criteria pollutants that are classified as “air toxics”. These are pollutants that have known 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.

Other sites within the network take measurements of atmospheric deposition, visibility, mercury and weather parameters such as wind speed and direction. Some monitoring sites are suitable for measuring a wide variety of pollutants while others are suitable for only one or two. An example of an air monitoring station is the Rider University site located in Lawrenceville, New Jersey shown in Figure 1. This site measures criteria pollutant data as well as weather parameters. Figure 2 shows a USEPA approved manual sampler to measure $PM_{2.5}$ located on the roof of the Hooper Avenue Elementary School in Toms River, Ocean County.

The map in Figure 3 shows the locations of all the sites that operated in 2013, and Table 1 shows which parameters were measured at each site.

Figure 3

New Jersey Air Monitoring Sites 2013
Network Summary

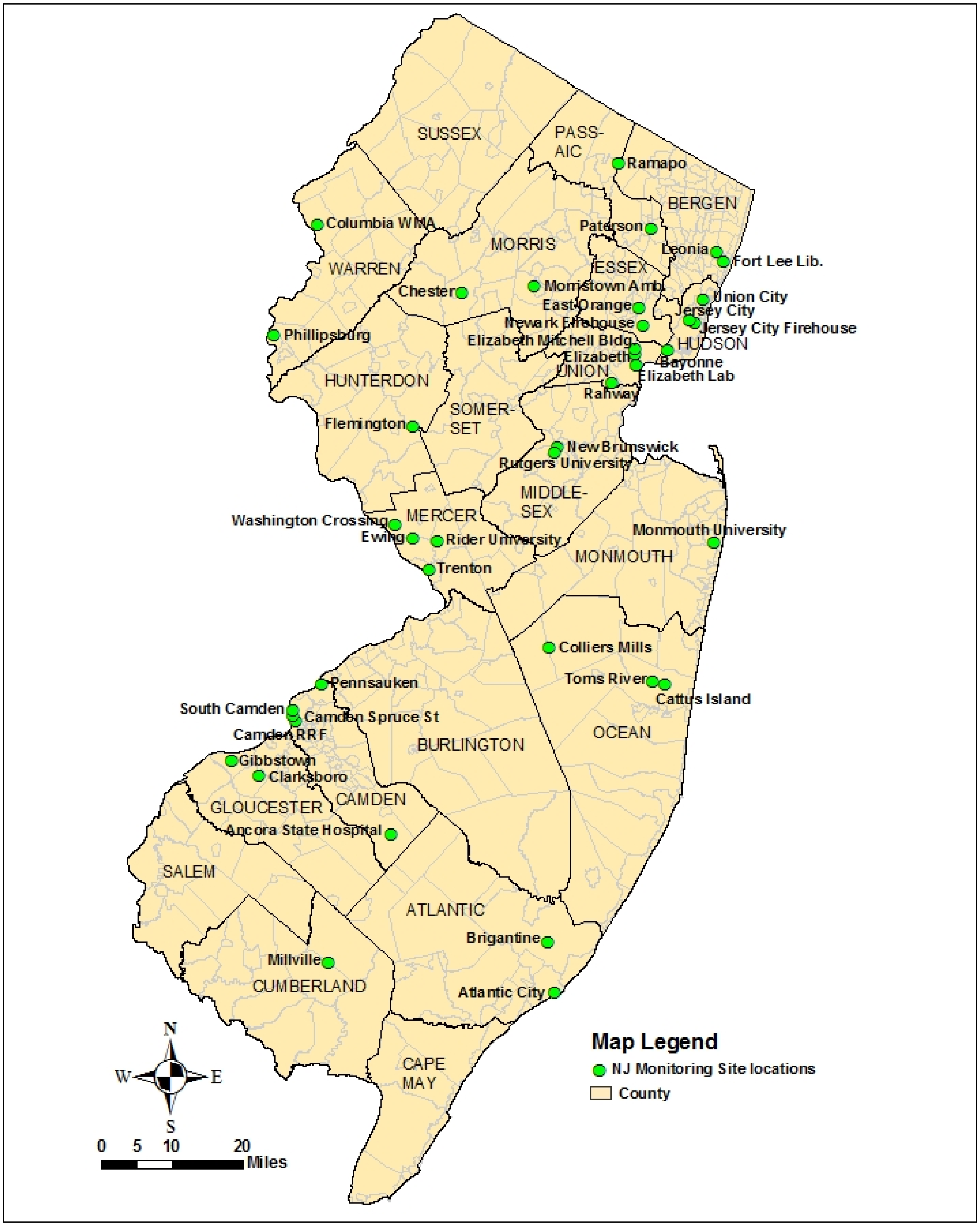


Table 1
2013 Monitoring Network Chart

	CO	NO_x	NOy	O_3	SO_2	Smoke Shade	$PM_{2.5}$	$PM_{2.5}$-Speciation	Real-Time $PM_{2.5}$ TEOM	Real-Time $PM_{2.5}$ Beta	Visibility	PM_{10}	O_3 Precursors - PAMS	VOCs/ Carbonyls	BTEX/ Black Carbon	Lead	Acid Deposition	Mercury	Barometric Pres./ Relative Humidity	Solar Radiation	Temperature	Wind Speed/ Direction
Ancora State Hospital				Y																		
Atlantic City							Y															
Bayonne		Y		Y	Y																	
Brigantine				Y	Y		Y		Y	Y	Y						Y[1]	Y				
Camden RRF												Y										
Camden Spruce Street	Y	Y		Y	Y		Y	Y						Y	Y				Y		Y	Y
Cattus Island																	Y					
Chester		Y		Y	Y		Y	Y						Y				Y		Y		
Clarksboro				Y																		
Colliers Mills				Y																		
Columbia WMA		Y		Y	Y		Y		Y										Y		Y	Y
East Orange	Y	Y																	Y		Y	Y
Elizabeth	Y				Y	Y																
Elizabeth Lab	Y	Y			Y	Y	Y	Y	Y	Y				Y	Y			Y				Y
Elizabeth Mitchell Bldg							Y															
Ewing									Y													
Flemington				Y					Y										Y	Y	Y	Y
Fort Lee Library							Y															
Gibbstown							Y															
Jersey City	Y				Y	Y																
Jersey City Firehouse							Y		Y			Y										
Leonia				Y																		
Millville		Y		Y						Y												
Monmouth University				Y																		
Morristown Amb Squad							Y															
New Brunswick							Y	Y	Y	Y				Y				Y				
Newark Firehouse	Y	Y	Y	Y	Y		Y	Y	Y	Y					Y	Y			Y	Y	Y	Y
Paterson							Y															
Pennsauken							Y															
Phillipsburg							Y															
Rahway							Y		Y													
Ramapo				Y																		
Rider University				Y															Y	Y	Y	Y
Rutgers University		Y		Y									Y						Y[2]	Y[2]	Y[2]	Y[2]
South Camden									Y													
Toms River							Y															
Trenton							Y															
Union City							Y															
Washington Crossing							Y										Y					
TOTAL	6	9	1	16	9	3	21	5	10	5	1	2	1	4	3	1	3	4	7	5	7	8

Y - Measuring Parameter Data in 2013

[1] The United States Fish and Wildlife Service is responsible for sample collection

[2] Meteorological measurements at the Site are collected by Rutgers University

Green: Began measuring data in 2013. See Table 2 (page 5)

Yellow: Re-started measuring data in 2013. See Table 2 (page 5)

Red: Shut-down measuring data in 2013. See Table 2 (page 5)

CHANGES TO THE NETWORK, 2013

In 2013, TEOM real-time $PM_{2.5}$ analyzers were replaced by Beta Attenuation analyzers at Brigantine, Elizabeth Lab, New Brunswick, and Newark Firehouse, while a TEOM analyzer was shut-down at Columbia WMA. BTEX analyzers and aethalometers were installed at the Camden Spruce Street, Elizabeth Lab, and Newark Firehouse. The Newark Firehouse station started measuring lead and the Camden Spruce Street station started measuring VOCs, carbonyls, $PM_{2.5}$ speciation and meteorological parameters. In March 2013, the Millville site, which was temporarily shut down in December 2012, was re-established and resumed collecting ozone, nitrogen oxides and real-time $PM_{2.5}$ data. In June and into July 2013, the Bayonne site, which was temporarily shut down in October 2012 due to damage caused by Superstorm Sandy, resumed measuring ozone, nitrogen oxides, and sulfur dioxide.

Table 2
2012-2013 Network Changes

Monitoring Site	Parameter(s)	Action	Date
East Orange	Barometric Pressure, Relative Humidity, Temperature, Wind Direction, Wind Speed	Start-up	08/17/12
Bayonne	NOx, O_3, SO_2	Temporary Shut-down	10/29/12
Cattus Island	Acid Deposition	Start-up	12/04/12
Millville	NOx, O_3,	Temporary Shut-down	12/05/12
Millville	Real Time $PM_{2.5}$ (TEOM)	Shut-down	12/05/12
Camden Spruce Street	BTEX, Black Carbon	Start-up	01/01/13
Elizabeth Lab	BTEX, Black Carbon	Start-up	01/02/13
Camden Spruce Street	VOC, Carbonyls	Start-up	01/04/13
Newark Firehouse	Pb	Start-up	01/04/13
Camden Spruce Street	$PM_{2.5}$ Speciation	Start-up	01/28/13
Millville	O_3	Re-start	03/01/13
Millville	NOx	Re-start	03/15/13
Elizabeth Lab	Real-Time $PM_{2.5}$ (Beta analyzer)	Start-up	05/03/13
Camden Spruce Street	Barometric Pressure, Relative Humidity, Temperature, Wind Direction, Wind Speed	Start-up	05/10/13
Elizabeth Lab	Real-Time $PM_{2.5}$ (TEOM)	Shut-down	05/10/13
Brigantine	Real-Time $PM_{2.5}$ (TEOM)	Shut-down	05/13/13
Bayonne	NOx	Re-start	06/12/13
Bayonne	O_3	Re-start	06/17/13

Monitoring Site	Parameter(s)	Action	Date
Newark Firehouse	Real-Time $PM_{2.5}$ (TEOM)	Shut-down	06/24/13
New Brunswick	Real-Time $PM_{2.5}$ (TEOM)	Shut-down	06/30/13
Bayonne	SO_2	Re-start	07/01/13
Brigantine	Real-Time $PM_{2.5}$ (Beta analyzer)	Start-up	07/25/13
Millville	Real-Time $PM_{2.5}$ (Beta analyzer)	Start-up	07/25/13
Newark Firehouse	BTEX, Black Carbon	Start-up	07/25/13
Newark Firehouse	Real-Time $PM_{2.5}$ (Beta analyzer)	Start-up	07/25/13
New Brunswick	Real-Time $PM_{2.5}$ (Beta analyzer)	Start-up	10/16/13
Columbia WMA	Real-Time $PM_{2.5}$ (TEOM)	Shut-down	11/24/13

REFERENCES

Ball, R. J. and G. E. Andersen, Optimum Site Exposure Criteria for Sulfur Dioxide Monitoring, EPA-450/3-77-013, The Center for the Environment and Man, Inc., Hartford, CT, Prepared for USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, April 1977

Ludwig, F. L. and J. H. S. Kealoha, Selecting Sites for Carbon Monoxide Monitoring, EPA-450/3-75-077, Stanford Research Institute, Menlo Park, CA. Prepared for USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 1975.

Ludwig, F. L. and E. Shelar, Site Selection for the Monitoring of Photochemical Air Pollutants, EPA-450/3-78-013, Stanford Research Institute, Menlo Park, CA, Prepared for USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, April 1978.

Network Design for State and Local Air Monitoring Stations (SLAMS), National Air Monitoring Stations (NAMS), and Photochemical Assessment Monitoring Stations (PAMS), 40 CFR 58 Appendix D, US Government Printing Office, Washington DC, July 1997.

Pelton, D. J. and R. C. Koch, Optimum Sampling Exposure Criteria for Lead, EPA-450/4-84-012, GEOMET Technologies, Inc., Rockville, MD, Prepared for UESPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, February 1984.

Watson, J. G., et. al., Guidance for Network Design and Optimum Site Exposure for $PM_{2.5}$ and PM10, EPA-454/R-99-022, Desert Research Institute, University and Community College System of Nevada, Reno, NV. Prepared for USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, December 1997

2013 Air Quality Index Summary

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). Generally, 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 (carbon monoxide, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide). Concentrations of pollutants that are associated with unhealthy ratings have been dropping over the past few years. The Nitrogen Dioxide and Sulfur Dioxide NAAQS were revised in 2010 because the U.S. Environmental Protection Agency (EPA) had determined that the old standards were not sufficiently protective of public health. The ozone standard was most recently revised in 2008 and is currently under review.

The AQI rating for a reporting region is equal to the highest rating recorded for any pollutant within that region. In an effort to make the AQI easier to understand, a descriptive rating and a color code, based on the numerical rating are used (see Table 1). For more information on the AQI, visit EPA's web site at http://www.airnow.gov.

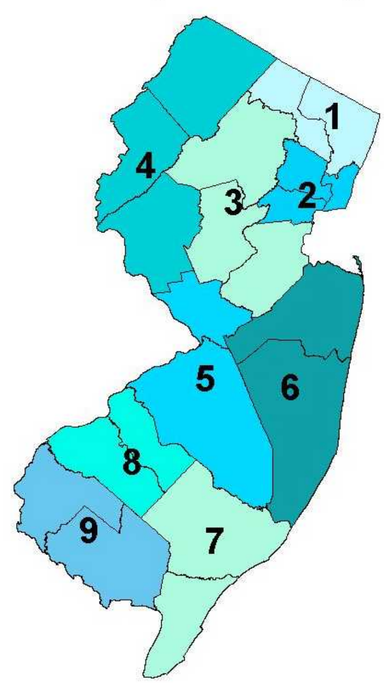
Every morning a forecast for the current and following day is prepared by NJDEP using the AQI format. The forecast is provided to EPA and is disseminated through the Enviroflash system to those who subscribe to receive air quality forecast and alert emails (http://www.enviroflash.info). Those who are not subscribed to Enviroflash can view the forecast and current air quality conditions at EPA's AirNow website or on NJDEP's air monitoring webpage.

For purposes of reporting the AQI, the state is divided into 9 regions (see Figure 1). Table 2 shows the monitoring sites and parameters used in each reporting region to calculate the AQI values.

Table 1
Air Quality Index

Numerical AQI Rating	Descriptive Rating	AQI Color Code
0-50	Good	Green
51-100	Moderate	Yellow
101-150	Unhealthy for Sensitive Groups	Orange
151-200	Unhealthy	Red
201-300	Very Unhealthy	Purple

Figure 1
Air Quality Index Regions



.

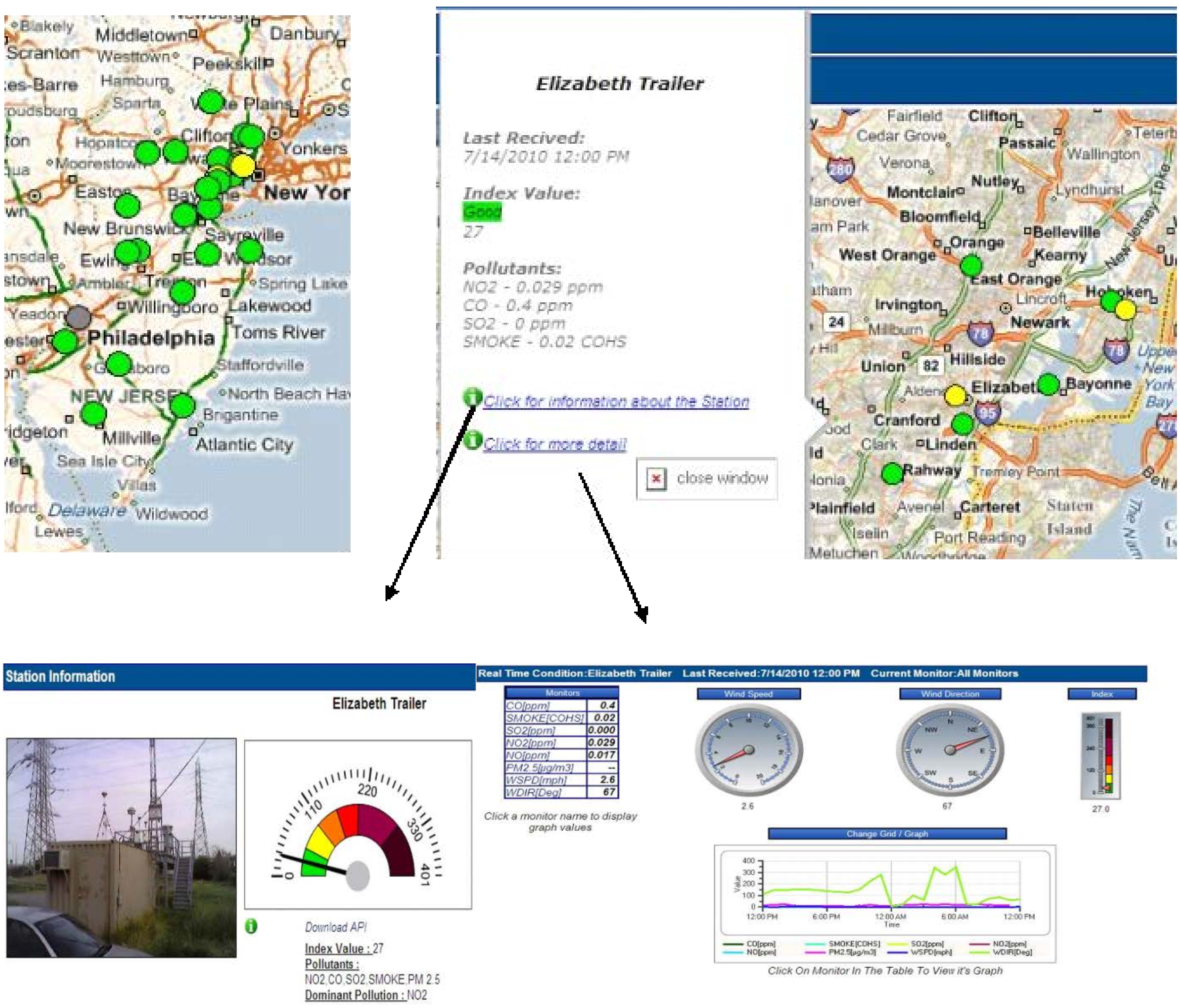
Table 2
Pollutants Monitored According to Air Quality Index Reporting Region – 2013

CO - Carbon Monoxide
SO_2 - Sulfur Dioxide
PM - Particulate Matter
O_3 - Ozone
NO_2 - Nitrogen Dioxide

Reporting Region	Monitoring Site	CO	SO_2	PM	O_3	NO_2
1. Northern Metropolitan	Leonia	---	---	---	X	---
	Ramapo	---	---	---	X	---
2. Southern Metropolitan	Bayonne	---	X	---	X	X
	East Orange	X	---	---	---	X
	Elizabeth	X	X	X	---	---
	Elizabeth Lab	X	X	X	---	X
	Jersey City	X	X	X	---	---
	Jersey City Firehouse	---	---	X	---	---
	Newark Firehouse	X	X	X	X	X
	Rahway	---	---	X	---	---
3. Suburban	Chester	---	X	---	X	X
	New Brunswick	---	---	X	---	---
	Rutgers University	---	---	---	X	X
4. Northern Delaware Valley	Columbia WMA	---	X	X	X	X
	Flemington	---	---	X	X	---
5. Central Delaware Valley	Ewing	---	---	X	---	---
	Rider University	---	---	---	X	---
6. Northern Coastal	Colliers Mills	---	---	---	X	---
	Monmouth University	---	---	---	X	---
7. Southern Coastal	Brigantine	---	X	X	X	---
8. Southern Delaware Valley	Ancora State Hospital	---	---	---	X	---
	Camden Spruce St.	X	X	---	X	X
	Clarksboro	---	---	---	X	---
	South Camden	---	---	X	---	---
9. Delaware Bay	Millville	---	---	X	X	X

Along with the forecast, cautionary statements are provided for days when the air quality is expected to reach the unhealthy for sensitive groups range and above. These air quality alerts are issued through Enviroflash emails, 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://www.erh.noaa.gov/er/phi/). Maps, charts and photos of the air quality information and sites from which data is collected are available on the NJDEP air monitoring web site as shown in Figure 2 below:

Figure 2
Examples of NJDEP's Air Monitoring Website



2013 AQI Summary

A summary of the AQI ratings for New Jersey in 2013 is presented in the pie chart in Figure 3 below. In 2013, there were 193 "Good" days, 153 were "Moderate", 19 were rated "Unhealthy for Sensitive Groups", zero were considered "Unhealthy", and zero 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 twenty. This is an improvement from last year when one in fifteen days was unhealthy. It is also the first year to have no days exceed the unhealthy limit for the general population since 2009, which was an unusually cool and wet summer accounting for much lower concentrations of pollutants. Table 3 lists the dates when the AQI reached the "Unhealthy for Sensitive Groups" threshold at any monitoring location and shows which pollutant(s) were in that range or higher. Figure 4 shows the AQI ratings for the year broken down by AQI region.

Not all regions have 365 valid days of reported air quality index values. Both the Northern Coastal and Northern Metropolitan regions only have about 260 reported AQI values because the ozone monitors in these regions operate seasonally from March to October. The Bayonne and Millville sites were temporarily shut down to repair extensive damage from the Superstorm Sandy, Bayonne was down for approximately half the year while Millville was down for about 2 months accounting for the 58 days in that region with no AQI value. This was the first complete year of sampling at the new air monitoring station in the city of Camden (Camden Spruce Street), which was established on April 18, 2012. Total days without AQI values are reported by region Figure 5.

Figure 3
2013 Air Quality Summary by Days

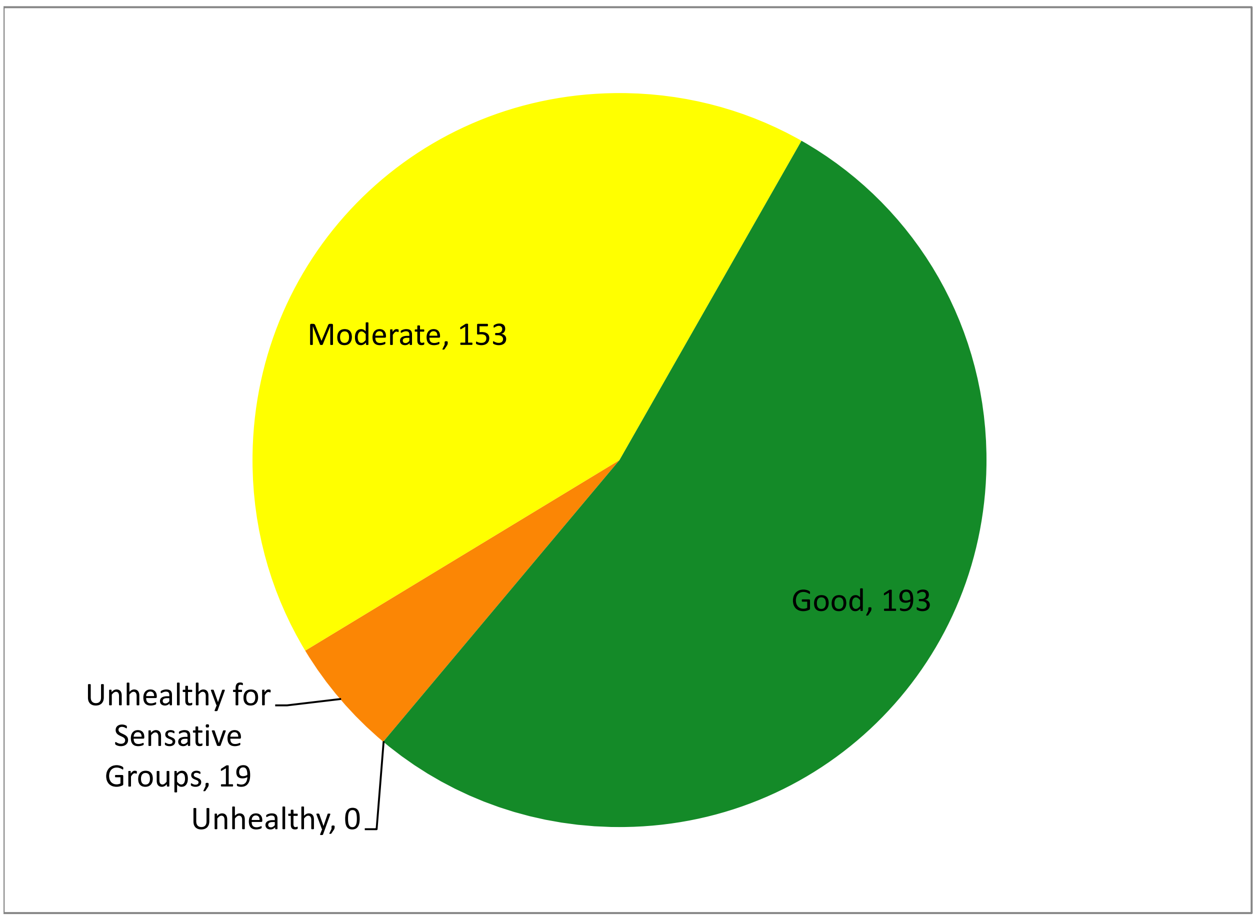


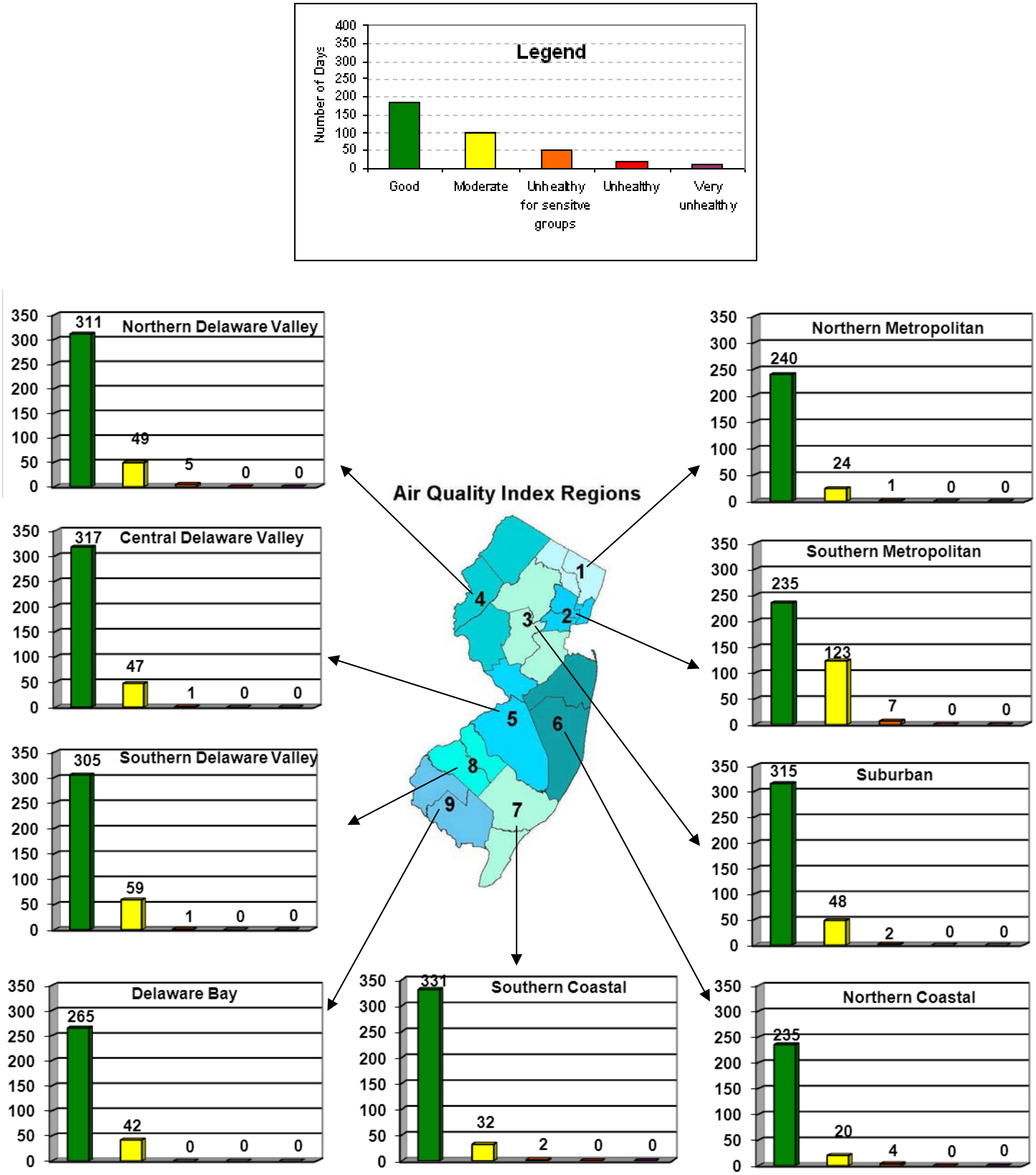
Table 3
Air Quality Index (AQI) Exceedances of 100 During 2013

Ratings			Pollutants		
USG	-	Unhealthy for Sensitive Groups	PM	-	Particle Matter (11 Sites)
UH	-	Unhealthy	O_3	-	Ozone (16 Sites)
VUH	-	Very Unhealthy	SO_2	-	Sulfur Dioxide (9 Sites)

* Number in parentheses ( ) indicates the total number of sites exceeding 100 by pollutant on the given day

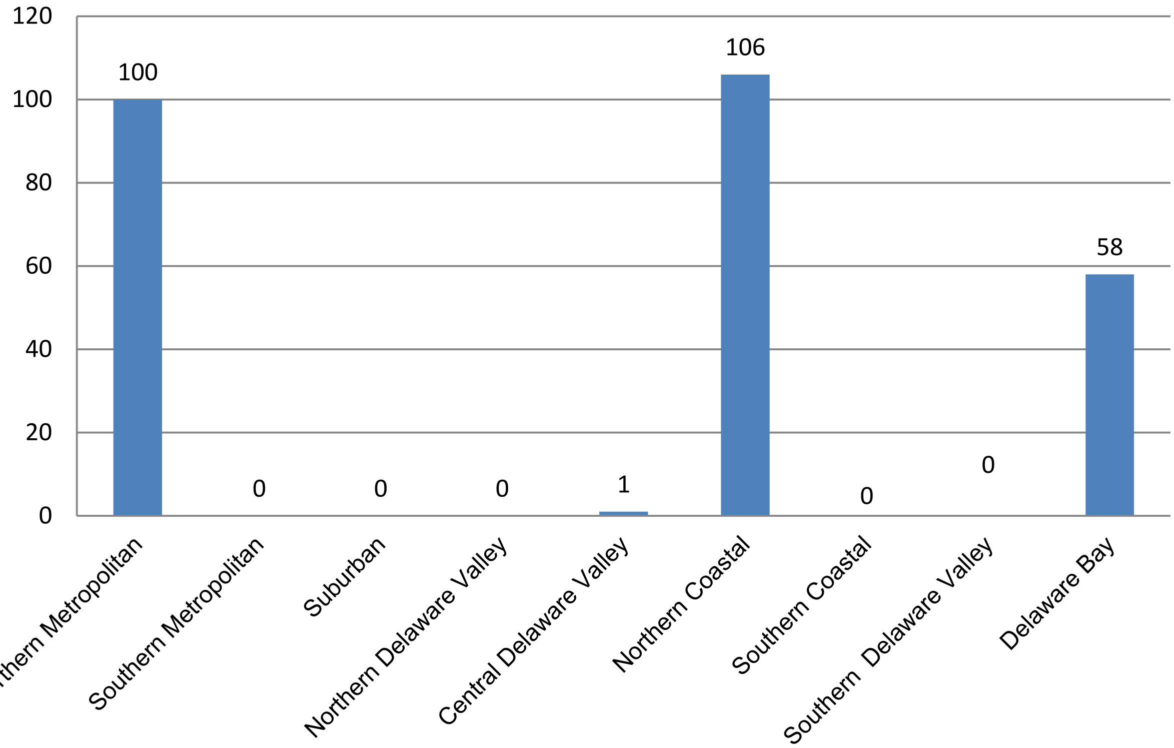
Date	Highest Location	Highest AQI value	Highest Pollutant	Highest rating	Pollutant(s) with AQI above 100
1/8/2013	Elizabeth Lab	103	PM	UHSG	PM (1)
1/25/2013	Columbia WMA	118	SO_2	UHSG	SO_2 (1)
1/27/2013	Elizabeth Lab	103	PM	UHSG	PM (1)
4/16/2013	Columbia WMA	112	SO_2	UHSG	SO_2 (1)
5/28/2013	Clarksboro	106	O_3	UHSG	O_3 (1)
5/30/2013	Newark Firehouse	106	O_3	UHSG	O_3 (2)
6/1/2013	Columbia WMA	103	SO_2	UHSG	SO_2 (1)
6/20/2013	Flemington	101	O_3	UHSG	O_3 (1)
6/24/2013	Monmouth	113	O_3	UHSG	O_3 (1)
7/15/2013	Monmouth	120	O_3	UHSG	O_3 (1)
7/16/2013	Brigantine	127	O_3	UHSG	O_3 (2)
7/17/2013	Monmouth	124	O_3	UHSG	O_3 (2)
7/18/2013	Chester	103	O_3	UHSG	O_3 (1)
8/20/2013	Colliers Mills	101	O_3	UHSG	O_3 (1)
8/25/2013	Columbia WMA	121	SO_2	UHSG	SO_2 (1)
9/10/2013	Ramapo	103	O_3	UHSG	O_3 (2)
12/1/2013	Elizabeth Lab	107	PM	UHSG	PM (2)
12/3/2013	Newark Firehouse	109	PM	UHSG	PM (2)
12/4/2013	Newark Firehouse	113	PM	UHSG	PM (2)

Figure 4
2013 Air Quality Index Summary
Number of Days by Reporting Region [a]



[a] Some days there was no index available see Figure 5

Figure 5
Days in 2013 Without Index Values Available by Reporting Region



REFERENCES

Air Quality Index, A Guide to Air Quality and Your Health, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, June 2000, EPA-454/R-00-005, URL: www.epa.gov/airnow/aqi_cl.pdf

Guideline for Reporting of Daily Air Quality - Air Quality Index (AQI), USEPA, Office of Air Quality Planning and Standards, July 1999, EPA-454/R-99-010, URL: www.epa.gov/ttn/oarpg/t1/memoranda/rg701.pdf

Air Quality Index Reporting, Final Rule: Title 40, Part 58, Code of Federal Regulations, August 4, 1999. URL: http://www.epa.gov/ttn/oarpg/t1/fr_notices/airqual.pdf

National Air Quality and Emissions Trend Report, 1999, EPA-454/R-01-004, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 2001, URL: www.epa.gov/air/airtrends/aqtrnd99/

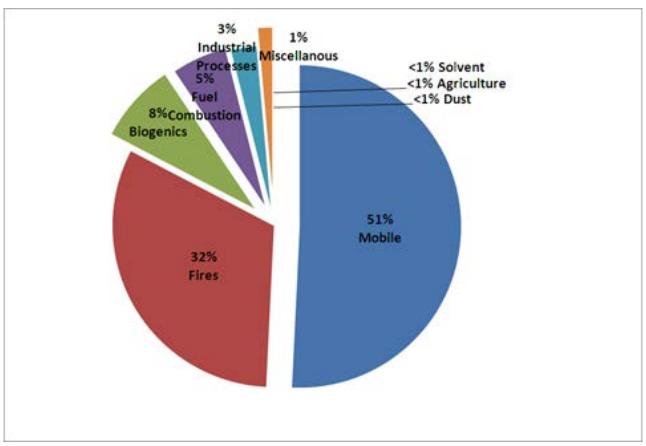
2013 Carbon Monoxide Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

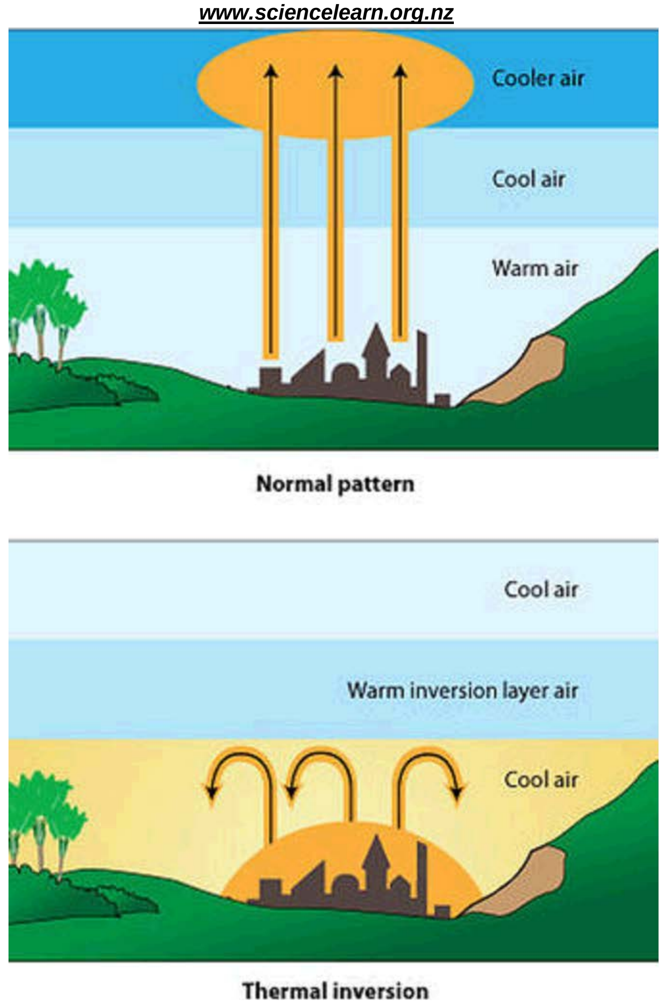
Carbon monoxide (CO) is a colorless, odorless, poisonous gas formed when carbon in fuels is not burned completely. It is a by-product of motor vehicle exhaust, which contributes over 51 percent of all CO emissions nationwide. Non-road engines and vehicles, such as construction equipment and boats, are also significant sources of CO. Other sources of CO include industrial processes, fuel combustion in sources such as boilers and incinerators, and natural sources such as forest fires. Figure 1 shows the national average contributions of these sources.

Figure 1
National Summary of CO
Emissions by Source Category 2011



Source: United States Environmental Protection Agency
www.epa.gov/air/emissions/co.htm

Figure 2
Effect of Atmospheric Inversion of Pollution
www.sciencelearn.org.nz



Atmospheric inversions, which usually occur overnight when cooler air is trapped beneath a layer of warmer air, allow CO levels to accumulate near the ground. The inversion acts like a lid, preventing pollution from mixing in the atmosphere and effectively trapping it close to ground level (see Figure 2). Figure 3 shows that CO levels 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, and this diurnal variation is displayed in Figure 4.

Figure 3
2013 Carbon Monoxide Average Concentrations – New Jersey
Monthly Variation, Parts Per Million (PPM)

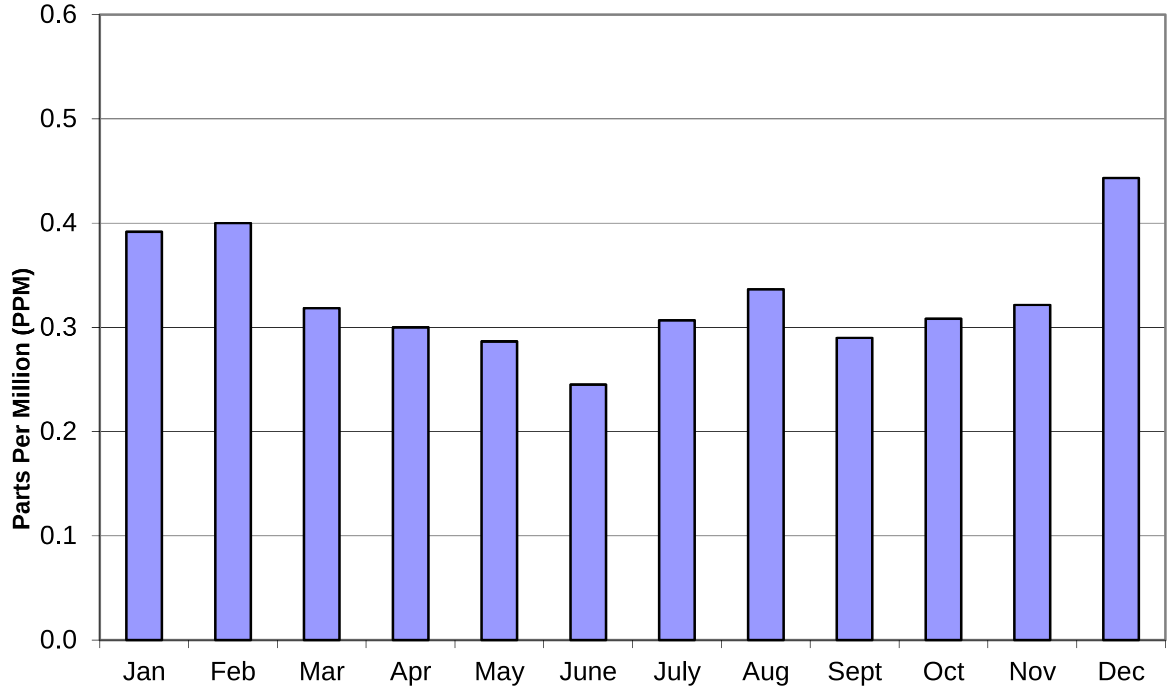
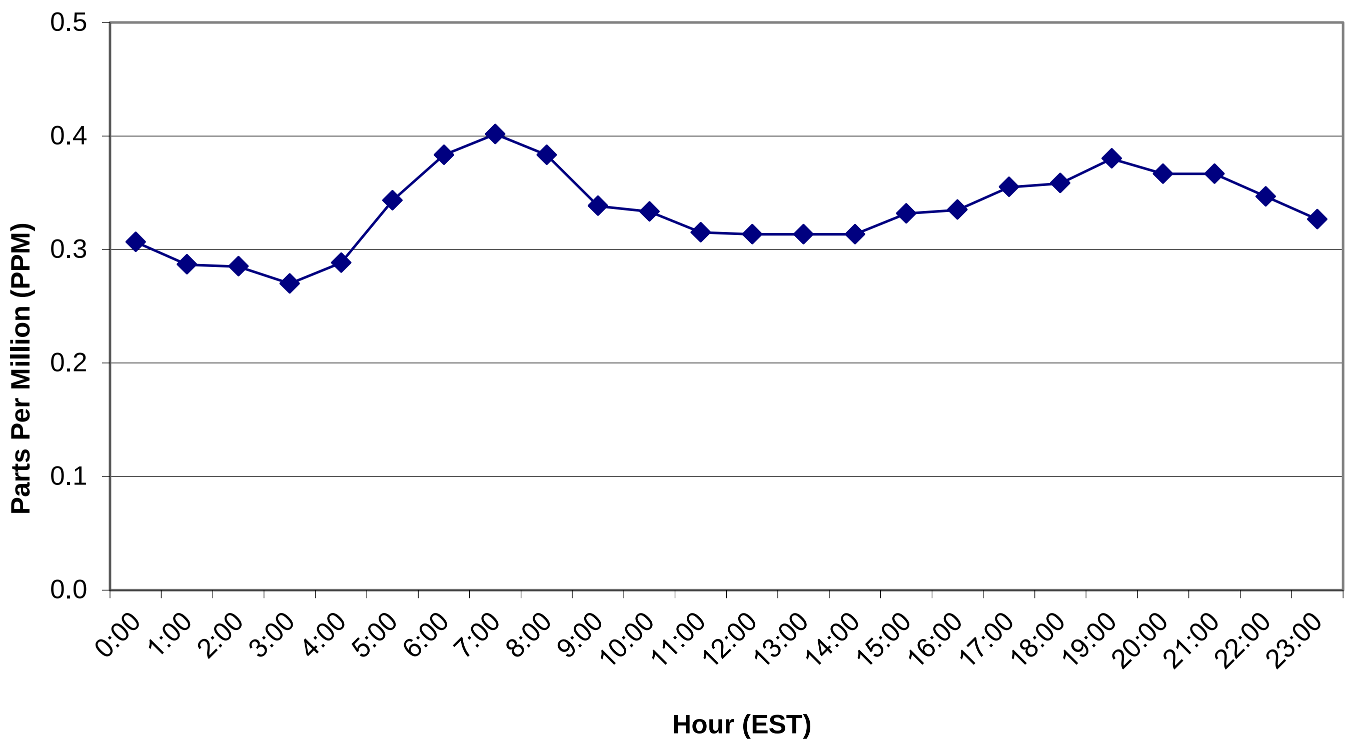


Figure 4
2013 Carbon Monoxide Average Concentrations-New Jersey
Hourly Variation, Parts Per Million (PPM)



Health and Environmental Effects

Carbon monoxide enters the bloodstream and reduces the body's ability to distribute oxygen to organs and tissues. The most common symptoms associated with exposure to carbon monoxide are headaches and nausea. The health threat from exposure to 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 cause chest pain and reduce that individual's ability to exercise. Healthy people are also affected, but only at higher levels of exposure. Elevated CO levels are also associated with visual impairment, reduced work capacity, reduced manual dexterity, decreased learning ability, and difficulty in performing complex tasks.

Standards

There are currently two national primary, or health based standards for carbon monoxide in ambient air. They are set at a 1-hour average concentration of 35 parts per million (ppm), and an 8-hour average concentration of 9 ppm. These levels are not to be exceeded more than once in any calendar year. There are no national secondary, or welfare based standards for CO at this time. The national standards are commonly known as National Ambient Air Quality Standards (NAAQS). New Jersey also has standards for CO, and they are based on different units (milligrams per cubic meter as opposed to parts per million), and 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 summarized in Table 1.

Table 1
National and New Jersey Ambient Air Quality Standards for Carbon Monoxide

mg/m^3 = Milligrams Per Cubic Meter
ppm = Parts per Million

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

Monitoring Locations

The New Jersey Department of Environmental Protection (NJDEP) operated 6 CO monitoring stations in 2013. These sites are shown in the map in Figure 5. The Newark Firehouse station measures CO concentrations at trace levels as part of the U.S. Environmental Protection Agency's (EPA) National Core (NCore) monitoring network. Trace level CO concentrations are measured and reported to the hundredth of a ppm. The Camden Spruce Street site began monitoring for CO in April 2012. The NJDEP is planning to establish a new CO monitoring location in Fort Lee by January 1, 2014.

CO LEVELS IN 2013

None of the monitoring sites recorded exceedances of any CO standards during 2013. The maximum 1-hour average CO concentration recorded in 2013 was 5.27 ppm at the Newark Firehouse station. The highest 8-hour average CO concentration recorded was 2.4 ppm at the East Orange station. Summaries of the 2013 data are provided in Table 2, Figure 6 and Figure 7.

Figure 5
2013 Carbon Monoxide
Monitoring Network

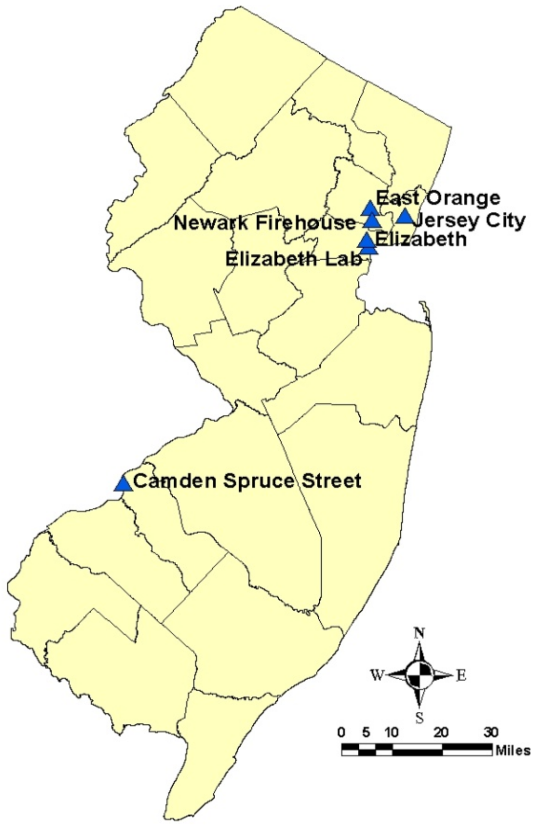


Table 2
Carbon Monoxide Data - 2013
1-Hour and 8-Hour Averages

Parts Per Million (PPM)
1-hour standard= 35 PPM
8-hour standard= 9 PPM

Monitoring Sites	Maximum 1-Hour Average	2nd Highest 1-Hour Average	Maximum 8-Hour Average	2nd Highest 8-Hour Average
Camden Spruce St.	1.8	1.8	1.3	1.1
East Orange	3.5	3.4	2.4	1.9
Elizabeth	2.4	2.4	2.1	1.7
Elizabeth Lab	2.3	2.0	1.7	1.3
Jersey City	2.8	2.7	2.2	1.8
Newark Firehouse	5.27	3.17	2.06	1.91

Figure 6
Highest and 2nd Highest 1-Hour Averages
Of Carbon Monoxide in New Jersey-2013
Parts Per Million (PPM)

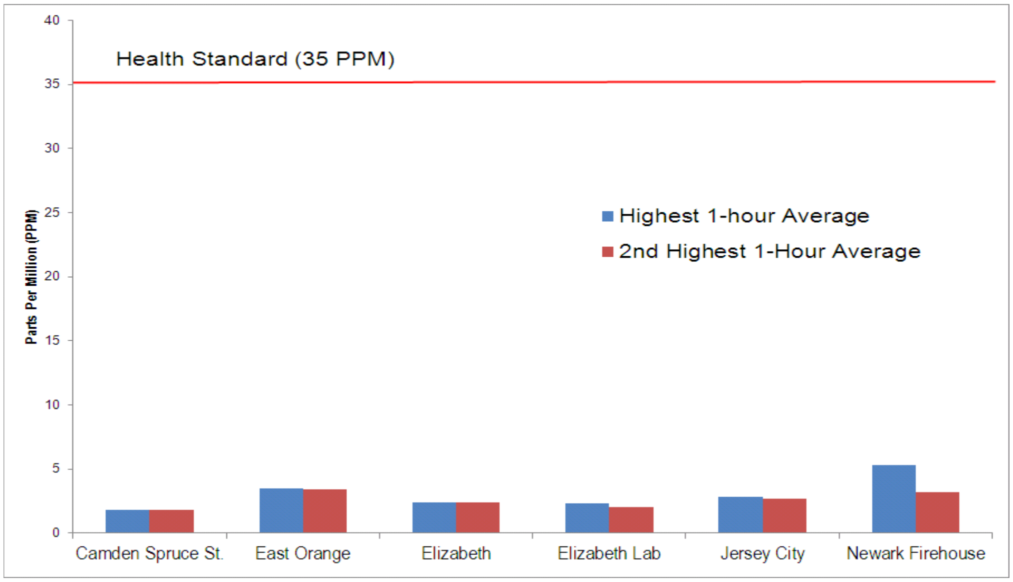
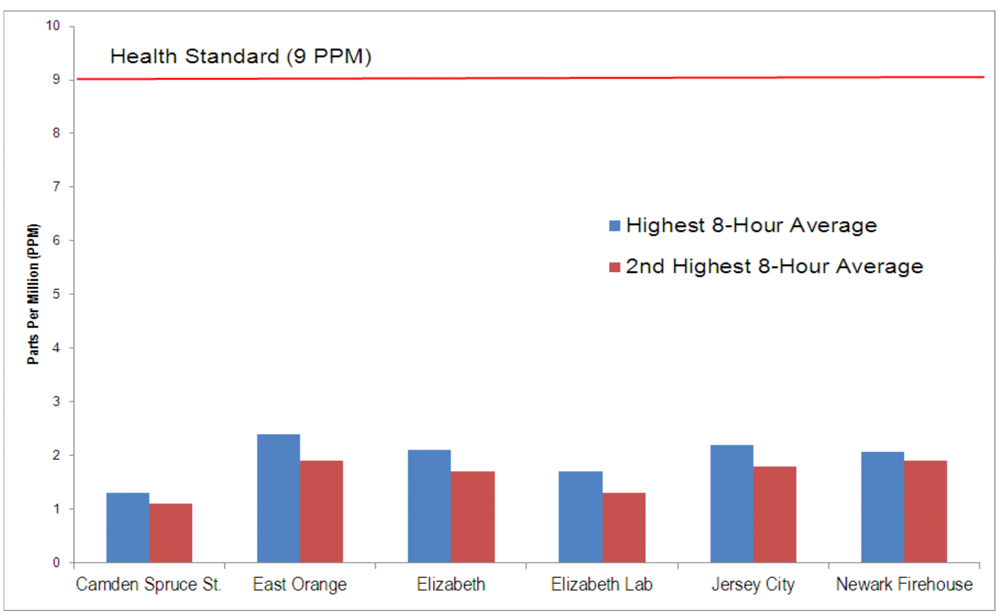


Figure 7
Highest and 2nd Highest 8-Hour Averages
Of Carbon Monoxide in New Jersey-2013
Parts Per Million (PPM)



TRENDS

Carbon monoxide levels have improved dramatically over the past 20 years. A trend graph of CO levels showing the concentrations recorded in each year since 1975 of the highest site, average of all sites and lowest site is provided in Figure 8. The graph depicts the second highest 8-hour value recorded since this is the value that determines if the health standard is being met (one exceedance per site is allowed each year). The last time the CO standard was exceeded in New Jersey was in January of 1995 (Figure 9), and the entire state was officially declared as having attained the CO standard on 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.

Figure 8
Carbon Monoxide Air Quality, 1975-2013
2nd Highest 8-hour Average
Parts Per Million (PPM)

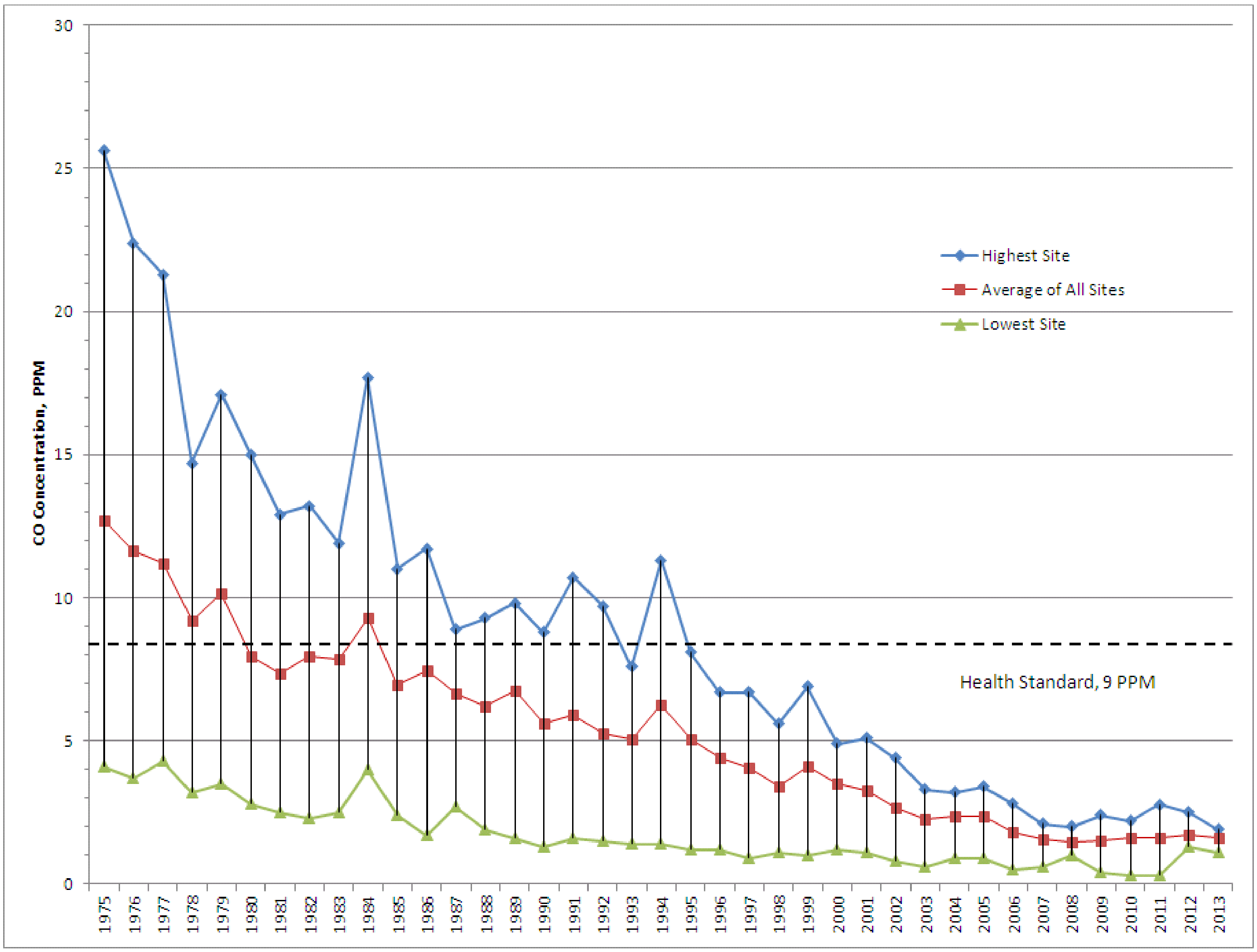
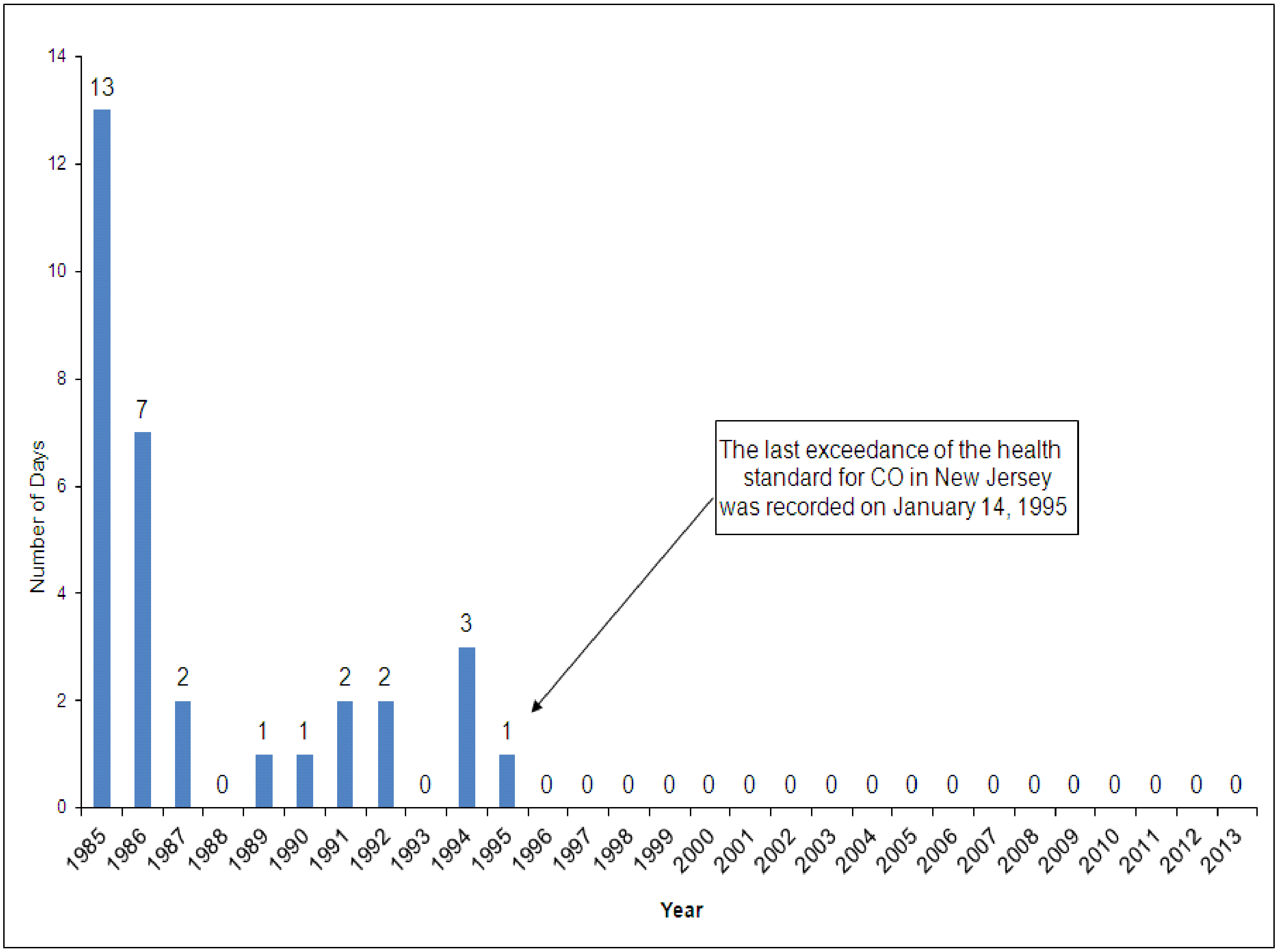


Figure 9
Carbon Monoxide
Unhealthful Days 1985-2013



References

Automobile Emissions: An Overview, USEPA, August 1994, EPA-400/F-92-007,URL: www.epa.gov/cgi-bin/broker?_service=data&_debug=0&_program=dataprog.state_1.sas&pol=CO&stfips=34

CO – How Carbon Monoxide Affects the Way We Live and Breathe, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC November 2000, URL: http://www.epa.gov/air/urbanair/co/index.html

Effect of Atmospheric Inversion on Air Pollution, http://www.sciencelearn.org.nz/Contexts/Enviro-imprints/Sci-Media/Images/Temperature-inversion

National Air Quality and Emissions Trend Report, 1999, EPA-454/R-01-004, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 2001, URL: http://www.epa.gov/air/airtrends/aqtrnd99/

Latest Findings on National Air Quality: 2000 Status and Trends, EPA-454/K-01-002, USEPA , Office of Air Quality Planning and Standards, RTP, September 2001, URL: http://www.epa.gov/air/airtrends/aqtrnd00/brochure/00brochure.pdf

Latest Findings on National Air Quality: 2002 Status and Trends, EPA-454/K-03-001, USEPA , Office of Air Quality Planning and Standards, RTP, September 2001, URL: www.epa.gov/airtrends/carbon.html

National Air Quality and Emissions Trend Report, 2003 Special Studies Edition, EPA-454/R-03-005, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 2003, URL: http://www.epa.gov/air/airtrends/aqtrnd03/

National Primary Ambient Air Quality Standards for Carbon Monoxide, 40 CFR 50.8, US Government Printing Office, Washington DC, July 2001.

http://www.epa.gov/air/emissions/co.htm

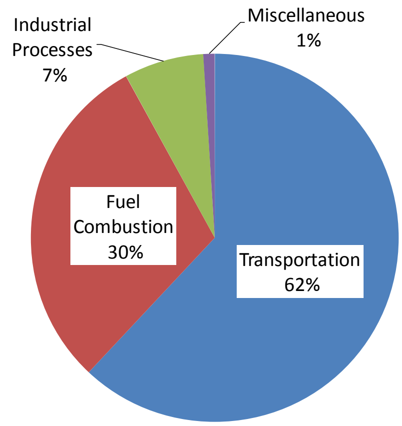
2013 Nitrogen Dioxide Summary

New Jersey Department of Environmental Protection

Nature and Sources

Nitrogen Dioxide (NO_2) is a reddish-brown, highly reactive gas that is formed in the air through the oxidation of Nitric Oxide (NO). When NO_2 reacts with other chemicals, it can form ozone, particulate matter, and other compounds which can contribute to regional haze and acid rain. Oxides of Nitrogen (NOx) is a mixture of gases which is mostly comprised of NO and NO_2. These gases are emitted from the exhaust of motor vehicles, the burning of coal, oil or natural gas, and during industrial processes such as welding, electroplating, and dynamite blasting. Although most NOx is emitted as NO, it is readily converted to NO_2 in the atmosphere. In the home, gas stoves and heaters produce substantial amounts of nitrogen dioxide. A pie chart summarizing the major sources of NOx is shown in Figure 1. As much of the NOx in the air is emitted by motor vehicles, concentrations tend to peak during the morning and afternoon rush hours. This is shown in the graphs in Figures 2-4 (pages 2-3).

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



Source: USEPA National Summary of Nitrogen Oxides Emissions, 2008

Health and Environmental Effects

Short-term exposures (less than 3 hours) to low levels of nitrogen dioxide may aggravate pre-existing respiratory illnesses, and can cause respiratory illnesses, particularly in children ages 5-12. Symptoms of low level exposure to NO and NO_2 include irritation to eyes, nose, throat and lungs, coughing, shortness of breath, tiredness and nausea. Long-term exposures to NO_2 may increase susceptibility to respiratory infection and may cause permanent damage to the lung. NO and NO_2 are found in tobacco smoke, so people who smoke or breathe in second-hand smoke may be exposed to NOx. The U.S. Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the U.S. Environmental Protection Agency (EPA) have determined that, with the available information, no conclusion can be made as to the carcinogenicity of NO or NO_2 to human beings. Nitrogen Oxides contribute to a wide range of environmental problems. These include potential changes in the composition of some plants in wetland and terrestrial ecosystems, acidification of freshwater bodies, eutrophication of estuarine and coastal waters, increases in levels of toxins harmful to fish and other aquatic life, and visibility impairment.

Figure 2
Nitric Oxide – New Jersey
2013 Hourly Variation
Parts Per Million (ppm)

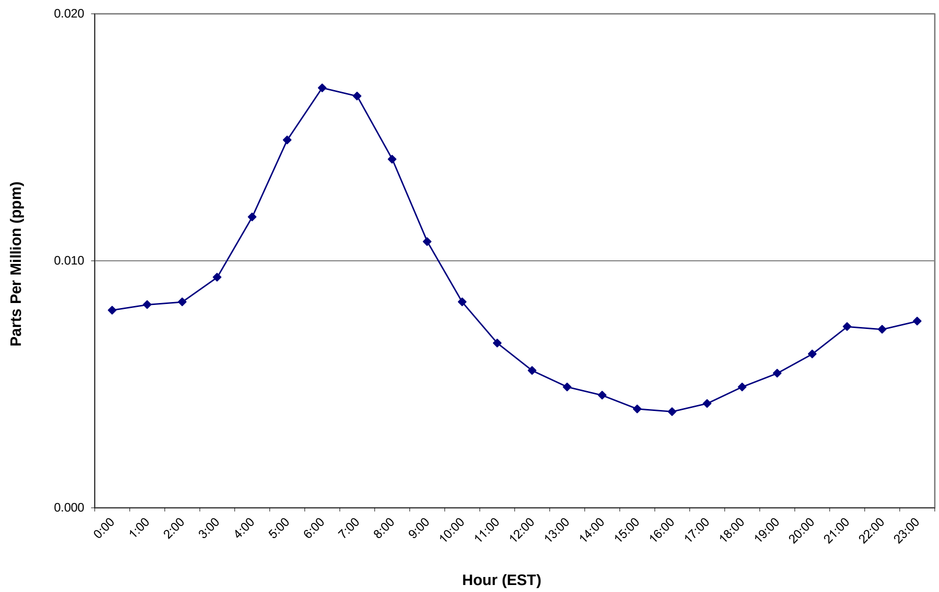


Figure 3
Nitrogen Dioxide – New Jersey
2013 Hourly Variation
Parts Per Million (ppm)

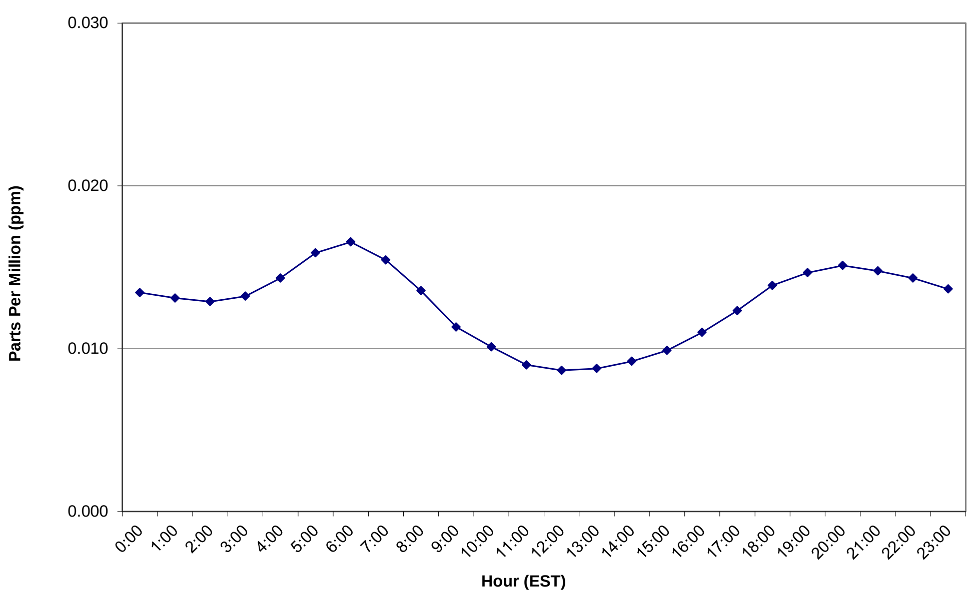
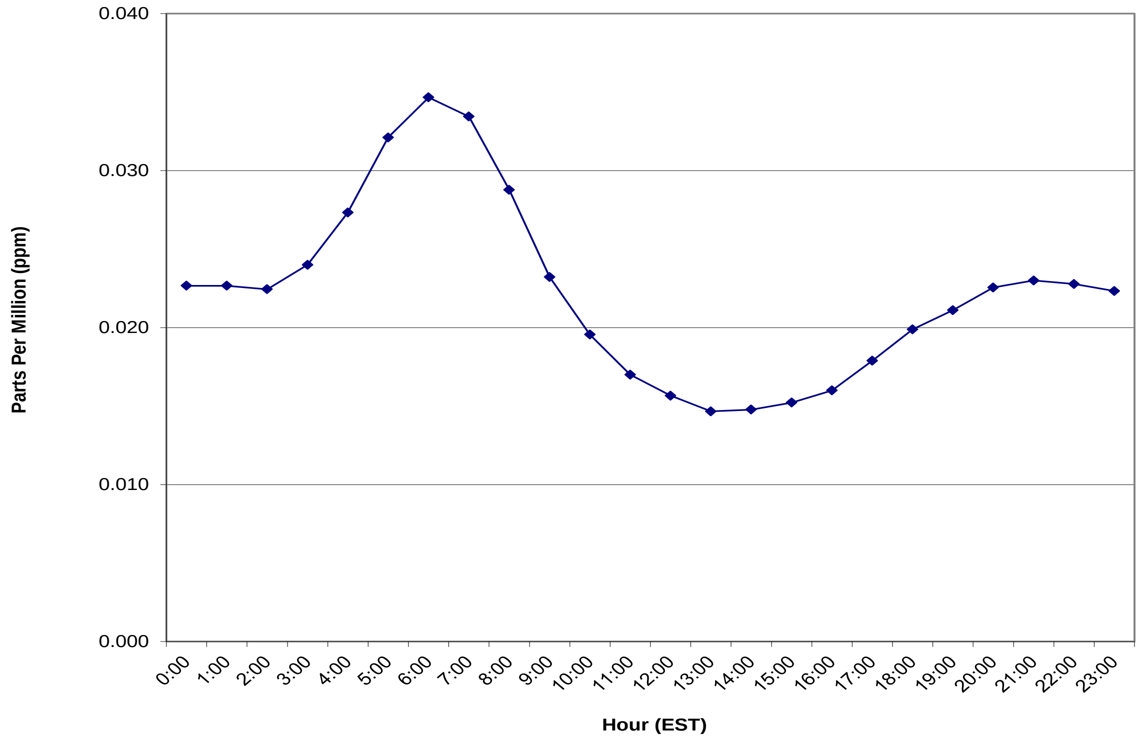


Figure 4
Total Oxides of Nitrogen – New Jersey
2013 Hourly Variation
Parts Per Million (ppm)



STANDARDS

The primary (health based) and secondary (welfare based) National Ambient Air Quality Standards (NAAQS) annual average for NO_2 are the same. They are set at a calendar year average concentration of 0.053 parts per million (ppm). The New Jersey Ambient Air Quality Standards (NJAAQS) are identical to the NAAQS except micrograms per cubic meter (µg/m^3) are the standard units and the state standard applies to any 12-month period, not just the calendar year. In 2010, the EPA strengthened the primary NAAQS by adding a 1-hour NO_2 standard of 0.100 ppm along with the current annual average NO_2 standard of 0.053 ppm. Table 1 provides a summary of the NO_2 standards.

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

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

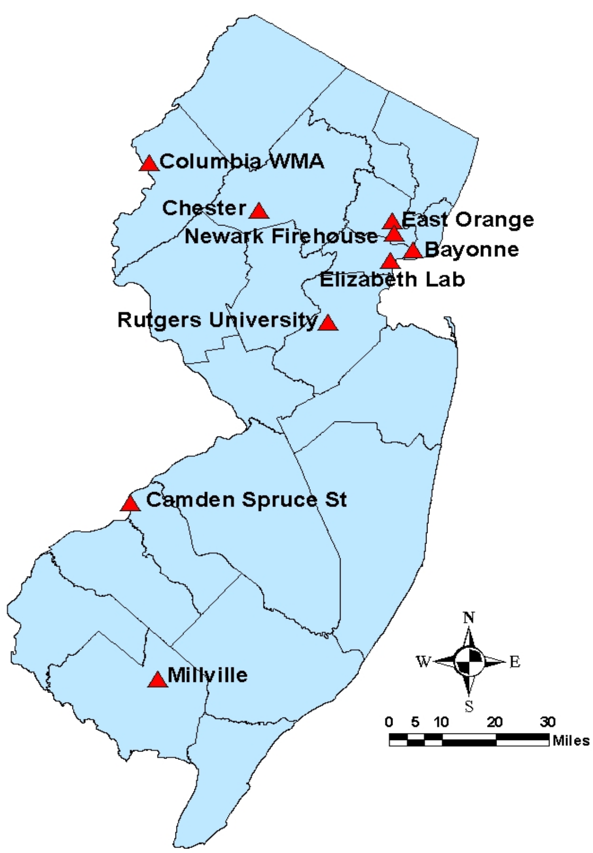
An area meets the new 1-hour NO_2 standard when the 3-year average of the 98th percentile of the daily maximum NO_2 concentrations measured in this area is less than 0.100 ppm. This statistic, also known as the design value, is determined by first obtaining the maximum 1-hour average NO_2 concentrations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

In addition to adding a 1-hour NO_2 standard of 0.100 ppm in 2010, the EPA requires a NO_2 near-roadway monitoring station to be operational by January 1, 2014. A near-roadway station must be located no more than 50 meters (164 feet) from the nearest traffic lane of a major roadway. NJDEP plans to establish one near-roadway NO_2 station in the New York-Northern New Jersey-Long Island Metropolitan area that meets the EPA criteria.

MONITORING LOCATIONS

The state monitored NO_2 levels at 9 locations in 2013. Bayonne monitoring station was temporarily shut down from October 2012 until June 2013 due to site damage caused by Superstorm Sandy. Also Millville monitoring station was temporarily shut down from December 2012 until March 2013 due to site renovations. These sites are shown in Figure 5.

Figure 5
2013 Nitrogen Dioxide Monitoring Network



NO_2 LEVELS IN 2013

None of the monitoring sites recorded exceedances of either the National or New Jersey Air Quality Standards for NO_2 during 2013. The highest 12-month (calendar year) average concentration of NO_2 recorded was 0.022 ppm at the Elizabeth Lab site located at Exit 13 of the New Jersey Turnpike (Table 2, below and Figure 6, page 6). There were not any measurements of the 1-hour average NO_2 concentration above 0.100 ppm. The sites that measured the highest 98th percentile of the daily maximum NO_2 concentrations in 2013 were Elizabeth Lab and Newark Firehouse with 0.062 ppm (Table 2, below and Figure 8, page 7). The site that measured the highest 3-year average of the 98th percentiles from 2011 to 2013 was Elizabeth Lab with 0.067 ppm (Table 2, below and Figure 9, page 7). All sites in New Jersey met the new 1-hour NO_2 standard. While national health and welfare standards have not been established for Nitric Oxide (NO), it is considered to be an important pollutant that contributes to the formation of ozone, fine particles and acid rain. The maximum annual average concentration of NO recorded in 2013 was 0.020 ppm, at the Columbia WMA site (Table 2, below and Figure 7, page 6).

Table 2
Nitrogen Dioxide (NO_2) and Nitric Oxide (NO) Data - 2013
1-Hour and 12-Month Averages
Parts Per Million (ppm)
National 1-Hour Standard = 0.100 ppm
National 12-Month Standard = 0.053 ppm

	Nitrogen Dioxide 1-Hour Average (ppm)				Nitrogen Dioxide 12-Month Average (ppm)		Nitric Oxide 12-Month Average (ppm)
Monitoring Sites	**Daily Maximum**	**2nd Highest Daily Max.**	**2013 98th%-ile**	**2011-2013 98^{th} %-ile (3-year Avg.)**	**Maximum (Running 12-month)**	**Calendar year**	**Calendar Year**
Bayonne	0.083	0.054	0.052	(a)	0.016	0.016	0.008
Camden Spruce Street	0.052	0.048	0.046	---*	0.012	0.012	0.004
Chester	0.048	0.042	0.035	0.036	0.004	0.004	0.000
Columbia WMA	0.051	0.050	0.043	0.045	0.013	0.012	0.020
East Orange	0.061	0.060	0.055	0.057	0.018	0.017	0.010
Elizabeth Lab	0.082	0.079	0.062	0.067	0.022	0.022	0.018
Millville	0.042	0.039	0.031	(b)	0.006	0.006	0.003
Newark Firehouse	0.080	0.073	0.062	0.062	0.018	0.018	0.009
Rutgers University	0.044	0.044	0.040	0.044	0.010	0.008	0.003

* Camden Spruce Street does not have enough data to calculate a 3-year average.

(a) Bayonne temporarily shut down due to Superstorm Sandy. Bayonne did not meet EPA data completeness requirements for the 2011-2013 design value for the NO_2 1-hour NAAQS.

(b) Millville temporarily shut down due to site renovations. Millville did not meet EPA data completeness requirements for the 2011-2013 design value for the NO_2 1-hour NAAQS.

Figure 6
Annual Average Nitrogen Dioxide Concentrations
In New Jersey – 2013
Parts Per Million (ppm)

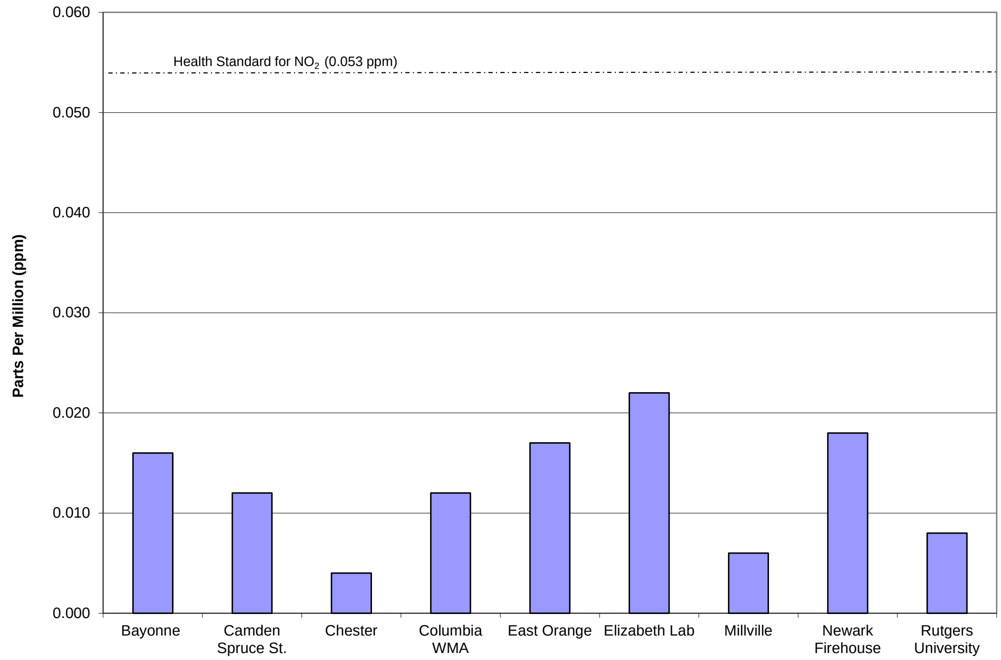


Figure 7
Annual Average Nitric Oxide Concentrations
In New Jersey – 2013
Parts Per Million (ppm)

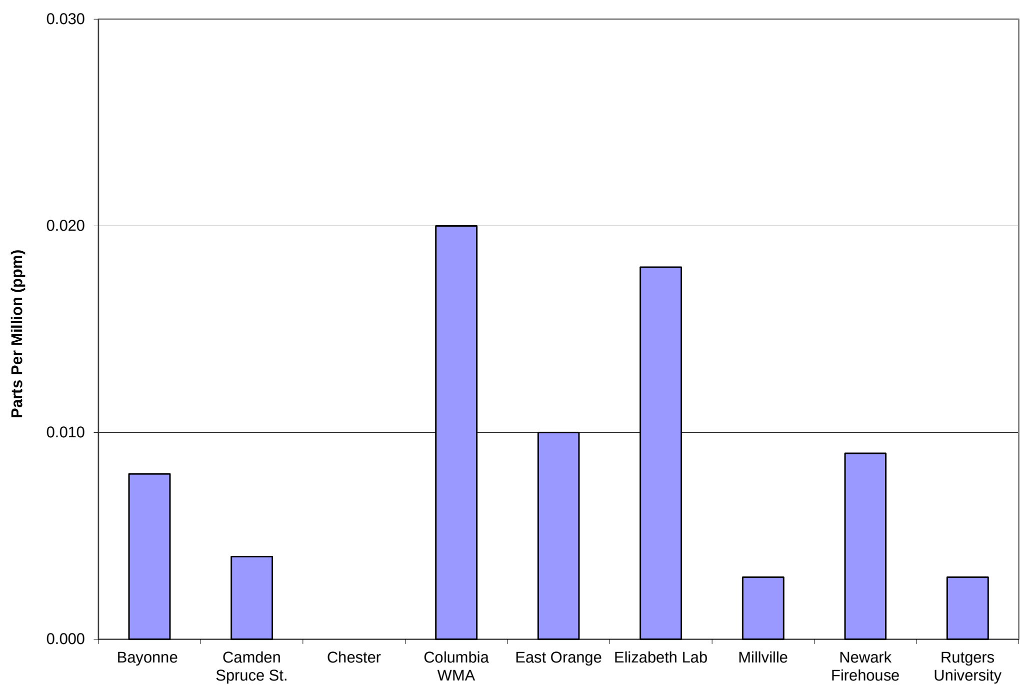


Figure 8
2013 98th Percentile Daily Maximum 1-Hour Nitrogen Dioxide Concentration in New Jersey
Parts Per Million (ppm)

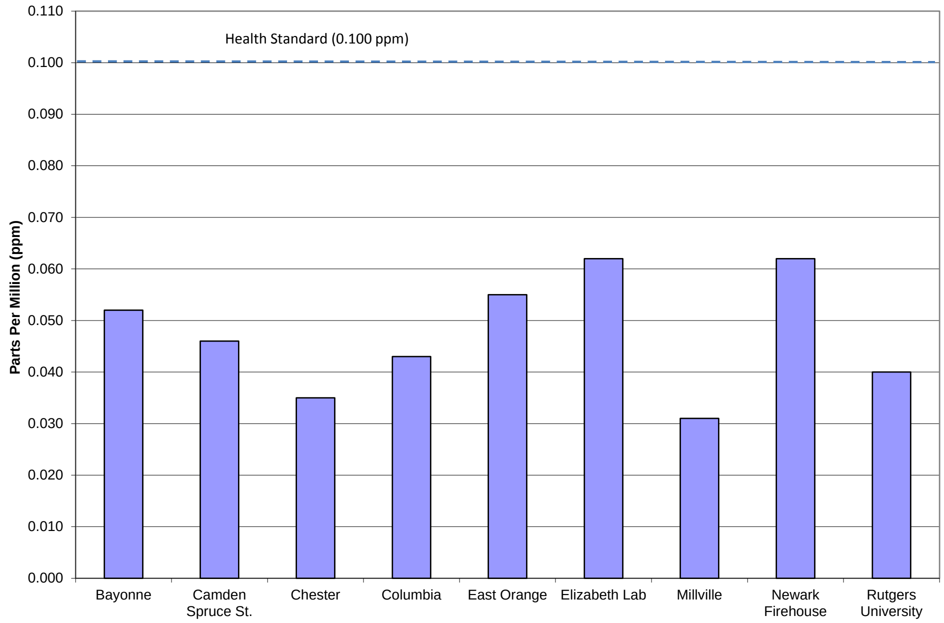
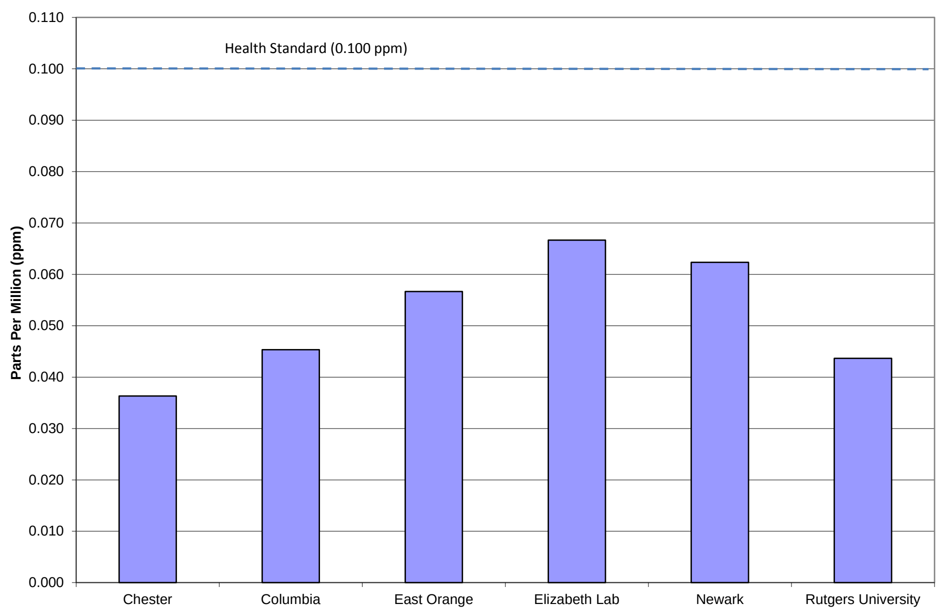


Figure 9
3-Year Average of the 98th Percentile Daily Maximum 1-Hour Average Nitrogen Dioxide Concentration in New Jersey (2011-2013)
Parts Per Million (ppm)



TRENDS

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

Routine monitoring for NO_2 began in 1966 and 1974 was the last year that the annual mean NO_2 concentrations exceeded the NAAQS in New Jersey. A graph of NO_2 levels provided in Figure 13 (page 10) shows the statewide average annual mean concentrations recorded from 1975 to 2013 in the form of a trendline. The graph also includes the levels of the sites that measured the highest annual mean and lowest annual mean in each year as points above and below this trendline. Although NO_2 concentrations are well within the NAAQS, there is still a great deal of interest in oxides of nitrogen because of their role in the formation of other pollutants – most notably ozone and fine particles. Both these pollutants are of concern over much of the northeastern United States and efforts to reduce levels of ozone and fine particles are likely to require reductions in NO emissions.

Figure 10
Nitric Oxide – New Jersey
2013 Monthly Variation
Parts Per Million (ppm)

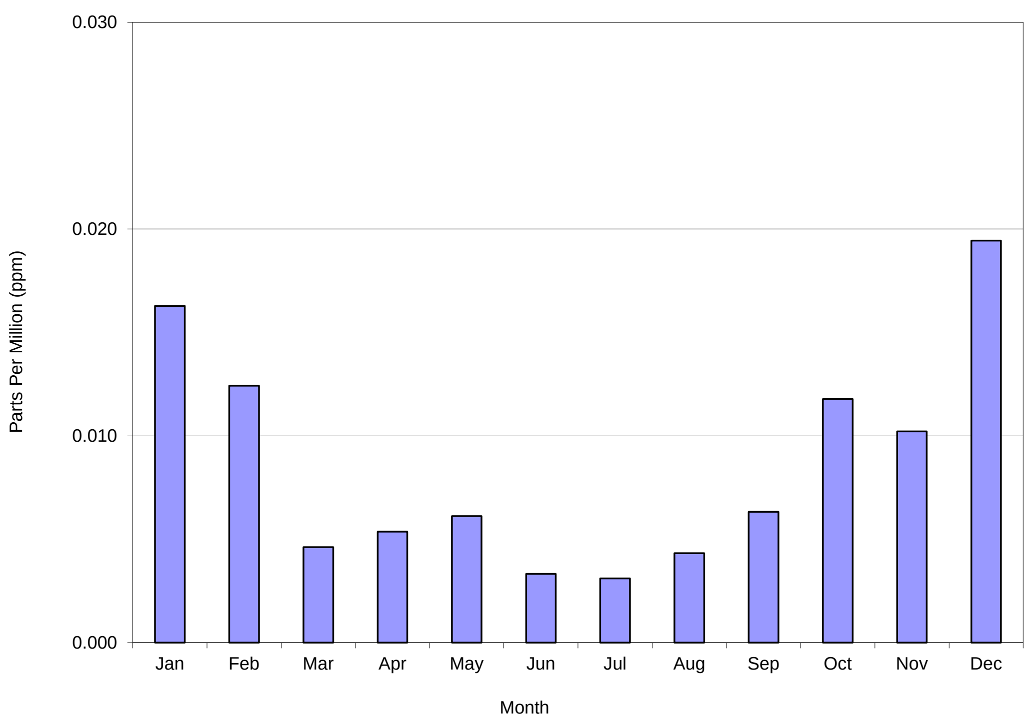


Figure 11
Nitrogen Dioxide – New Jersey
2013 Monthly Variation
Parts Per Million (ppm)

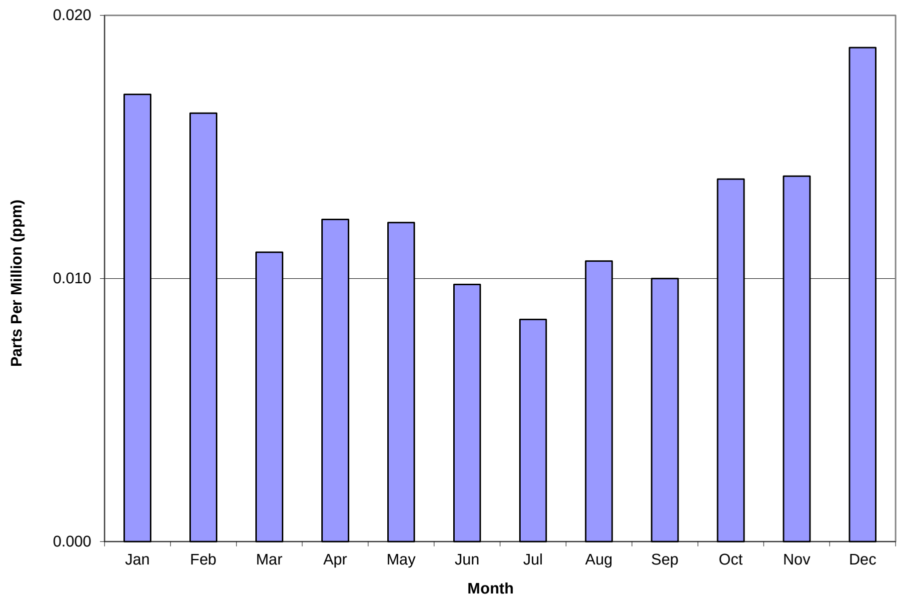


Figure 12
Total Oxides of Nitrogen – New Jersey
2013 Monthly Variation
Parts Per Million (ppm)

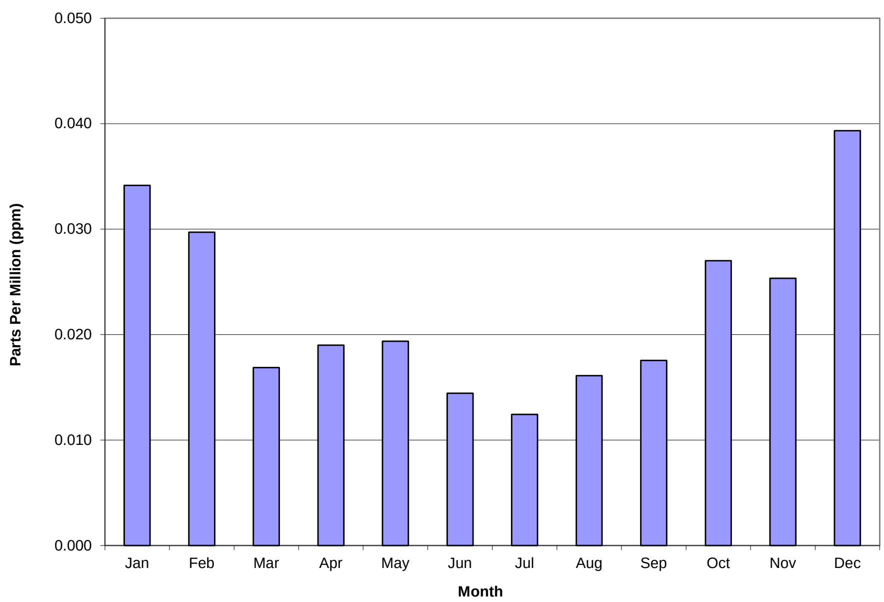
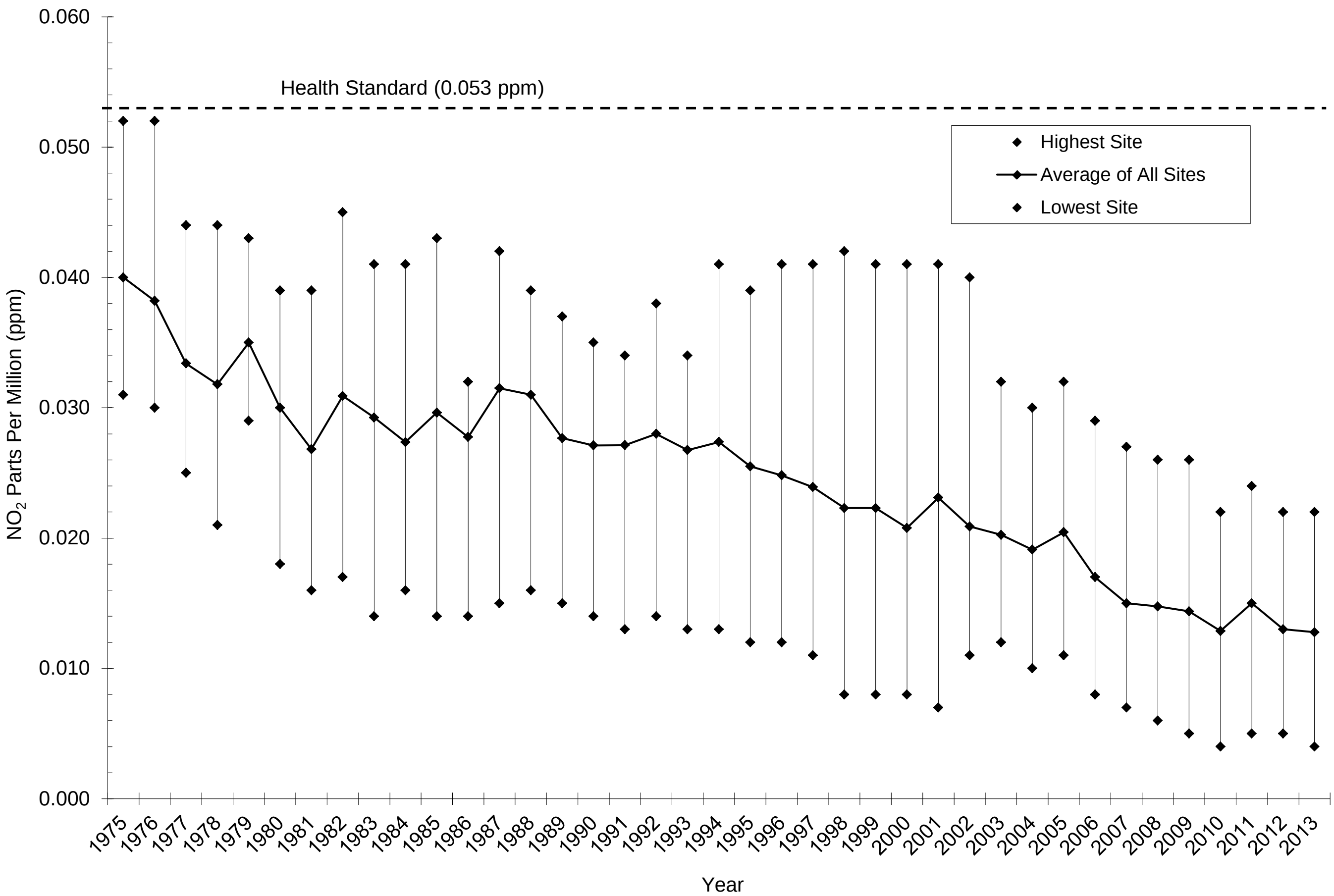


Figure 13
Nitrogen Dioxide Concentrations in New Jersey 1975-2013
12-Month (Calendar Year) Average
Parts Per Million (ppm)



References

Fact Sheet Final Revisions to the National Ambient Air Quality Standards for Nitrogen Dioxide, USEPA, January 22, 2010, URL: http://www.epa.gov/airquality/nitrogenoxides/pdfs/20100122fs.pdf.

History of California's Ambient Air Quality Standards, California Air Resources Board (CARB), Sacramento, California, March 5, 2008, URL: http://www.arb.ca.gov/research/aaqs/caaqs/hist1/hist1.htm

Meyer, Edwin L., Sennet, Donald H., Cole, Henry S., Richter, Harold G., Technical Basis for Developing Control Strategies for High Ambient Concentrations of Nitrogen Dioxide, EPA-450/4-80-017, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, 1980.

National Primary and Secondary Ambient Air Quality Standards for Nitrogen Dioxide, 40 CFR 50.11, US Government Printing Office, Washington DC, July 2001.

National Summary of Nitrogen Oxides Emissions, USEPA, Research Triangle Park, NC, 2008, URL: http://www.epa.gov/cgi-bin/broker?_service=data&_debug=0&_program=dataprog.national_1.sas&polchoice=NOX

Nitrogen Dioxide and Respiratory Illness in Children, Health Effects Institute, 1994.

NOx – How Nitrogen Oxides Affect the Way We Live and Breathe, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 1998, URL: http://www.epa.gov/air/nitrogenoxides/.

The Regional Transport of Ozone, New EPA Rulemaking on Nitrogen Oxide Emissions, EPA-456/F-98-006, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, URL: http://www.epa.gov/air/noxfacts.pdf.

Review Of The National Ambient Air Quality Standards For Nitrogen Dioxide Assessment Of Scientific And Technical Information, EPA-452/R-95-005, OAQPS staff paper, USEPA, Office of Air and Radiation, Office of Air Quality Planning and Standards, 1995.

Sittig, M., Handbook of Toxic and Hazardous Chemicals and Carcinogens Third Edition, Volume 2, Noyes Publications, Park Ridge, NJ, 1991.

ToxFaQs for Nitrogen Oxides, U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, April 2002, URL: http://www.atsdr.cdc.gov/tfacts175.pdf.

Utell, Mark J., Mechanisms of Nitrogen Dioxide Toxicity in Humans, Health Effects Institute, 1991

2013 Ozone Summary

New Jersey Department of Environmental Protection

Nature and Sources

Figure 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.

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 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 (VOC's) react in the presence of sunlight. NO_x is primarily emitted by motor vehicles, power plants, and other sources of combustion. VOC's are emitted from sources such as motor vehicles, chemical plants, factories, consumer and commercial products, and even natural sources such as trees. Ozone and the pollutants that form ozone (precursor pollutants) 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 daytime problem 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 (EPA) publication "Ozone: Good Up High, Bad Nearby".

Environmental Effects

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 disease, insects, other pollutants, and harsh weather. "Bad" ozone 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 2, are damage caused by exposure to ground-level ozone.

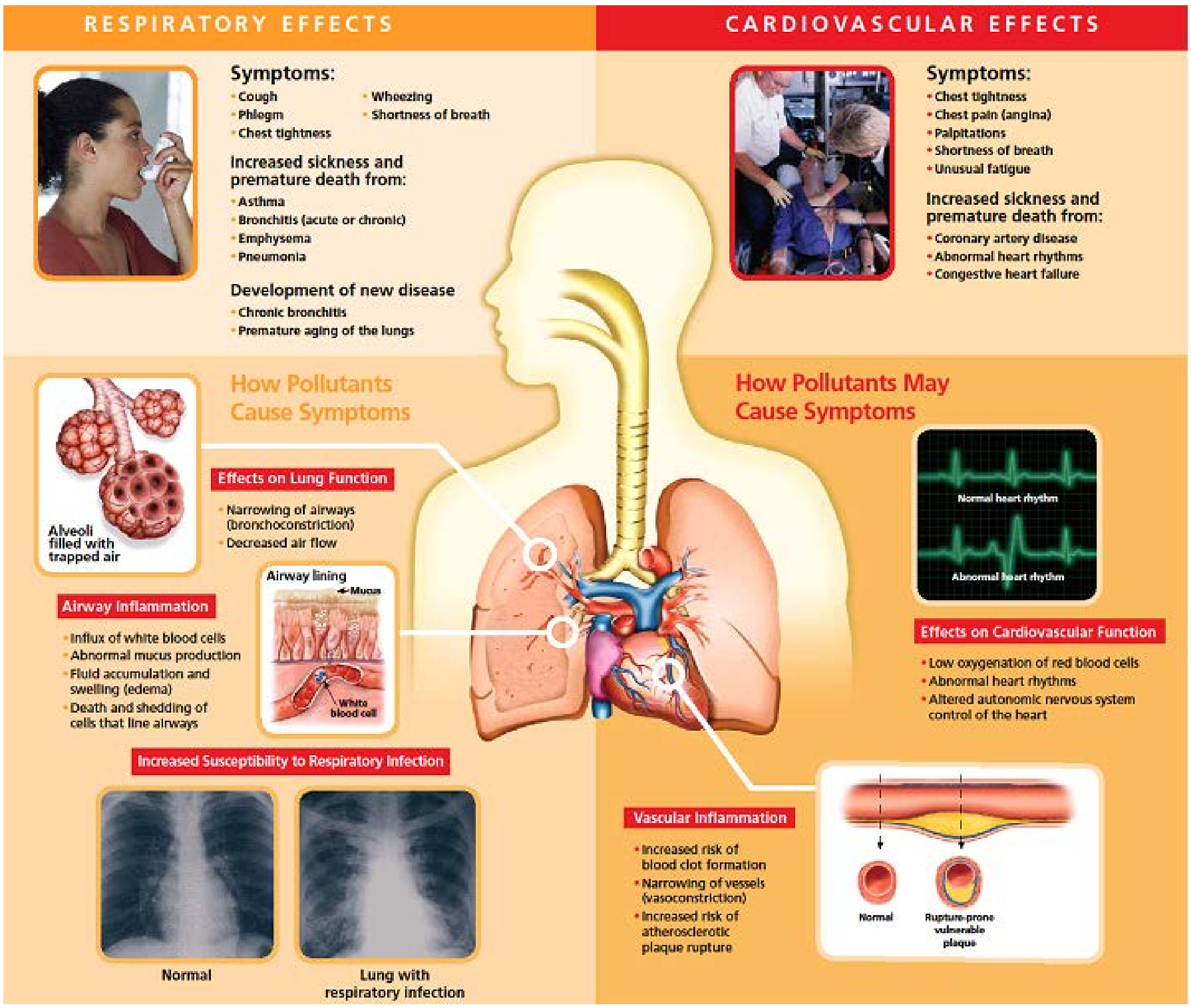
Figure 2 – Damage Caused by Ozone

(Photos by: Gerald Holmes, NCSU Dept. of Horticulture)

HEALTH EFFECTS

Repeated exposure to ozone pollution may cause permanent damage to the lungs. Even when ozone is present in 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 health problems 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. As shown in Figure 3 ozone can irritate the entire respiratory tract. Children are also at risk for ozone related problems. Their respiratory systems are still developing and they breathe more air per pound of body weight than adults. They are also generally 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 3
Effects of Ozone & Common Air Pollutants



Source: www.airnow.gov

Ambient Air Quality Standards for Ozone

National and state air quality standards have been established for ground-level ozone. There are both primary standards, which are based on health effects, and secondary standards, which are based on welfare effects (e.g. 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 1). The ozone NAAQS were revised in 2008 because EPA determined that the old standard of 0.08 parts per million (ppm) maximum daily eight-hour average was not sufficiently protective of public health. The revised standard of 0.075 ppm maximum daily 8-hour average went into effect on May 27, 2008. As many people are accustomed to the old standards, summary information relative to that standard will be provided in this report along with summaries based on the new standard.

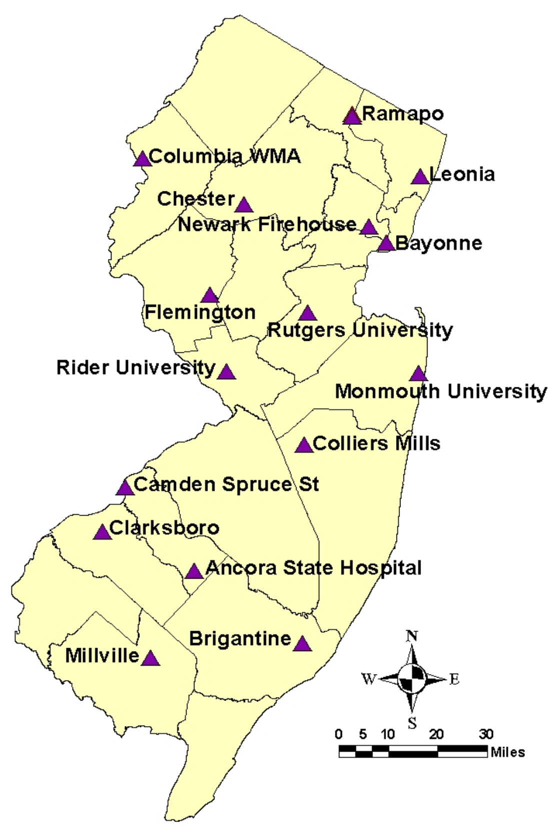
Table 1
National and New Jersey Ambient Air Quality Standards for Ozone
ppm = Parts per Million

Averaging Period	Type	New Jersey	National
1-Hour	Primary	0.12 ppm	-----
1-Hour	Secondary	0.08 ppm	-----
8-Hour	Primary	-----	0.075 ppm
8-Hour	Secondary	-----	0.075 ppm

Ozone Network

Ozone was monitored at 16 locations in New Jersey during 2013. (See Figure 4) Of those 16 sites, 10 operated year round and 6 operated only during the ozone season (April 1st through October 31st). Ancora State Hospital, Clarksboro, Colliers Mills, Leonia, Monmouth University, and Ramapo were only operated during the ozone season.

Figure 4
2013 Ozone Monitoring Network

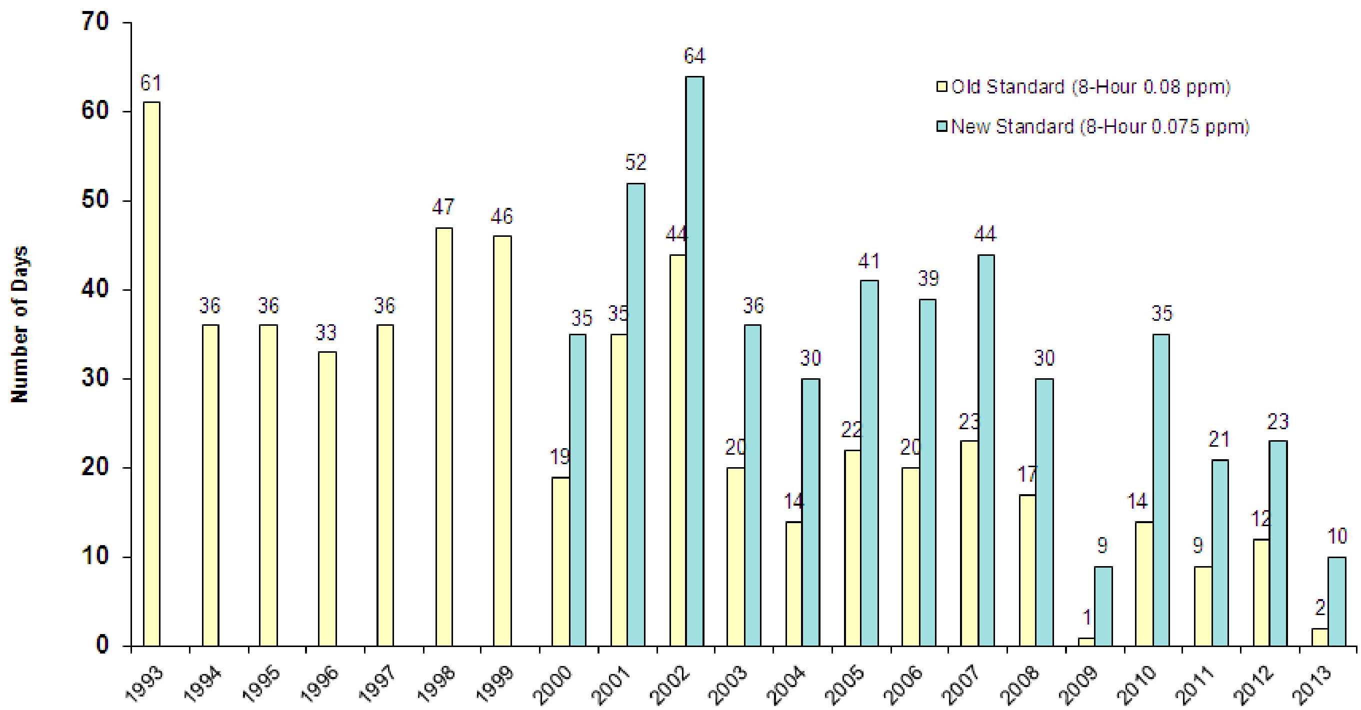


How the Changes to the Ozone Standards Affect Air Quality Ratings

In May of 2008 the U.S. Environmental Protection Agency revised the NAAQS for ozone from a daily maximum 8-hour average concentration of 0.08 ppm to a daily maximum 8-hour average of 0.075 ppm. While this may not seem like a major change, it does result in significantly more days with levels above the standard recorded. In 2013 for example, there were 10 days on which the 0.075 ppm was exceeded, but only 2 days on which the old 0.08 ppm standard was exceeded.

However, exceedances of both standards are still recorded on a regular basis (see Figure 5 below). As a result, additional control measures to reduce ozone levels will be needed. These measures will have to be implemented over a wide area and will require the cooperative effort of many states and the federal government if they are to be successful. In figure 5 the new standard has been projected back through 2000 for comparison purposes.

Figure 5
Days on Which the Old and New
Ozone Standards have been exceeded in New Jersey
1993-2013



DESIGN VALUE

The NAAQS for ozone are set in such a way that determining whether they are being attained is not based on a single year. For example, an area was considered to be attaining the old 1-hour average standard if the average number of times the standard was exceeded over a three-year period was 1 or less (after correcting for missing data). Thus it was the fourth highest daily maximum 1-hour concentration that occurred over a three-year period that determined if an area would be in attainment. If the fourth highest value was above 0.12 ppm then the average number of exceedances would be greater than 1. The fourth highest value is also known as the design value.

Under the new standard, attainment is determined by taking the average of the fourth highest daily maximum 8-hour average concentration that is recorded each year for three years. This becomes the design value for an area under the new standard. When plans are developed for reducing ozone concentrations, an area must demonstrate that the ozone reduction achieved will be sufficient to ensure the design value will be below the NAAQS, as opposed to ensuring that the standards are never exceeded. This avoids developing plans based on extremely rare events.

Table 2 and Table 3 on the following pages display the current design values for the 1-hour standard and the 8-hour standard respectively.

SUMMARY OF 2012 OZONE DATA RELATIVE TO THE OLD 1-HOUR STANDARD

Of the 16 monitoring sites that were operated during the 2013 ozone season, none recorded levels above the old 1-hour standard of 0.12 ppm. The highest 1-hour concentration was 0.105 ppm recorded at Bayonne and Monmouth University on July 17th and 18th, respectively. As recently as 2002, New Jersey recorded 16 days above this old 1-hour standard. Figure 6 on the following page shows both the highest and second highest daily 1-hour averages.

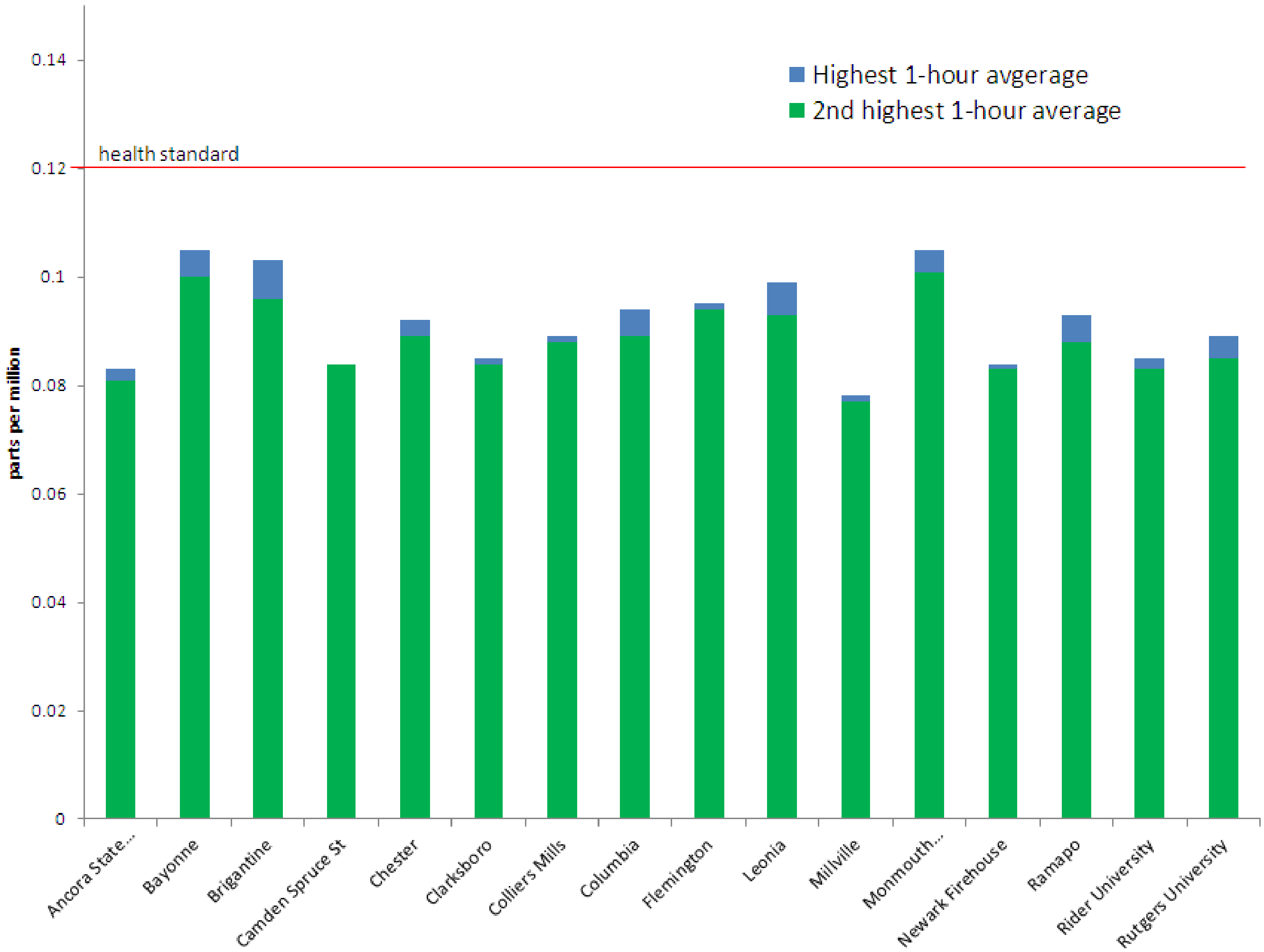
Table 2
Ozone Data – 2013
1-Hour Averages
Parts Per Million (ppm)

Old 1-hour standard is 0.12 ppm

Monitoring Site	1-hr Max	2nd Highest 1-hr Max	4th Highest 1-hour Average 2011-2013	# of days in 2013 with 1-hour Average above 0.12ppm
Ancora S.H.	0.083	0.081	0.105	0
Bayonne	0.105	0.100	0.102	0
Brigantine	0.103	0.096	0.096	0
Camden Spruce St.*	0.084	0.084	---	0
Chester	0.092	0.089	0.093	0
Clarksboro	0.085	0.084	0.107	0
Colliers Mills	0.089	0.088	0.107	0
Columbia WMA	0.094	0.089	0.092	0
Flemington	0.095	0.094	0.095	0
Leonia	0.099	0.093	0.101	0
Millville	0.078	0.077	0.097	0
Monmouth Univ.	0.105	0.101	0.105	0
Newark Firehouse	0.084	0.083	0.100	0
Ramapo	0.093	0.088	0.091	0
Rider University	0.085	0.083	0.101	0
Rutgers University	0.089	0.085	0.104	0

**Camden Spruce St. data only available for 2012-2013.*

Figure 6
New Jersey Ozone Data - 2013
Highest and Second Highest
Daily Maximum 1-hour Averages



Summary of 2013 Ozone Data Relative to the 8-Hour Standard

Just 11 of 16 monitoring sites operating during the 2013 ozone season recorded levels above the 8-hour standard of 0.075 ppm. The highest daily maximum 8-hour concentration recorded was 0.088 ppm at Brigantine on July 17th. Design values for the 8-hour standard were above the standard at 11 of 16 sites, indicating that the ozone standard is being violated throughout almost all of New Jersey. Camden Spruce St. does not have three complete years of data to calculate a valid design value. Figure 7 on the following page charts the 8-hour design values for the 2011-2013 period.

Table 3
Ozone Data – 2013
8-Hour Averages
Parts Per Million (ppm)

Monitoring Site	Highest Daily Maximum 8-hour Average for 2013	Average of 4th Highest Daily Maximum 8-hour Averages, 2011-2013	# of days in 2013 with 8-hour Average above 0.075 ppm
Ancora S.H.	.075	0.081	0
Bayonne	.086	0.072	1
Brigantine	.088	0.073	2
Camden Spruce St.*	.073	---	---
Chester	.078	0.076	2
Clarksboro	.079	0.084	2
Colliers Mills	.076	0.080	1
Columbia WMA	.076	0.066	1
Flemington	.077	0.077	1
Leonia	.077	0.077	2
Millville	.068	0.070	0
Monmouth Univ.	.087	0.078	3
Newark Firehouse	.079	0.076	2
Ramapo	.078	0.072	2
Rider University	.075	0.076	0
Rutgers University	.075	0.079	0

**Camden Spruce St. only has 2 years of data and does not have a valid design value for 2011-2013.*

Figure 7
Ozone Design Values for 2011-2013
3-Year Average of the 4th Highest Daily Maximum 8-hour Average

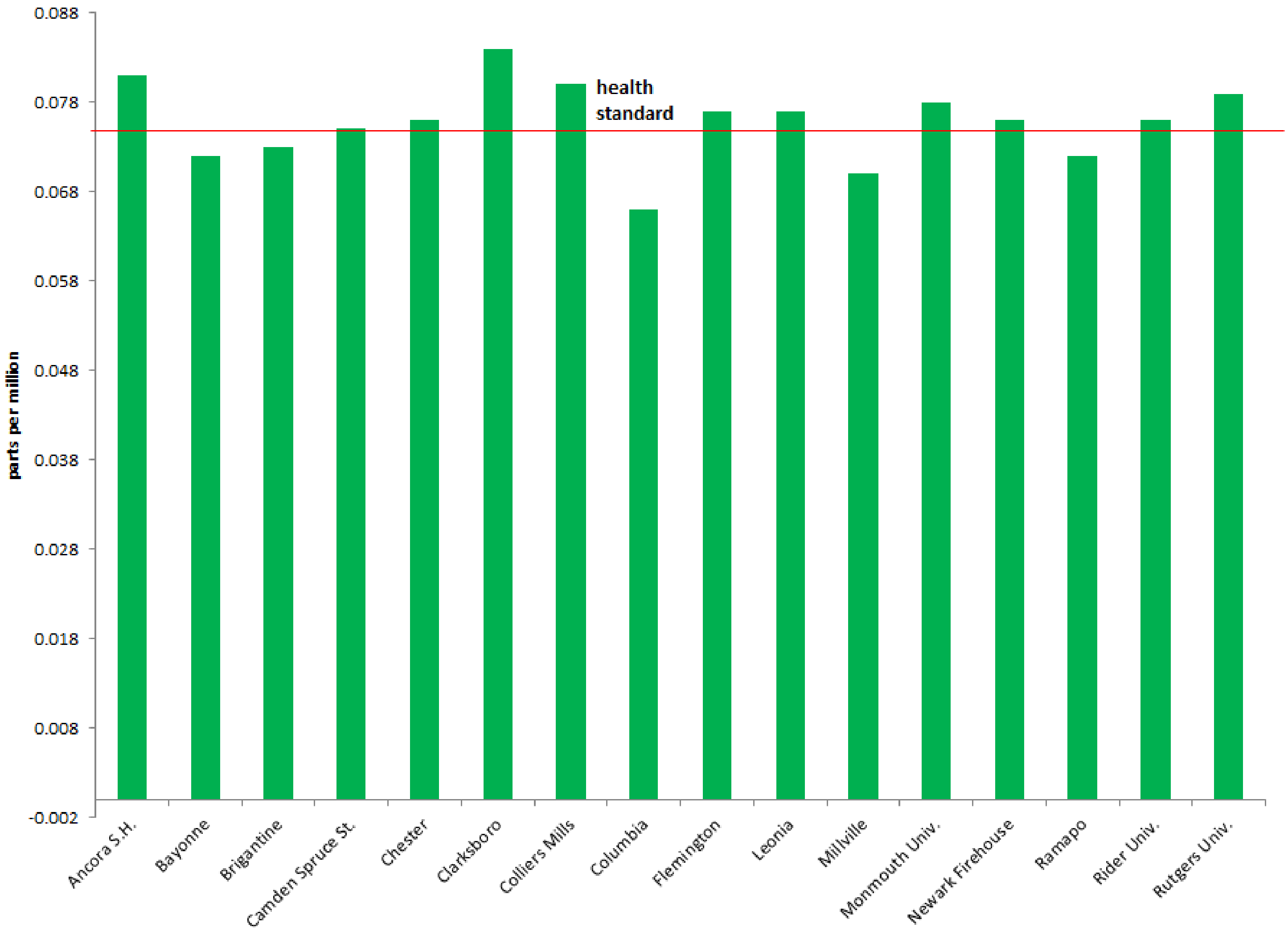
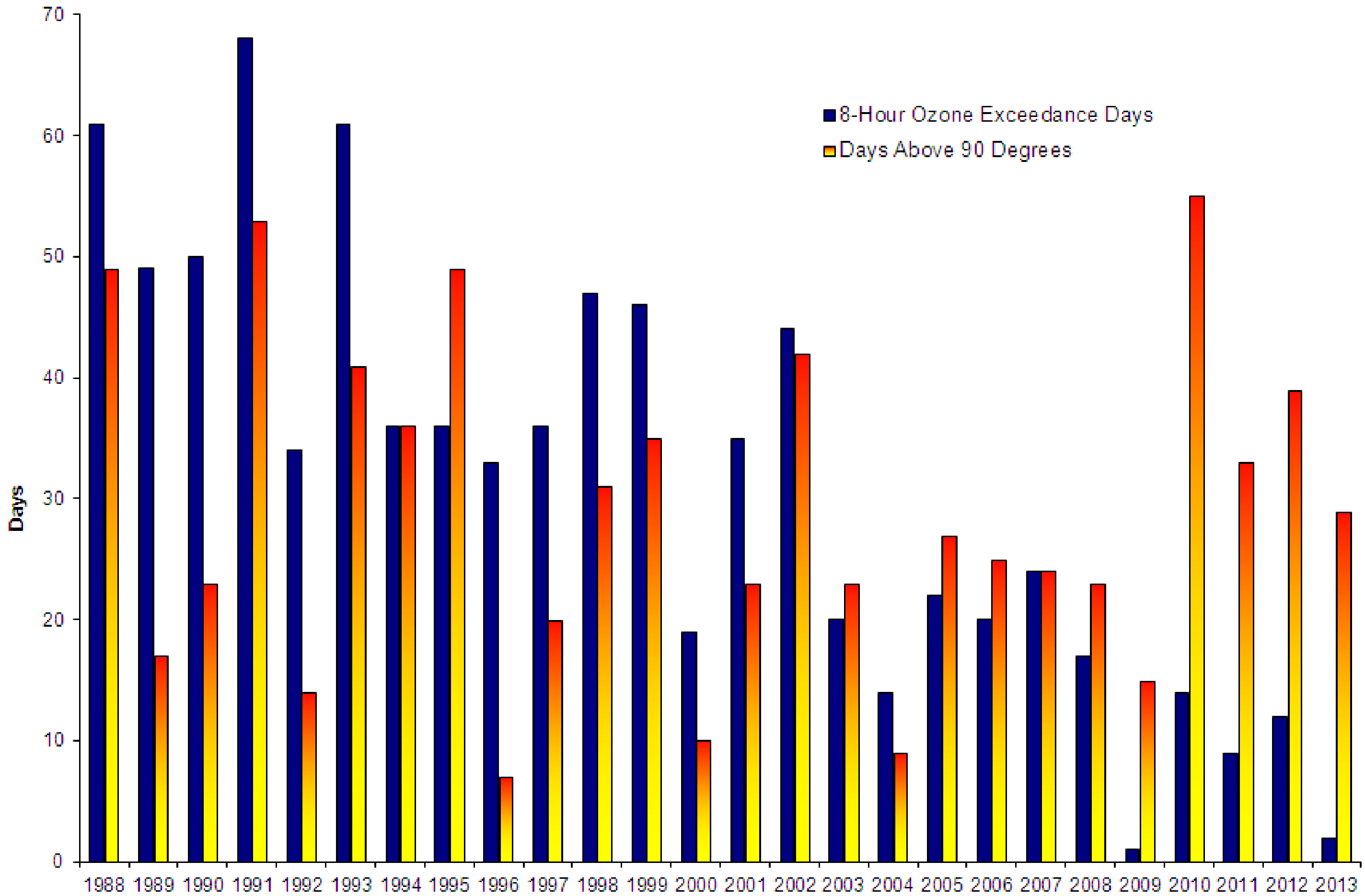


Figure 8
Number of Days 8-Hour Ozone Standard was Exceeded and
Number of Days Above 90 Degrees in New Jersey 1988-2013
(Using 8-Hour 0.08 ppm standard (old) across entire time period)

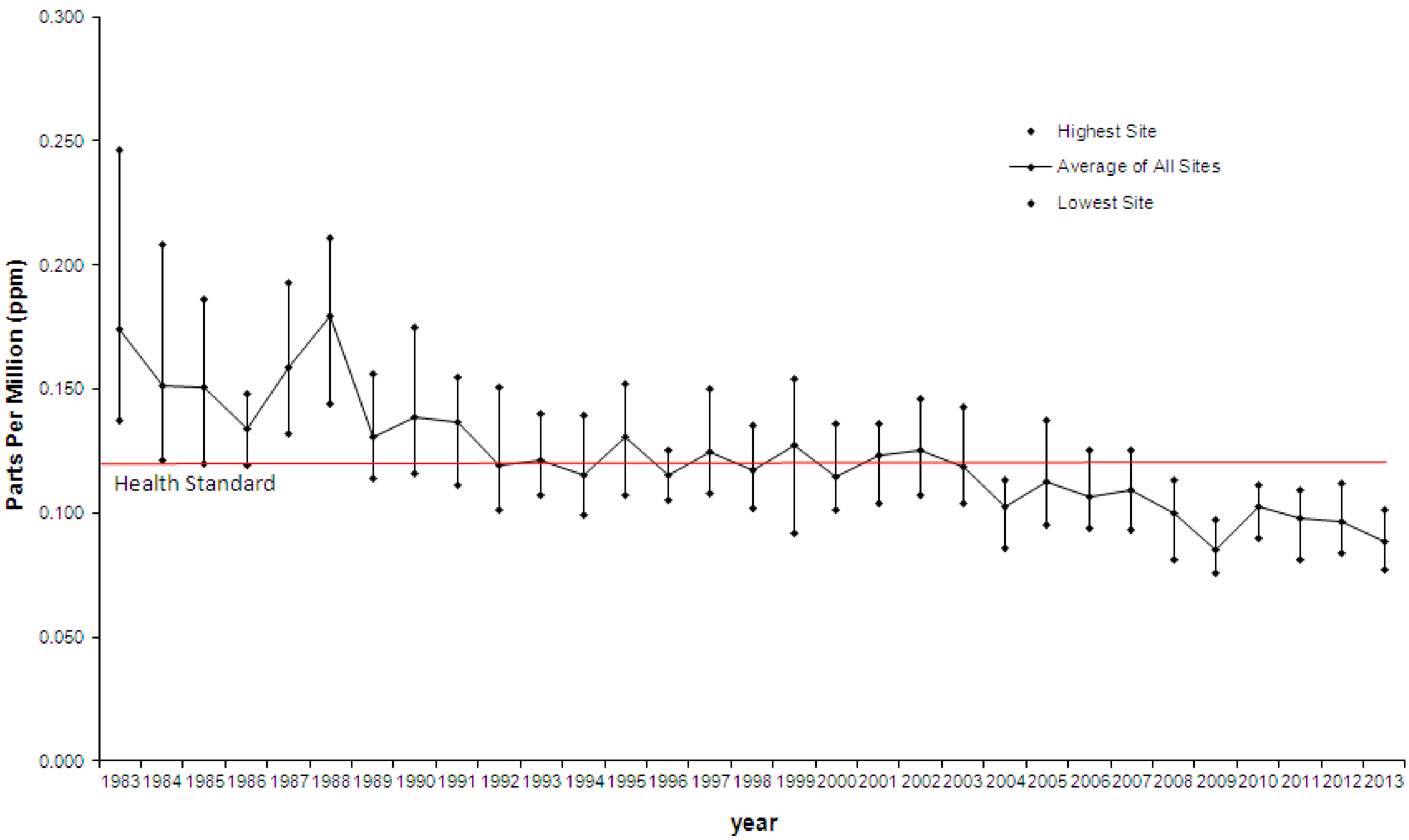


ACCOUNTING FOR THE INFLUENCE OF WEATHER

Trends in ground level ozone are influenced by many factors including weather conditions, transport, growth, and the state of the economy, in addition to changes brought about by regulatory control measures. Of these factors, weather probably has the most profound effect on year to year variations in ozone levels. Several methods have been developed to try to account for the effect of weather on ozone levels so that the change due to emissions could be isolated. While none of these methods are completely successful they do show that over the long term, real reductions in ozone levels have been achieved. A simple way of showing the changing effect of weather on ozone is shown above in Figure 8. The number of days each year on which the ambient temperature was 90 degrees or greater is shown next to the number of days the ozone standard was exceeded. In the earliest years shown (1988-1993) there are significantly more days with high ozone than days above 90 degrees. But this pattern gradually changes and for the most recent years there are more “hot” days than “ozone” days. This is an indication that on the days when conditions are suitable for ozone formation, unhealthy levels are being reached less frequently.

OZONE TRENDS

The primary focus of efforts to reduce concentrations of ground-level ozone in New Jersey has been on reducing emissions of volatile organic compounds (VOCs). Studies have shown that such an approach should lower peak ozone concentrations, and it does appear to have been effective in achieving that goal. The chart in Figure 9 is based on the second highest 1-hour average concentrations recorded each year. We use this statistic when showing long term trends as it is what the early ozone health standards were based on, so historical data including those values is readily available. As Figure 9 illustrates, the maximum 1-hour concentrations have not exceeded 0.200 ppm since 1988 and the last time levels above 0.180 ppm were recorded was in 1990. Improvements have leveled off in recent years; and further improvements will require reductions in both VOCs and NO_x. The NO_x reductions will have to be achieved over a very large region of the country because levels in New Jersey are dependent on emissions from upwind sources.

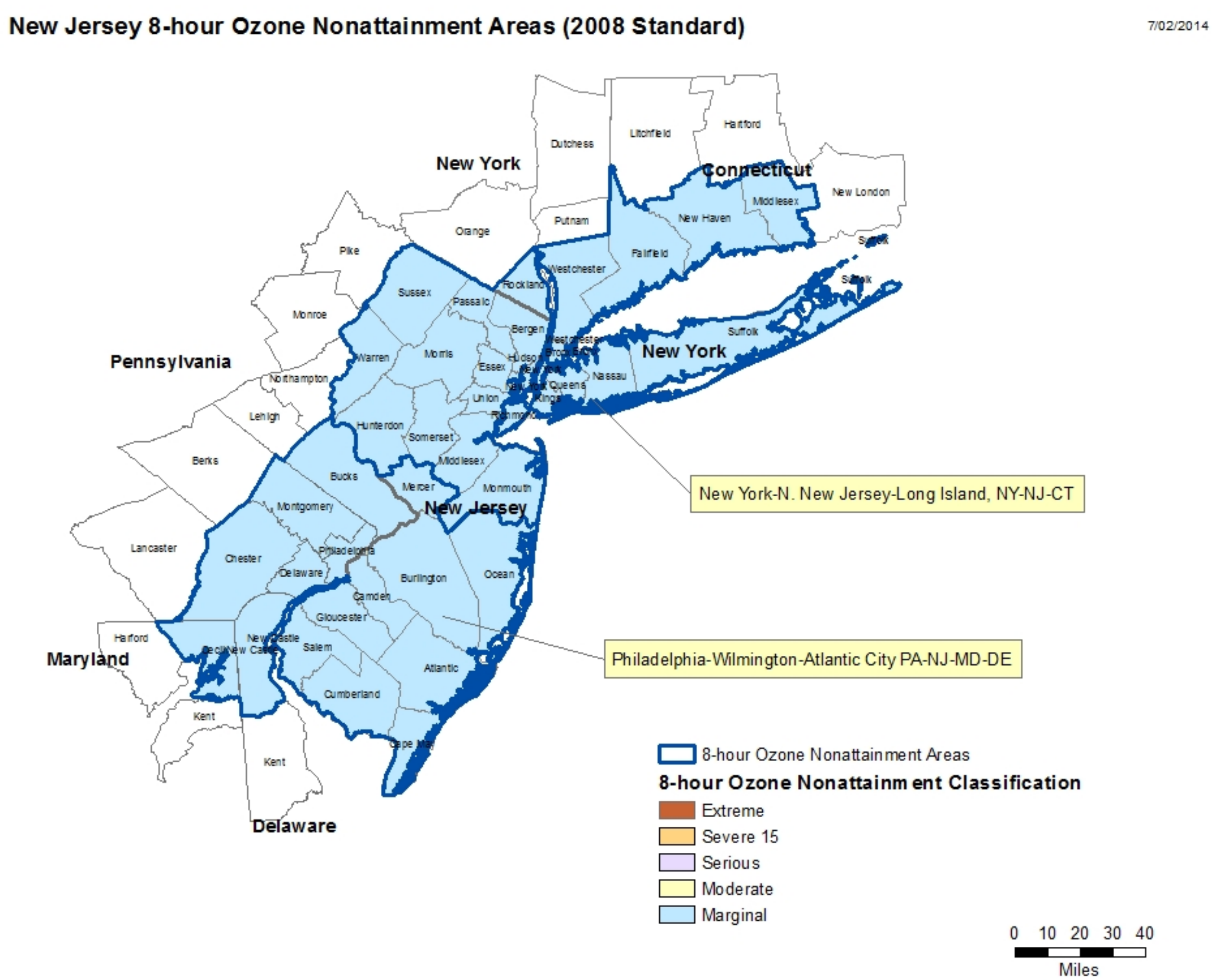


OZONE NON-ATTAINMENT AREAS IN NEW JERSEY

The Clean Air Act requires that all areas of the country be evaluated and then classified as attainment or non-attainment areas for each of the National Ambient Air Quality Standards. Areas can also be found to be “unclassifiable” under certain circumstances. The 1990 amendments to the act required that areas be further classified based on the severity of non-attainment. The classifications range from “Marginal” to “Extreme” and are based on “design values”. The design value is the value that actually determines whether an area meets the standard. For the 8-hour ozone standard for example, the design value is the average of the fourth highest daily maximum 8-hour average concentration recorded each year for three years.

Their classification with respect to the 8-hour standard is shown in Figure 10 below. The entire state of New Jersey is in non-attainment and is classified as being “Marginal.” A “Marginal” classification is applied when an area has a design value of 0.085 ppm up to but not including 0.092 ppm.

Figure 10



Source: U.S. EPA Greenbook

REFERENCES

Ozone: Good Up High, Bad Nearby, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC October 1997, URL: www.epa.gov/oar/oaqps/gooduphigh/

USEPA Fact Sheet: Health and Environmental Effects of Ground Level Ozone, USEPA, Office of Air and Radiation, July 1997, URL: www.epa.gov/ttn/oarpg/naaqsfin/o3health.html

Guidelines for Developing an Air Quality (Ozone and PM2.5) Forecasting Program, EPA-456/R-03-002, June 2003

National Air Quality and Emissions Trend Report, 1999, EPA-454/R-01-004, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 2001, URL: www.epa.gov/airtrends/aqtrnd99/

Latest Findings on National Air Quality: 2000 Status and Trends, EPA-454/K-01-002, USEPA, Office of Air Quality Planning and Standards, RTP, September 2001, URL: www.epa.gov/airtrends/aqtrnd00/brochure/00brochure.pdf

Smog – Who Does it Hurt?, EPA-452/K-99-001, USEPA, Air and Radiation, Washington, DC, July 1999, URL: www.epa.gov/airnow/health/smog.pdf

Ozone and Your Health, EPA-152/F-99-000, USEPA, Air and Radiation, Washington, DC, September 1999, URL: www.epa.gov/airnow/ozone-c.pdf

Air Quality Guide for Ozone, EPA-456/F-002, Air and Radiation, Washington, DC, July 1999, URL: www.airnow.gov/index.cfm?action=aqibasics.aqi

Archived temperature data gathered from NOAA/NWS URL: www.weather.gov/climate/index.php?wfo=phi

USEPA Greenbook, URL: www.epa.gov/oar/oaqps/greenbk/nj8_2008.html

2013 Particulate Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

Particulate air pollution is a complex mixture of organic and inorganic substances present in the atmosphere 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 undetectable by the human eye. Also, particulates may travel hundreds of miles suspended in the atmosphere from their sources before reaching ground level.

Generally, particulate pollution is categorized by size. Particulates with diameters of 2.5 microns or less are considered Fine Particulates, often referred to as $PM_{2.5}$ (Figure 1). Particulates with diameters of 10 microns or less are considered to be Inhalable Particulates and are referred to as PM_{10}. Total Suspended Particulates (TSP) consists of all suspended Particulates including the largest ones. Particulates smaller than 10 microns are considered to be inhalable and are a greater health risk, but particulates of all sizes have an impact on the environment.

Particulates can occur naturally or be man-made. Examples of naturally occurring particulates are windblown dust and sea salt. Man-made particulates, which come from sources such as fossil fuel combustion and industrial processes, can be divided into two categories: Primary Particulates and Secondary Particulates. Primary Particulates are directly emitted from their sources while Secondary Particulates are created in the atmosphere through reactions of gaseous emissions.

ENVIRONMENTAL EFFECTS

Particulate matter is the major cause of reduced visibility in many parts of the United States. Figure 2a provides an example of reduced visibility due to particulate pollution recorded by the New Jersey

Figure 1
Size of $PM_{2.5}$ Particle Compared to a Human Hair

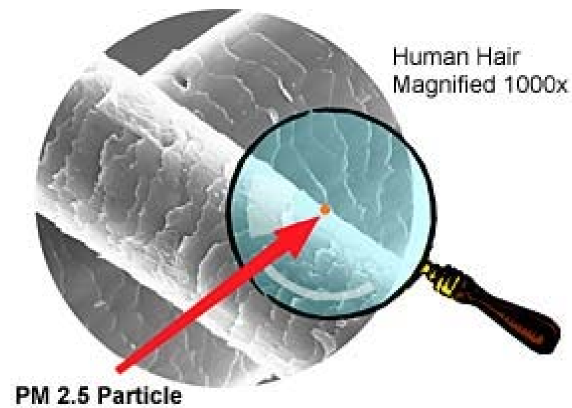
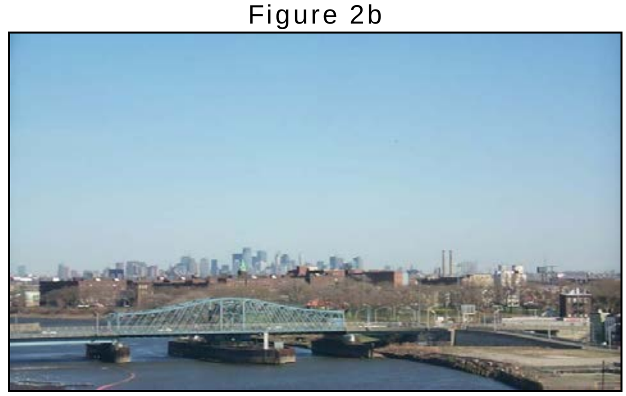


Figure 2a

Figure 2b



Department of Environmental Protection's (NJDEP) visibility camera in Newark that shows the New York City skyline. Figure 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. More information regarding NJDEP's visibility efforts is provided in the Regional Haze and Visibility section of the 2012 Air Quality Report.

HEALTH EFFECTS

Inhalable Particulates (PM_{10}) and especially Fine Particulates ($PM_{2.5}$) are health concerns because they are easily breathed into the lungs. Various health problems are associated with both long and short-term exposures. When inhaled, these particles can accumulate in the respiratory system and are responsible for heart and lung conditions, such as asthma, bronchitis, cardiac arrhythmias, heart attacks, and can even be attributed to premature death. Groups that appear to be at the greatest risk from particulates include children, the elderly, and individuals with heart and lung diseases, such as asthma.

STANDARDS

In 1971, U.S. Environmental Protection Agency (EPA) set primary (health based) and secondary (welfare based) standards for Total Suspended Particulate matter (TSP). These standards, known as the National Ambient Air Quality Standards (NAAQS), were based on maximum 24-hour and annual concentrations. The annual standards were based on the geometric mean concentrations over a calendar year, and the 24-hour standards were based on the arithmetic average concentration from midnight to midnight. The primary 24-hour average standard for TSP was set at 260 micrograms per cubic meter ($\mu g/m^3$) and the annual geometric mean health standard was set at 75 $\mu g/m^3$. The 24-hour secondary standard was set at 150 $\mu g/m^3$. While EPA did not establish a secondary annual standard for TSP, they did set a guideline of 60 $\mu g/m^3$ to be used to ensure that the secondary 24-hour standard was being met throughout the year. Although New Jersey still maintains state standards for TSP, the national standards have been replaced with standards for smaller particles as described below. As a result, the monitoring effort for TSP has steadily diminished. NJDEP's sole TSP sampler was discontinued in early 2008.

In 1987, EPA replaced the TSP standards with standards that focused only on Inhalable Particulates (PM_{10}). The 24-hour PM_{10} primary and secondary standards were set at 150 $\mu g/m^3$, and the annual primary and secondary standards were set at 50 $\mu g/m^3$. The annual standard for PM_{10} is based on the arithmetic mean, as opposed to the geometric mean that was used for TSP.

In 1997, EPA promulgated new standards for Fine Particulates ($PM_{2.5}$), while maintaining the existing standards for PM_{10} as well. The $PM_{2.5}$ annual primary and secondary standards were set at 15.0 $\mu g/m^3$ and the 24-hour standard was set at 65 $\mu g/m^3$. In October 2006 the EPA revised the 24-hour Standard to the current value at 35 $\mu g/m^3$. Table 1 provides a summary of the Particulate Matter standards.

On December 14, 2012, the EPA promulgated a revised annual standard of 12.0 $\mu g/m^3$ that was published as a final rule in the Federal Register on January 15, 2013. The new standard took effect on on March 18, 2013. The 24-hour standard was unchanged and remains at 35 $\mu g/m^3$.

Table 1
National and New Jersey
Ambient Air Quality Standards for Particulate Matter

Micrograms Per Cubic Meter ($\mu g/m^3$)

Standard	Averaging Period	Type	New Jersey	National
Total Suspended Particulates (TSP)	12-Month‡	Primary	75 $\mu g/m^3$	---
	24-Hour	Primary	260 $\mu g/m^3$	---
	12-Month‡	Secondary	60 $\mu g/m^3$	---
	24-Hour	Secondary	150 $\mu g/m^3$	---
Inhalable Particulates (PM_{10})	Annual†	Primary & Secondary	---	50 $\mu g/m^3$
	24-Hour Average	Primary & Secondary	---	150 $\mu g/m^3$
Fine Particulates ($PM_{2.5}$)	Annual†	Primary & Secondary	----	12.0 $\mu g/m^3$ @
	24-Hour Average	Primary & Secondary	----	35 $\mu g/m^3$

‡ Annual Geometric Mean
† Annual Arithmetic Mean
@ Revision effective 2013

PARTICULATE MONITORING NETWORK

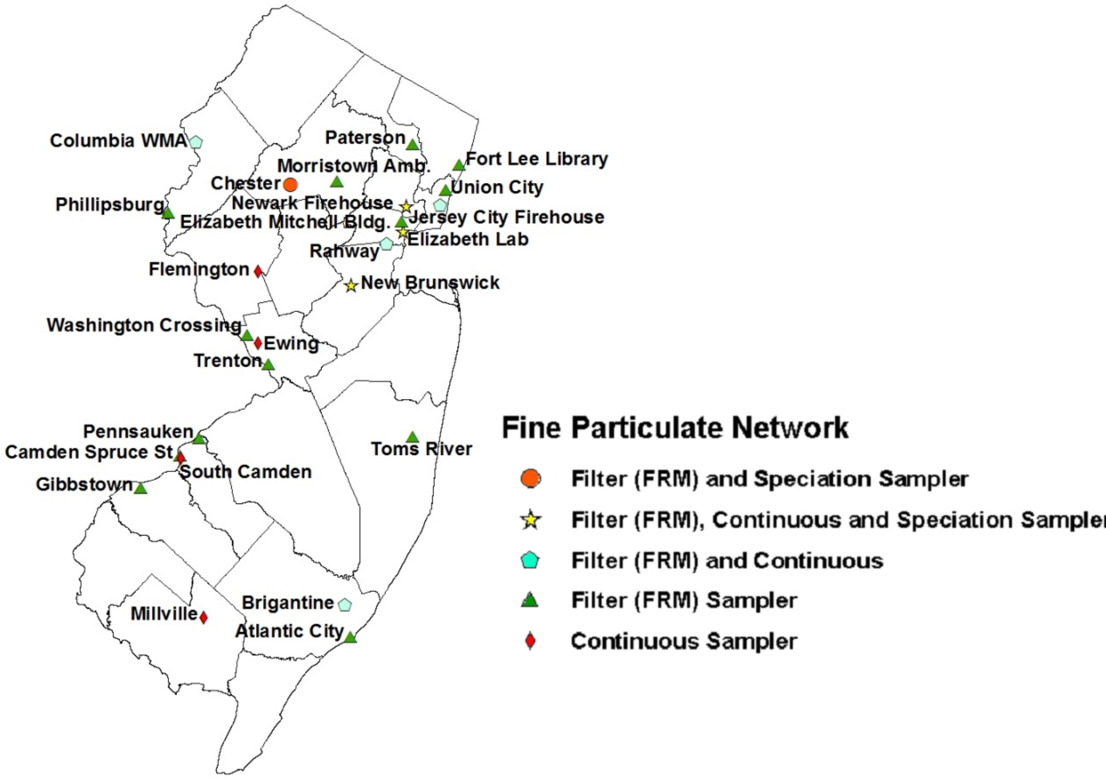
New Jersey's Particulate Monitoring Network consists of 25 $PM_{2.5}$ monitoring sites, 2 PM_{10} monitoring sites, and 3 sites where smoke shade is monitored.

The NJDEP operates $PM_{2.5}$ and PM_{10} samplers that comply with strict EPA requirements, and are designated as Federal Reference Method (FRM) samplers. These samplers pull a predetermined amount of air through $PM_{2.5}$ or PM_{10} size-selective inlets onto a filter for a 24-hour period, thereby capturing particles on the filter. The filters are weighed before and after sampling under controlled environmental conditions to determine the concentration. The data is then used by the NJDEP and EPA to determine whether the state, or portions of the state, meets the NAAQS for particulate matter.

Because these samplers are required to run for 24-hour period and do not provide data in real time, the NJDEP employs additional monitors that continuously measure particulate concentrations. These monitors are used by the NJDEP to report current air quality to the public through the Air Quality Index (www.njaqinow.net). The NJDEP uses Beta Attenuation Monitors (BAM), Tapered Element Oscillating Microbalance (TEOM) analyzers and smoke shade instruments for real-time particulate reporting. The 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. The Beta Attenuation Monitors measure the loss of intensity (attenuation) of beta particles due to absorption by $PM_{2.5}$ particles collected on a filter tape. Smoke shade instruments collect a sample of TSP on a paper tape for one hour. At the end of each hour the amount of light that will pass through the spot that has formed on the tape is measured, the tape advanced, and the cycle started over. The amount of light transmittance measured is used as an estimate of actual particulate concentrations.

Additionally, at five locations, a separate 24-hour filter based sampler collects $PM_{2.5}$ on three types of filter media which are subsequently analyzed using ion chromatography (IC), X-ray fluorescence (XRF), and Thermal Optical Transmittance (TOT) to determine the concentrations of the chemical analytes that constitute the sample.

Figure 3
2013 $PM_{2.5}$
Monitoring Network



FINE PARTICLE ($PM_{2.5}$) SUMMARY

$PM_{2.5}$ MONITORING SITES

The 21 monitoring sites in New Jersey where FRM samplers routinely collect 24-hour $PM_{2.5}$ samples are shown on Figure 3**.** At 11 sites, continuous particulate monitors measure the concentrations of fine particles every minute and transmit the data to the Bureau of Air Monitoring's central computer, where it is made available on the Bureau's public website (www.njaqinow.net).

$PM_{2.5}$ CONCENTRATION SUMMARY

The annual mean concentrations of $PM_{2.5}$ ranged from 7.0 $\mu g/m^3$ at Chester to 10.7 $\mu g/m^3$ at the Elizabeth Lab. The highest 24-hour concentrations ranged from 24.0 $\mu g/m^3$ at Chester to 38.0 $\mu g/m^3$ at the Elizabeth Lab. Figure 4a and 4b depict the annual mean concentrations and the 98th percentile 24-hour concentrations in 2013 for all the sites. Table 2 shows the 2013 annual mean, highest 24-hour and 98th percentile 24-hour concentrations as well as the 2011-2013 annual and 24-hour design values. An annual design value for a given site is calculated by averaging the annual mean concentrations for the 3 most recent consecutive calendar years, in this case 2011-2013. Similarly, the 24-hour design value for a given site is calculated by averaging the 98th percentile 24-hour concentrations for each year for the same 3-year period. Design values are used to determine attainment status. No sites were in violation of either the annual standard of 12.0 $\mu g/m^3$ or the 24-hour standard of 35 $\mu g/m^3$.

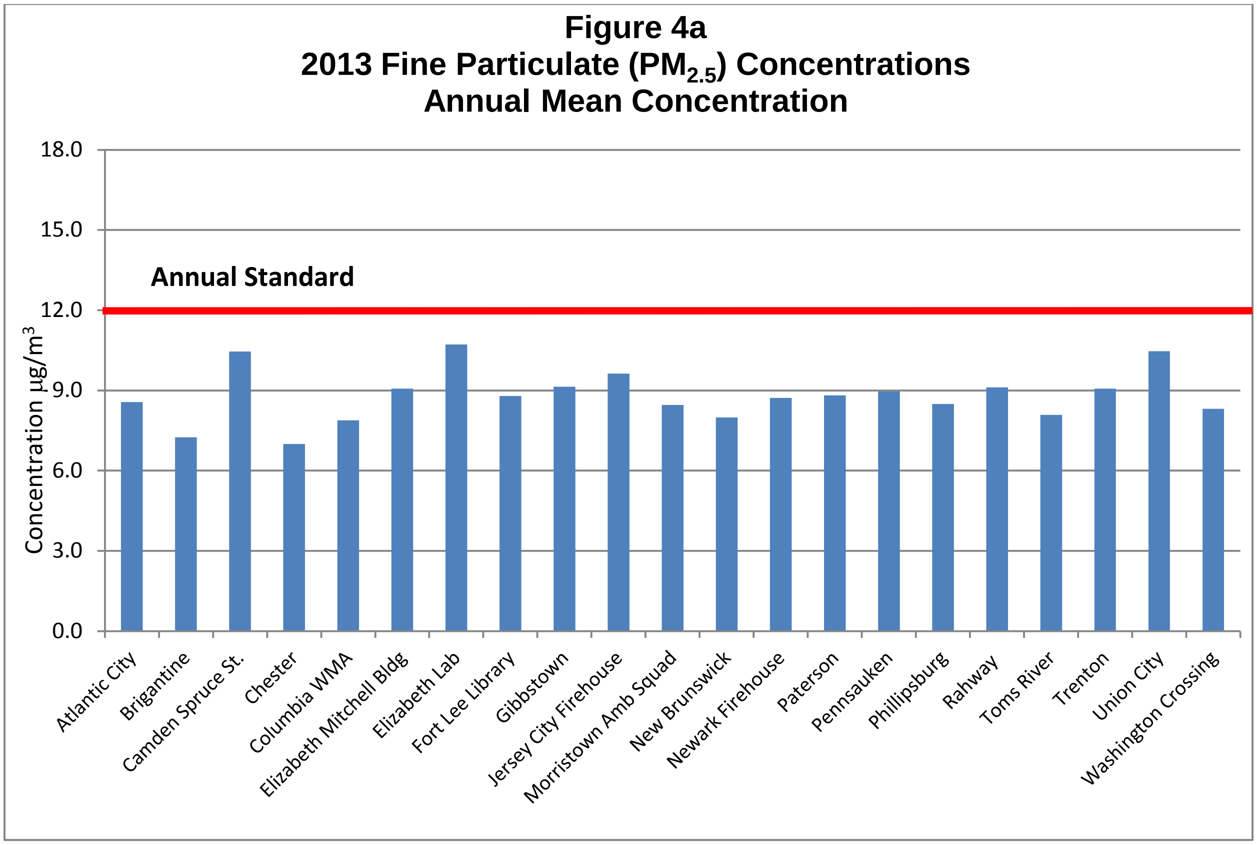


Figure 4a
2013 Fine Particulate ($PM_{2.5}$) Concentrations
Annual Mean Concentration
Annual Standard
Concentration µg/m3
18.0
15.0
12.0
9.0
6.0
3.0
0.0
Atlantic City
Brigantine
Camden Spruce St.
Chester
Columbia WMA
Elizabeth Mitchell Bldg
Elizabeth Lab
Fort Lee Library
Gibbstown
Jersey City Firehouse
Morristown Amb Squad
New Brunswick
Newark Firehouse
Paterson
Pennsauken
Phillipsburg
Rahway
Toms River
Trenton
Union City
Washington Crossing

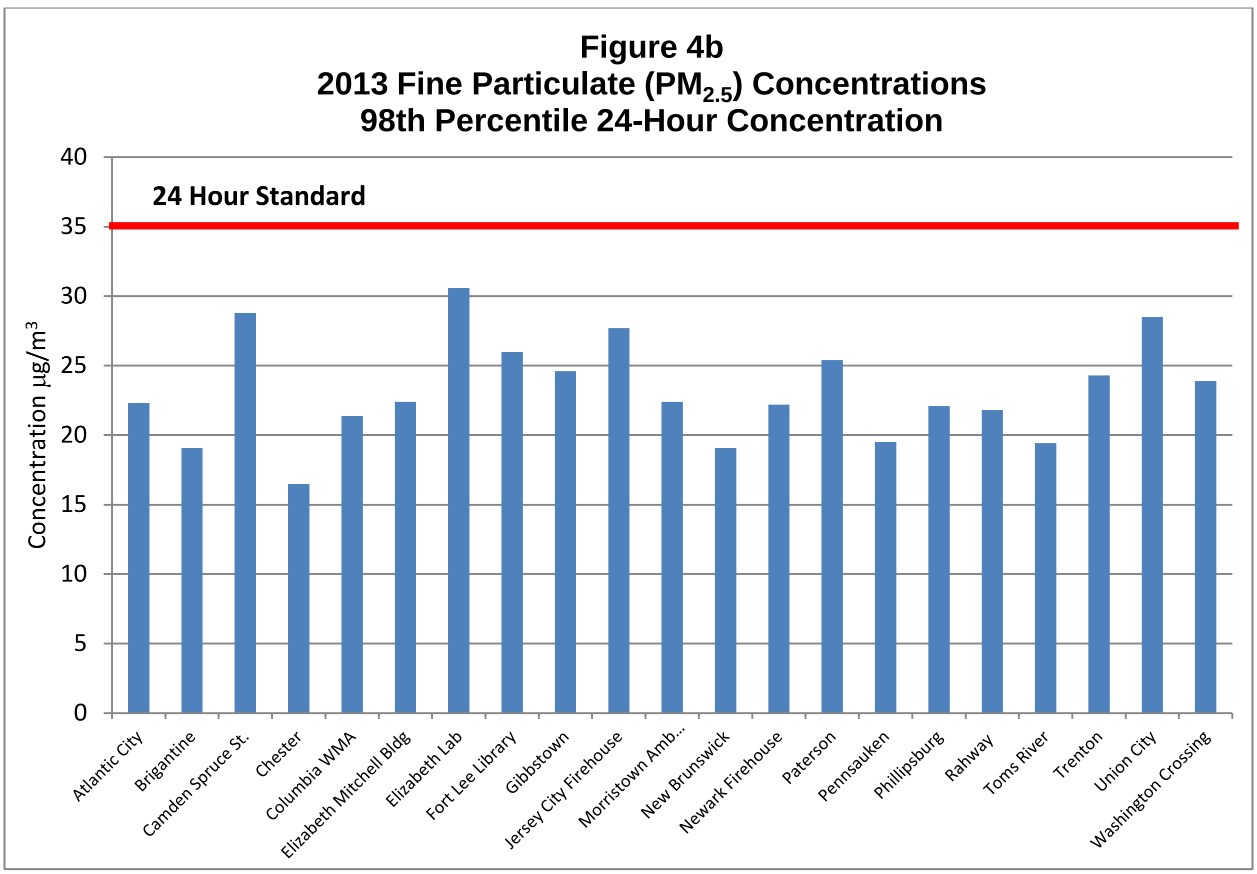


Figure 4b
2013 Fine Particulate ($PM_{2.5}$) Concentrations
98th Percentile 24-Hour Concentration
24 Hour Standard
Concentration µg/m3
40
35
30
25
20
15
10
5
0
Atlantic City
Brigantine
Camden Spruce St.
Chester
Columbia WMA
Elizabeth Mitchell Bldg
Elizabeth Lab
Fort Lee Library
Gibbstown
Jersey City Firehouse
Morristown Amb...
New Brunswick
Newark Firehouse
Paterson
Pennsauken
Phillipsburg
Rahway
Toms River
Trenton
Union City
Washington Crossing

Table 2
2013 Summary of $PM_{2.5}$ Sampler Data

Concentration in Micrograms Per Cubic Meter (µg/m^3)

Monitoring Site	Number of Samples	Annual Mean Concentration	Highest 24-Hour Concentration	98th %-ile 24-Hour Concentration	2011-2013 24-Hour Design Value (98th %-ile)	2011-2013 Annual Design Value
Atlantic City *	111	8.6	24.5	22.3	--	--
Brigantine	119	7.3	24.0	19.1	21	7.8
Camden Spruce St.*	112	10.5	36.0	28.8	--	--
Chester	116	7.0	26.8	16.5	19	7.5
Columbia WMA*	111	7.9	24.1	21.4	24	8.6
Elizabeth Mitchell Bldg	116	9.1	32.6	22.4	23	9.5
Elizabeth Lab	340	10.7	38.0	30.6	30	11.2
Fort Lee Library	120	8.8	32.7	26.0	23	9.1
Gibbstown	120	9.1	31.9	24.6	23	9.3
Jersey City Firehouse	317	9.6	33.1	27.7	27	10.1
Morristown Amb Squad	122	8.5	27.9	22.4	21	8.4
New Brunswick *	114	8.0	27.0	19.1	--	--
Newark Firehouse	118	8.7	27.6	22.2	23	9.4
Paterson	122	8.8	28.6	25.4	24	9.3
Pennsauken	115	9.0	35.1	19.5	21	9.3
Phillipsburg	116	8.5	32.9	22.1	24	9.1
Rahway	118	9.1	33.5	21.8	23	9.7
Toms River	354	8.1	31.2	19.4	22	8.3
Trenton	352	9.1	34.4	24.3	24	9.4
Union City	117	10.5	31.7	28.5	26	11.1
Washington Crossing	112	8.3	30.4	23.9	21	8.2

*Site does not have enough data to calculate 2011-2013 design values.

$PM_{2.5}$ Real-Time Monitoring

New Jersey's continuous $PM_{2.5}$ monitoring network consists of 11 sites: Brigantine, Columbia WMA, Elizabeth Lab, Ewing, Flemington, Jersey City Firehouse, Millville, New Brunswick, Newark Firehouse, Rahway and South Camden. The data is transmitted at least hourly to a central computer in Trenton, where it is averaged and automatically updated on the Bureau's website every hour. Table 3 provides a summary of the data from these sites, and Figure 5 depicts the health level associated with the highest 24-hour fine particulate concentration recorded in the state each day for the entire year.

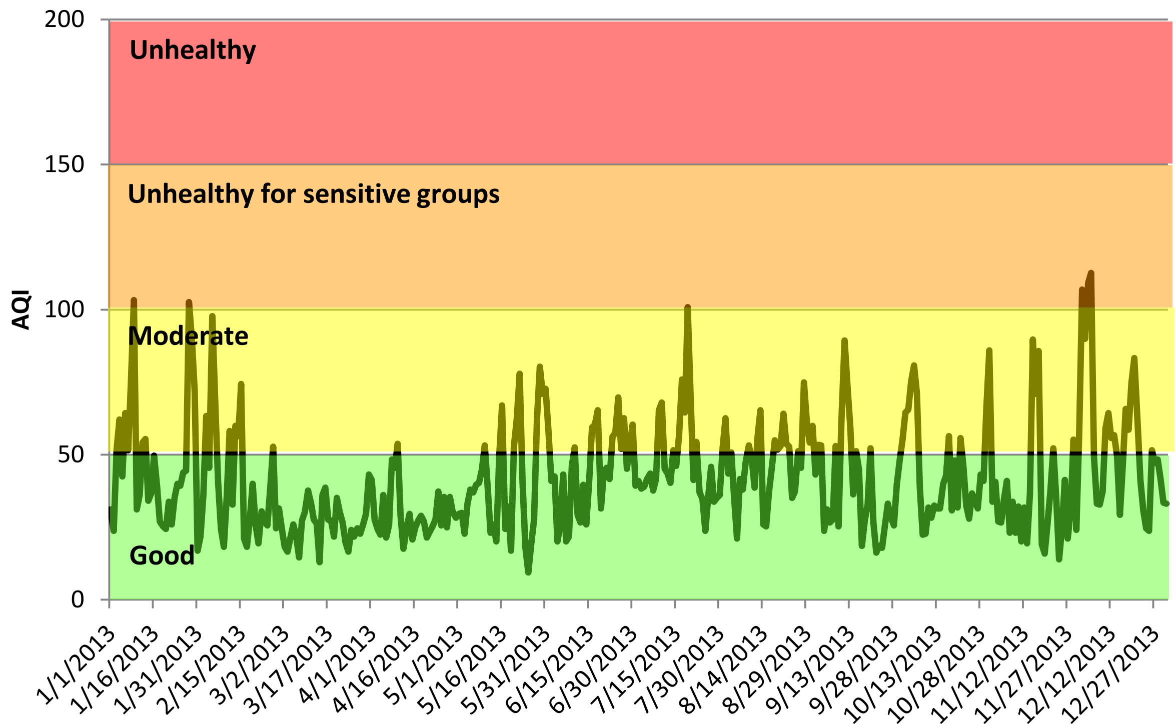
Table 3
2013 Summary of Continuous $PM_{2.5}$ Data

Concentration in Micrograms Per Cubic Meter ($\mu g/m^3$)

Monitoring Site	Annual Mean Concentration	Highest 24-Hour Concentration	Number of Unhealthy Air Quality Days
Brigantine	8.9	24.6	0
Columbia WMA	6.9	31.3	0
Elizabeth Lab	13.0	39.1	6
Ewing	8.2	26.7	0
Flemington	7.8	27.7	0
Jersey City Firehouse	8.2	31.2	0
Millville*	---	30.6	0
New Brunswick	6.7	33.8	0
Newark Firehouse	10.6	42.6	3
Rahway	9.2	27.8	0
South Camden	8.6	32.1	0

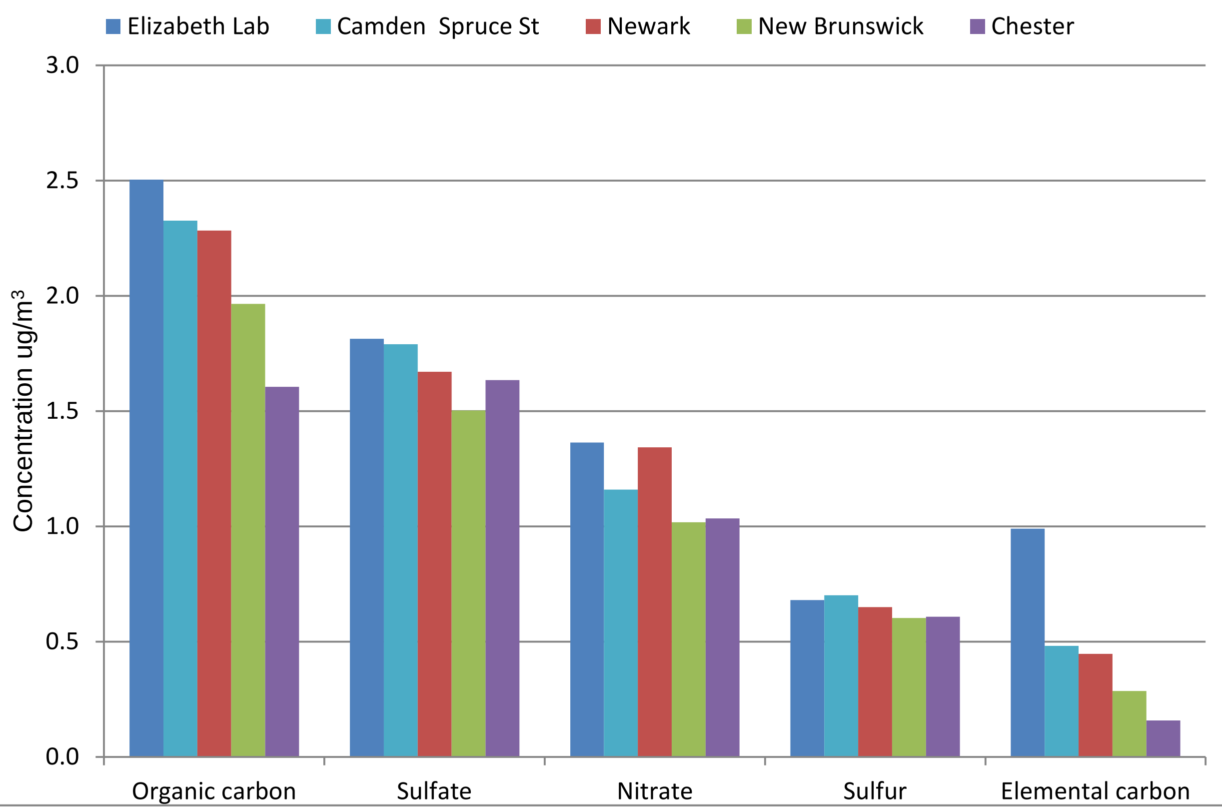
*Site does not have enough data to calculate an annual mean concentration

Figure 5
2013 Highest 24-Hour Continuous $PM_{2.5}$ Concentrations
(Highest of all Sites)
Air Quality Index (AQI)



New Jersey's $PM_{2.5}$ Speciation Network consists of 5 monitoring sites: Elizabeth Lab, Newark Firehouse, New Brunswick, and Chester. Samplers run every third day on a schedule concurrent with the Federal Reference Method sampling network. Of the 39 measured analytes, organic carbon, sulfate, nitrate, sulfur and elemental carbon are the most prevalent species; and combined, they create the majority of the $PM_{2.5}$ total mass concentration. Figure 6 depicts the average concentration of these five most prevalent species. High elemental carbon concentrations at Elizabeth Lab are due to the sites' proximity to high traffic volume, as motor vehicles are a primary source of Elemental Carbon. Appendix B of the 2013 Air Quality Report provides the average, highest, and 2nd highest 24-hour average concentrations for each species for 2013.

Figure 6
2013 $PM_{2.5}$ Analyte Composition
(Highest Analytes Depicted)



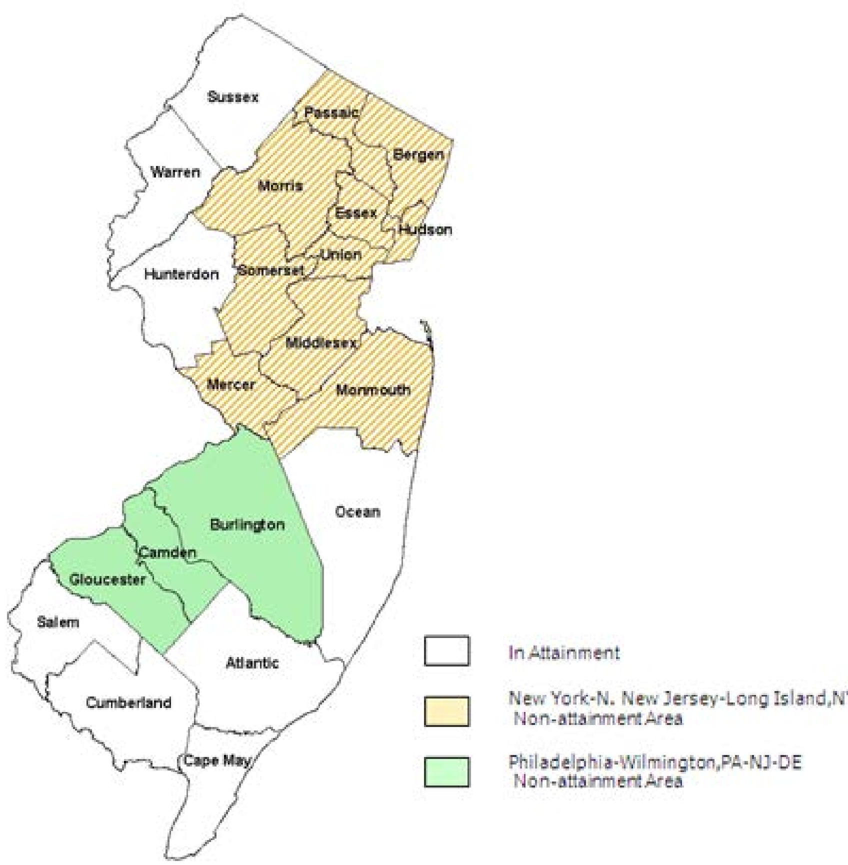
PM$_{2.5}$ NON-ATTAINMENT AREAS

In order to determine if the PM$_{2.5}$ annual or 24-hour NAAQS are met in New Jersey, 12 consecutive quarters of valid data within 3 calendar years are required. The classification of attainment or non-attainment areas for the PM$_{2.5}$ NAAQS is proposed by New Jersey, and final attainment or non-attainment designations are made by the EPA. Non-attainment classification is given to an area that violates the air quality standard or contributes to the violation of that standard.

On April 5, 2005, thirteen New Jersey counties were designated by the EPA as non-attainment areas for PM$_{2.5}$. These counties are shown in Figure 7. While Elizabeth Lab was the only site to record a violation of the annual standard, 10 counties in the northeast and central region of the state were designated as non-attainment due to their potential PM$_{2.5}$ contribution to the Elizabeth Lab monitor and to additional sites in New York City that recorded violations of the PM$_{2.5}$ annual standard.

Similarly, 3 counties in the southwestern part of the state have been classified as non-attainment due to their PM$_{2.5}$ contribution to monitors in the city of Philadelphia that violated the PM$_{2.5}$ NAAQS. NJDEP is currently devising a strategy to lower PM$_{2.5}$ levels in these affected areas.

Figure 7
New Jersey Fine Particulate Matter (PM$_{2.5}$)
Non-attainment Areas

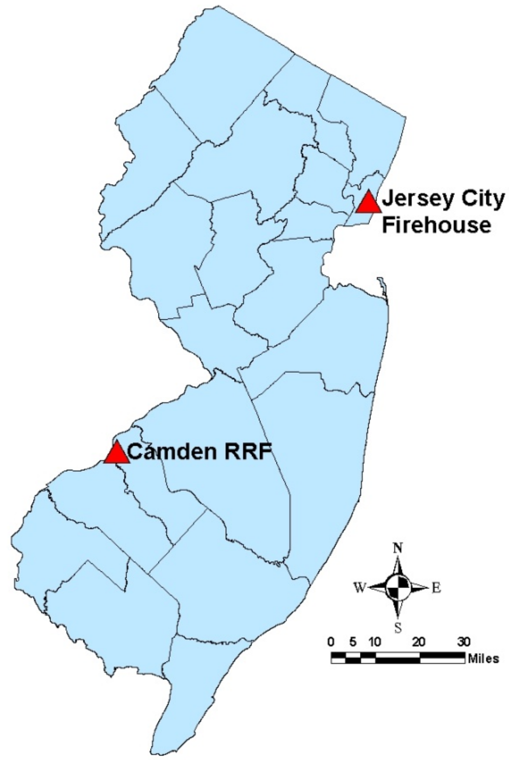


2013 Inhalable Particulate (PM_{10}) Summary

PM_{10} Monitoring Sites

At one time, NJDEP's PM_{10} monitoring network consisted of more than 20 sampling sites. Due to many years of low concentrations and the greater focus on fine particulate monitoring ($PM_{2.5}$), the network has been reduced to its current level of only 2 sites, Camden RRF and the Jersey City Firehouse. PM_{10} samples, taken once every six days, are collected on a filter that is weighed before and after sampling to determine the concentration. Figure 8 depicts the PM_{10} particulate monitoring network in New Jersey.

Figure 8
2013 $PM_{2.5}$
Monitoring Network



PM_{10} Concentration Summary

In 2013, the annual mean concentration measured at the Camden RRF and at the Jersey City Firehouse was 24 μg/m^3 and 19 μg/m^3 respectively. Table 4 and Figures 9a and 9b show the annual mean and highest 24-hour PM_{10} concentrations. All areas of the state are in attainment for the both the annual PM_{10} standards of 50 μg/m^3 and the 24-hour standard of 150 μg/m^3.

Table 4
PM_{10} Data - 2013
24-Hour and Annual Averages

Micrograms Per Cubic Meter (μg/m^3)
24-hour Standard = 150 (μg/m^3)
Annual Standard = 50 μg/m^3

Monitoring Site	Number of Samples	Highest 24-Hour Concentration	Second Highest 24-Hour Concentration	Annual Mean
Camden RRF	55	51	47	24
Jersey City Firehouse	59	53	43	19

FIGURE 9A
Summary of PM_{10} Concentrations, New Jersey 2013

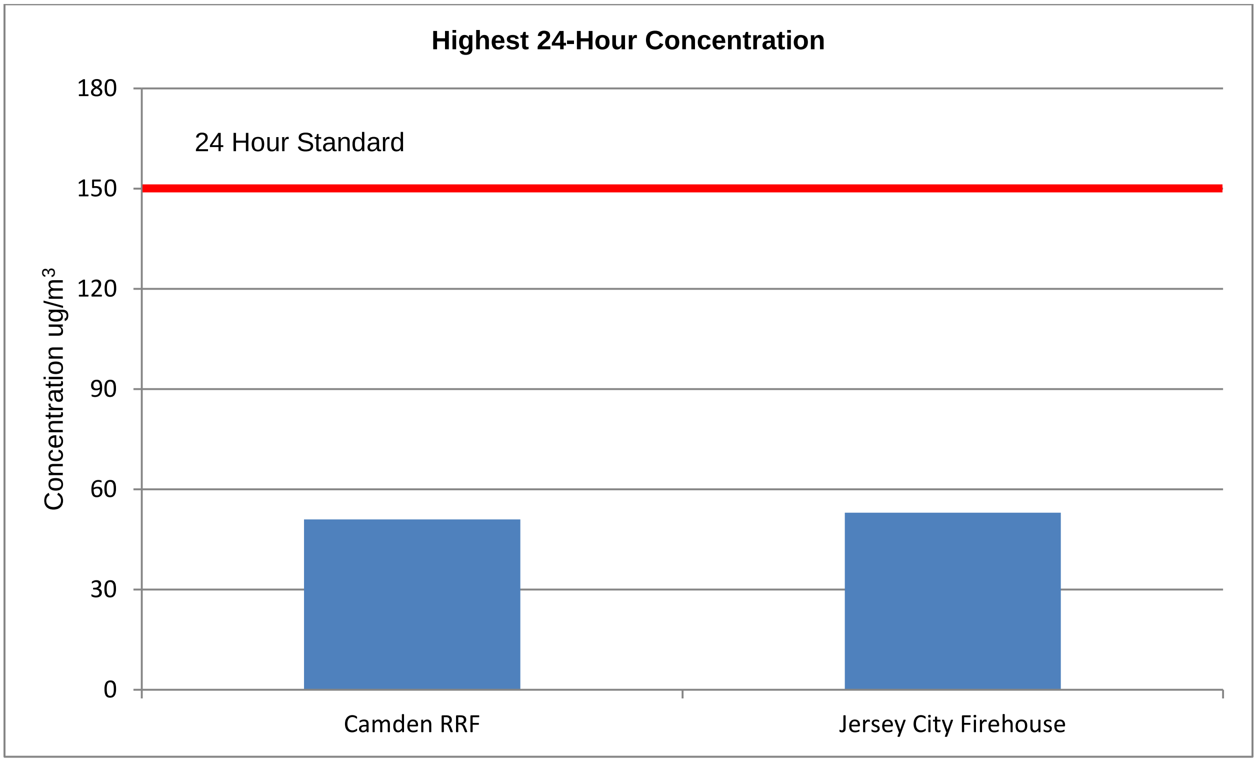
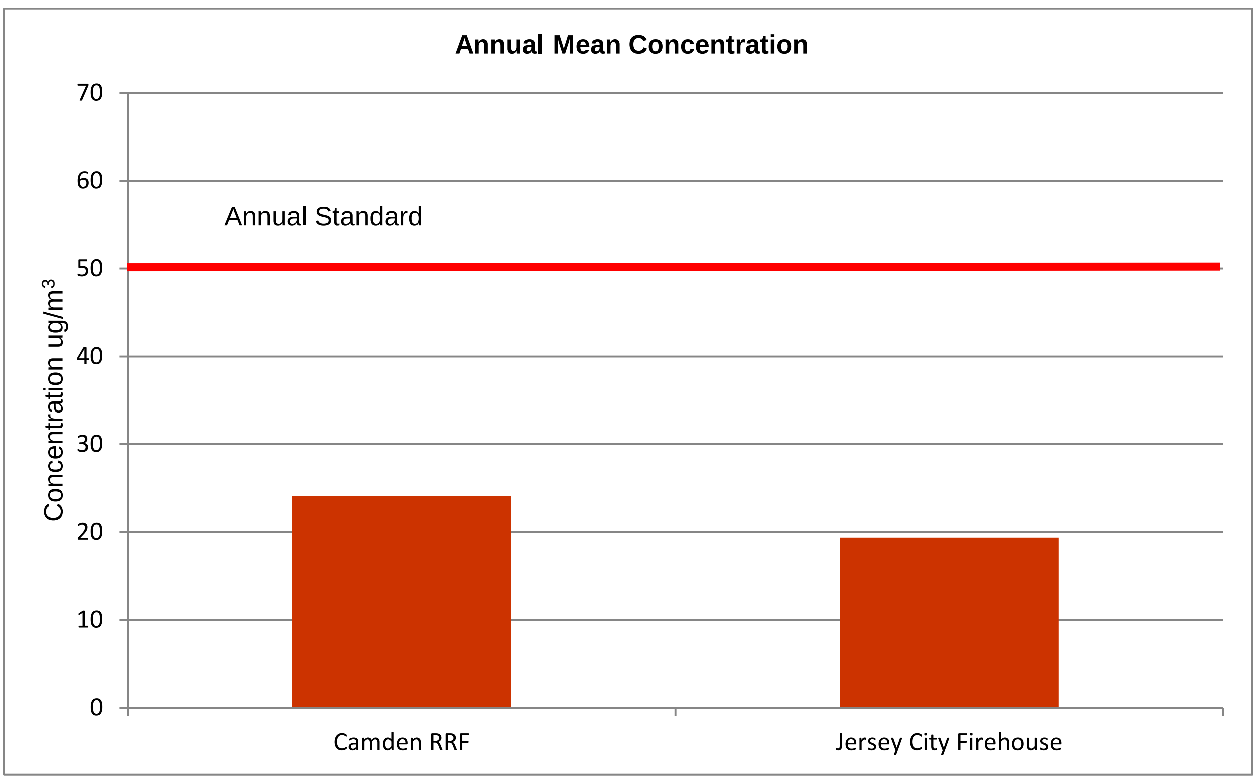


FIGURE 9B
Summary of PM_{10} Concentrations, New Jersey 2013



Smoke Shade Summary

Smoke Shade Monitoring Sites

In addition to $PM_{2.5}$ and PM_{10} monitoring, smoke shade is also monitored at 3 stations around the state. Smoke shade, which is an indirect measurement of particles in the atmosphere, has been monitored in New Jersey for over 40 years. Smoke shade is primarily used for the daily reporting of particulate levels in the Air Quality Index. The sites monitoring smoke shade are shown in Figure 10.

Smoke Shade Concentration Summary

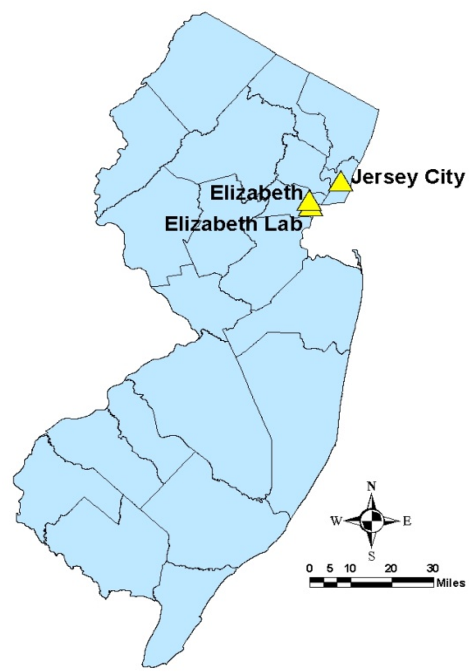
In 2013, the annual mean concentration of smoke shade ranged from 0.20 Coefficient of Haze units (COH) at the Elizabeth site to 0.32 COH at the Elizabeth Lab. COH are units of light transmittance, and smoke shade is not a direct measure of particle mass. A 24-hour average level of 2.0 COH is used as a benchmark. Readings above the 2.0 COH benchmark are reported as Unhealthy for Sensitive Groups on the daily Air Quality Index. For more details see the Air Quality Index section of this report. Table 5 lists the highest and second highest 24-hour average, and annual mean smoke shade levels recorded at the monitoring sites in 2013.

Table 5
Smoke Shade - 2013

Coefficient of Haze (COHs)
No Standard

Site	Highest 24-Hour Average	2nd Highest 24-Hour Average	Annual Mean
Elizabeth	0.78	0.74	0.20
Elizabeth Lab	1.11	0.99	0.32
Jersey City	1.36	0.96	0.29

Figure 10
2013 Smoke Shade Network



TRENDS IN PARTICULATE CONCENTRATIONS

The longest continuously operating particulate monitoring network in the state that is suitable for looking at trends is the smoke shade network. As noted earlier, this monitoring program has been running for over 40 years and still has 3 active sites. The trend graph for smoke shade, shown in Figure 11 indicates that particulate levels have steadily declined over the past 40 years. Smoke shade is not a direct measurement of particle mass, but can be related to TSP, PM_{10} and $PM_{2.5}$ health standards.

The $PM_{2.5}$ monitoring network has been in place since 1999. Thirteen years of sampling has shown a noticeable decline in fine particulate concentrations. Figure 12 shows the trend of the annual mean $PM_{2.5}$ concentrations for all FRM sampler sites since the network began.

Figure 11
Long Term Trends in Particulate Levels as Smoke Shade
Statewide Average
1967-2013

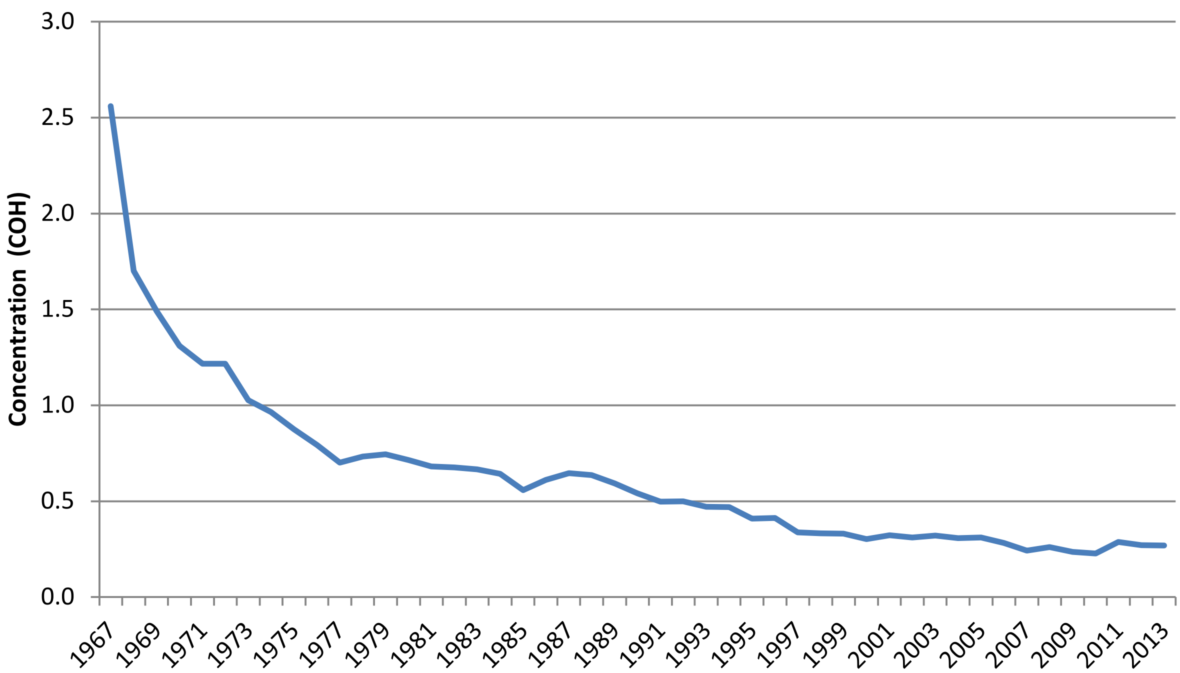
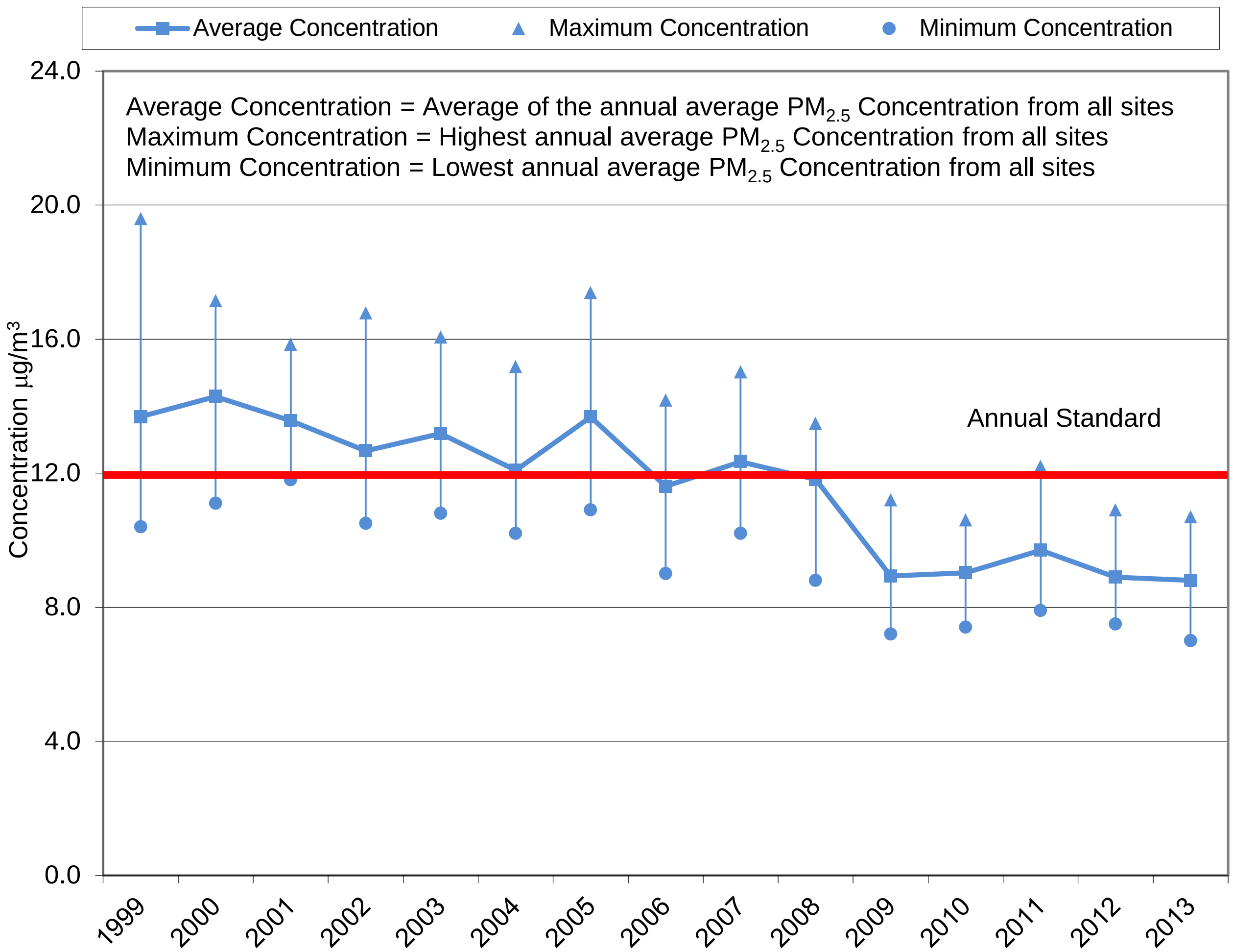


Figure 12
New Jersey
Trend of $PM_{2.5}$ Annual Average of All Sites
1999-2013



REFERENCES

PM – How Particulate Matter Affects the Way We Live and Breathe, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC November 2000, URL: www.epa.gov/air/urbanair/pm/index.html

Air Quality Criteria for Particulate Matter, USEPA, Office of Research and Development, EPA-600/P-99-002A and B, March 2001

Environmental Health Threats to Children, USEPA, Office of the Administrator, EPA-176/F-96-001, September 1996.

National Ambient Air Quality Standards for Particulate Matter, Final Rule, USEPA, Part 50 of Title 40 of the Code of Federal Regulations, July 1997.

National Air Quality and Emissions Trend Report, 1999, EPA-454/R-01-004, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 2001, URL: www.epa.gov/airtrends/reports.html

Latest Findings on National Air Quality: 2000 Status and Trends, EPA-454/K-01-002, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, September 2001, URL: www.epa.gov/airtrends/reports.html

2013 Sulfur Dioxide Summary

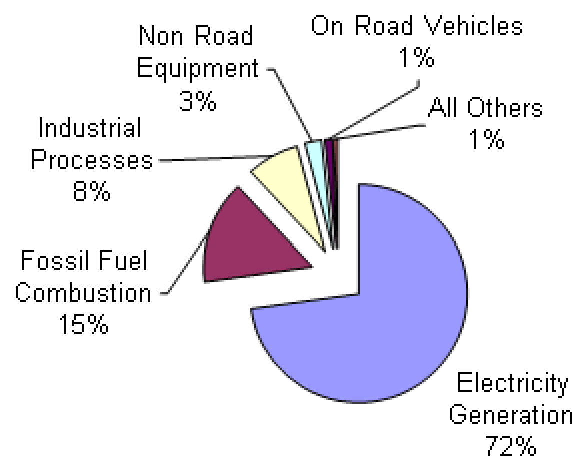
New Jersey Department of Environmental Protection

NATURE AND 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 can be formed when fuels containing sulfur are burned, or when gasoline is extracted from oil. Most of the sulfur dioxide released into the air comes from electric utilities, especially those that burn coal with high sulfur content. Sulfur is found in raw materials such as crude oil, coal, and ores that contain metals such as aluminum, copper, zinc, lead and iron. Industrial facilities that derive their products from these materials may also release SO_2. A pie chart summarizing the major sources of SO_2 is shown in Figure 1.

Figure 2 (page 2) shows that SO_2 concentrations in New Jersey are generally higher in the winter than in the summer due to higher emissions from space heating and other sources, but peak SO_2 daily levels can occur any time during the year. As shown in Figure 3 (page 2), SO_2 levels tend to peak in mid to late morning as emissions accumulate prior to being more effectively dispersed when wind speeds increase and atmospheric mixing increases later in the day.

Figure 1
National Summary
SO_2 Emissions by Source Category



SOURCE: USEPA WEBSITE
HTTP://WWW.EPA.GOV/AIR/EMISSIONS/SO2.HTM
2005 data.

HEALTH AND ENVIRONMENTAL EFFECTS

Sulfur dioxide causes irritation of the mucous membranes. This is probably the result of the action of sulfurous acid that is formed when the highly soluble SO_2 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 belonging to these sensitive groups and those who are active outdoors may have trouble breathing. The International Agency for Research on Cancer (IARC) evaluated SO_2 and based on available information, determined that no conclusion can be made as to the carcinogenicity of SO_2 to human beings (IARC, 1992).

Sulfur dioxide reacts with other gases and particles in the air to form sulfates that can be harmful to people and the environment. Sulfate particles are the major cause of reduced visibility in the eastern United States. SO_2 can also react with other substances in the air to form acids that fall to the earth in rain and snow. Better known as acid rain, this acidic precipitation can damage forests and crops, can make lakes and streams too acidic for fish, and eventually can speed up the decay of building materials and paints.

Figure 2
Sulfur Dioxide – New Jersey
2013 Monthly Variation
Parts Per Million (ppm)

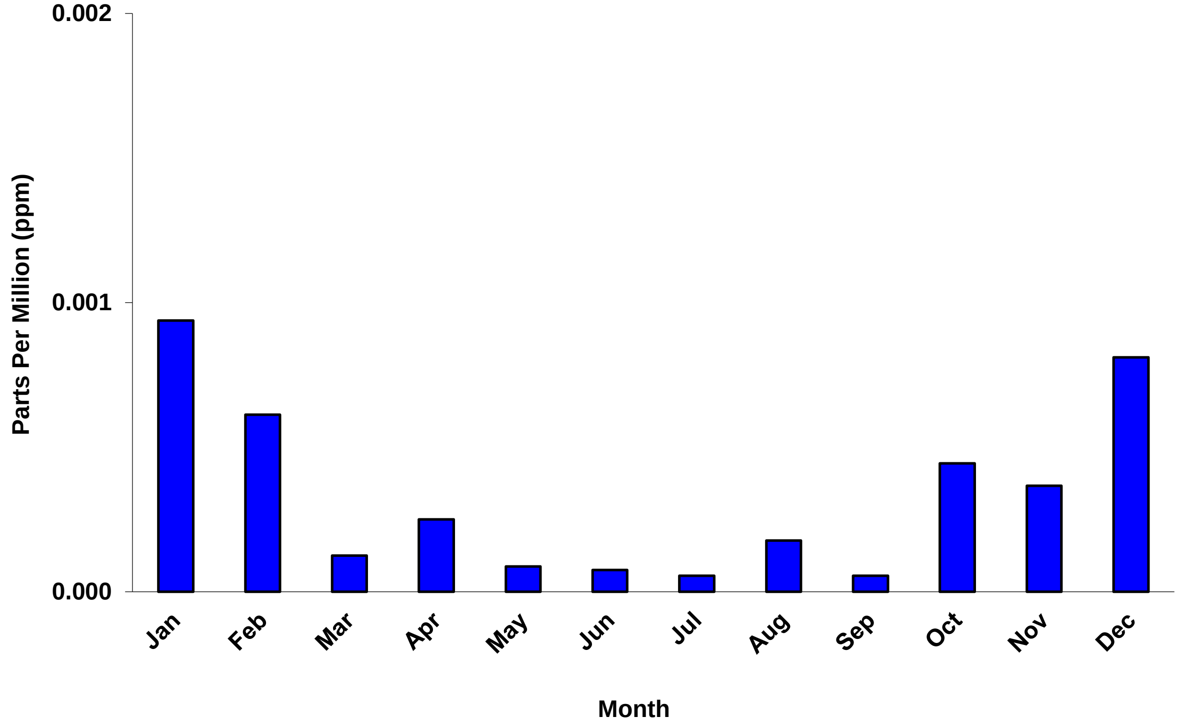
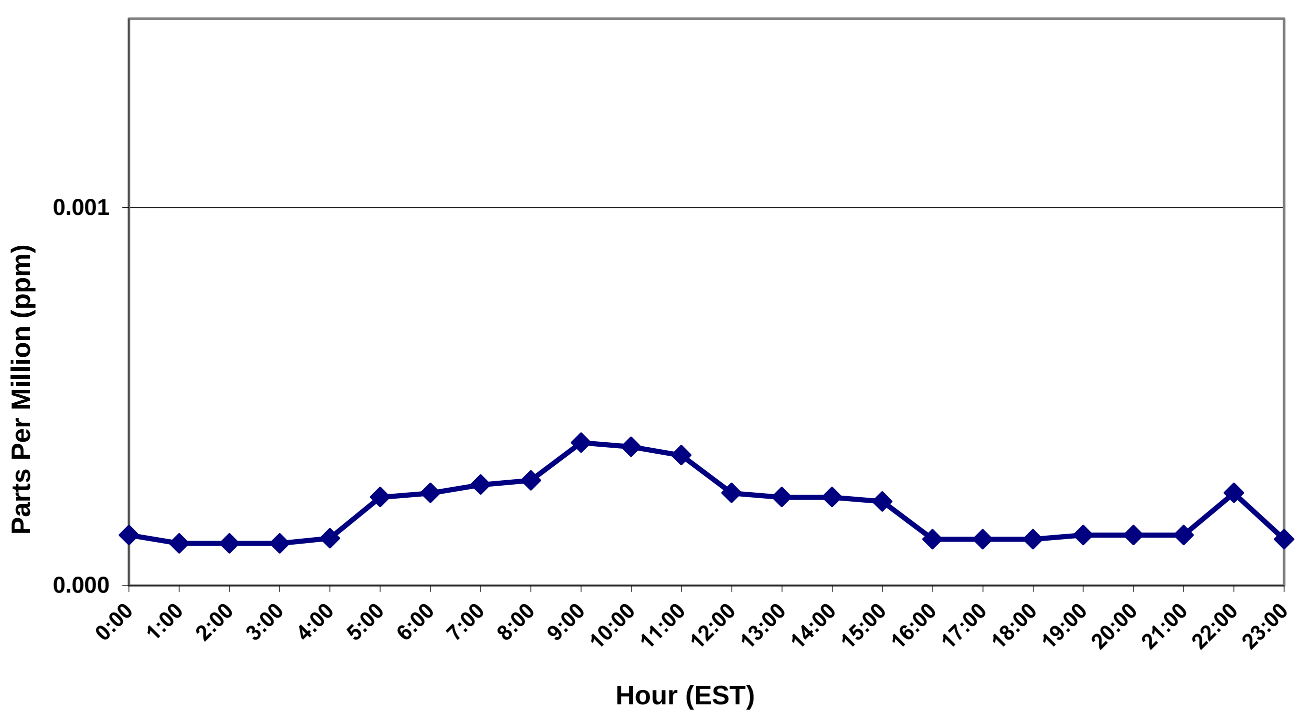


Figure 3
Sulfur Dioxide – New Jersey
2013 Hourly Variation
Parts Per Million (ppm)



STANDARDS

From 1971 through June 2010, the National Ambient Air Quality Standards (NAAQS) for SO_2 were revised three times. In June 2010, based on its review of the air quality standard for oxides of sulfur (as measured by SO_2), the United States Environmental Protection Agency (USEPA) established a new 1-hour NAAQS for SO_2 at a level of 75 parts per billion (ppb), and revoked the 24-hour average and the annual average NAAQS. The USEPA did not revoke the 3-hour secondary NAAQS. The new 1-hour standard is based on the 3-year average of the 99th percentile of 1-hour daily maximum concentrations (Federal Register, 2010). The 1971 SO_2 standards remain in effect until one year after an area is designated for the 2010 standard. In areas designated nonattainment for the 1971 standards, the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standards are approved (USEPA, 2010). The 1971 standards include an annual average health standard of 0.03 parts per million (ppm). This is based on a calendar year average of continuously monitored levels. There is also a 24-hour average health based standard of 0.14 ppm which is not to be exceeded more than once a year, and a secondary (welfare based) 3-hour average concentration standard of 0.5 ppm that is also not to be exceeded more than once per year.

New Jersey also has state air quality standards for SO_2. They are similar to the Federal standards but are expressed in micrograms per cubic meter ($\mu g/m^3$) instead of ppm, and are based on rolling averages rather than block averages. This means the State's primary 12-month standard is based on any twelve-month average recorded during two consecutive years, while the Federal standard is based solely on the calendar year (block) average. The State also has secondary 12-month, 24-hour, and 3-hour average standards. Table 1 summarizes the NAAQS and the New Jersey Ambient Air Quality Standards (NJAAQS) for SO_2.

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

Averaging Period	Type	New Jersey	National[a]
12 – month average	Primary	80 $\mu g/m^3$ (0.03 ppm)	--
12 – month average	Secondary	60 $\mu g/m^3$ (0.02 ppm)	---
24 – hour average	Primary	365 $\mu g/m^3$ (0.14 ppm)	--
24 – hour average	Secondary	260 $\mu g/m^3$ (0.10 ppm)	---
3 – hour average	Secondary	1300 $\mu g/m^3$ (0.5 ppm)	0.5 ppm
1 – hour average[b]	Primary	---	75 ppb

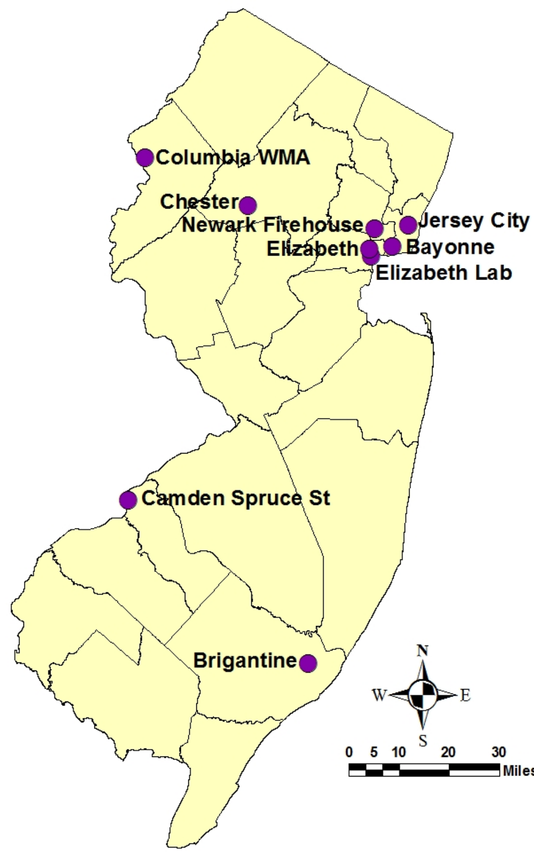
[a] – National standards are block averages rather than moving averages.

[b] – Final rule signed June 2, 2010 and effective on August 23, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hr average at each monitor within an area must not exceed 75 ppb.

MONITORING LOCATIONS

The state monitored SO_2 levels at 9 locations in 2013. These sites are shown in Figure 4. The Bayonne site was temporarily shut down in October 2012 because of damage from Superstorm Sandy and was restarted July 2013. In 2010, the NJDEP submitted to the EPA a petition under Section 126 of the Clean Air Act that showed emissions from the Portland Generating Station, located in Pennsylvania, significantly contribute to nonattainment or interfere with maintenance of the 1-hour SO_2 NAAQS. In support of this petition, NJDEP has been monitoring SO_2 concentrations at the Columbia Wildlife Management Area (WMA) station in Warren County since September 23, 2010.

Figure 4
2013 Sulfur Dioxide
Monitoring Network



SO_2 LEVELS IN 2012

In 2013, 4 exceedances of the 1-hour standard were recorded at the Columbia WMA site. The highest 99th percentile of the 1-hour daily maximum concentration for 2013 was recorded at Columbia WMA (81 ppb). The highest 3-year average of the 99th percentile of the 1-hour daily maximum SO2 concentrations was 91 ppb, also measured at the Columbia WMA station. The Camden Spruce Street and Bayonne sites did not have sufficient data from 2011-2013 to determine whether these sites meet the 1-hour SO_2 standard.

No other monitoring sites recorded exceedances of the primary or secondary SO_2 standards during 2013. The maximum 12-month average concentration recorded was 0.001 ppm at Elizabeth Lab site. The maximum 24-hour average level recorded was 0.016 ppm at the Columbia WMA site. The highest 3-hour average recorded was 0.059 ppm at the Columbia WMA site. Summaries of the 2013 data are provided in Tables 2, 3, 4, Figure 5 and Figure 6 (pages 5 - 7),

Table 2
2013 Sulfur Dioxide Data
3-Year Average of 99th Percentile
of Daily Maximum 1-Hour Average
Parts Per Billion (ppb)

Location	1-Hour Average (ppb)			3 – Year Average 2011-2013
	Highest 1-Hr Daily Maximum	2nd Highest 1-Hr Daily Maximum	99th %-ile 1-Hr Daily Maximum	99th %-ile 1-hr Daily Maximum
Bayonne[c]	12	10	10	---
Brigantine	13.7	7.2	6.9	6.2
Camden Spruce[d]	24	20	9	---
Chester	12	9	6	14
Columbia WMA	121	114	81	91
Elizabeth	12	7	6	10
Elizabeth Lab	22	15	14	26
Jersey City	9	9	8	14
Newark Firehouse	9.6	8.2	7.7	13.2

[c] – Bayonne site temporarily shut down October 2012 due to Superstorm Sandy and restarted July 2013.
[d] – Camden Spruce site started in April 2012.

Table 3
2013 Sulfur Dioxide Data
3-Hour and Annual Averages
Parts Per Million (ppm)

Monitoring Sites	3-Hour Average Maximum	3-Hour Average 2nd Highest [a]	12-Month Average Maximum	Calendar Year Average
Bayonne[c]	0.009	0.008	---	---
Brigantine	0.0064	0.0047	0.0004	0.0004
Camden Spruce[d]	0.016	0.015	---	---
Chester	0.008	0.006	0.000	0.001
Columbia WMA	0.059	0.056	0.000	0.001
Elizabeth	0.010	0.008	0.000	0.001
Elizabeth Lab	0.012	0.011	0.001	0.001
Jersey City	0.008	0.007	0.000	0.001
Newark Firehouse	0.0073	0.0065	0.0008	0.0008

[a] – Based on non-overlapping 3 – hour moving averages.
[c] – Bayonne site temporarily shut down October 2012 due to Superstorm Sandy and restarted July 2013.
[d] – Camden Spruce site started in April 2012, 12-month average and calendar year average not available.

Table 4
2013 Sulfur Dioxide Data
24-Hour and Daily Averages
Parts Per Million (ppm)

Monitoring Sites	24-Hour Average Maximum	24-Hour Average 2nd Highest [a]	Daily Average Maximum	Daily Average 2nd Highest
Bayonne [c]	0.004	0.003	0.003	0.003
Brigantine	0.0026	0.0024	0.0025	0.0022
Camden Spruce [d]	0.005	0.003	0.004	0.003
Chester	0.003	0.003	0.003	0.003
Columbia WMA	0.016	0.014	0.013	0.013
Elizabeth	0.004	0.003	0.004	0.003
Elizabeth Lab	0.007	0.006	0.007	0.006
Jersey City	0.005	0.005	0.005	0.004
Newark Firehouse	0.0042	0.0039	0.0042	0.0038

[a] – Based on non-overlapping 24 – hour moving averages.
[c] – Bayonne site temporarily shut down October 2012 due to Superstorm Sandy and restarted July 2013.
[d] – Camden Spruce site started in April 2012.

Figure 5
Sulfur Dioxide – New Jersey
2013 – 3 Year Design Value
Parts Per Billion (ppb)

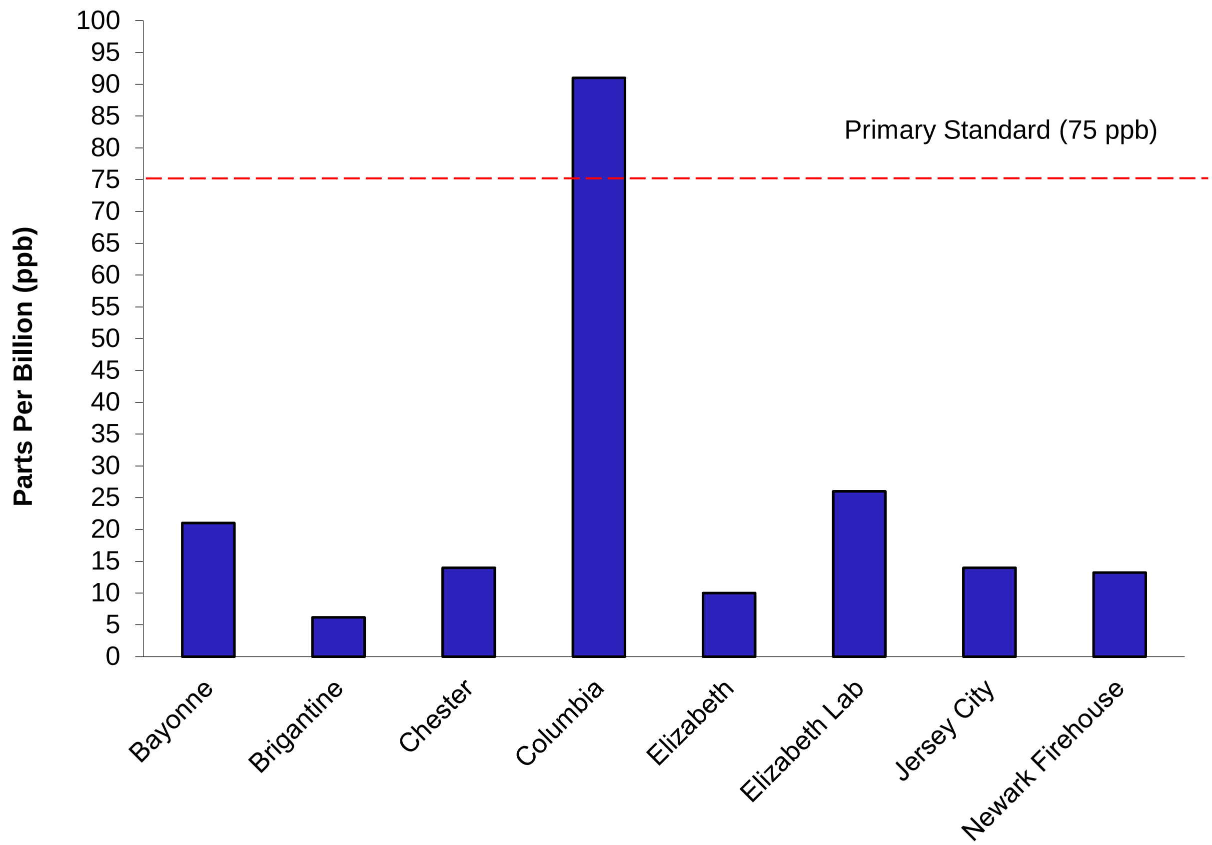
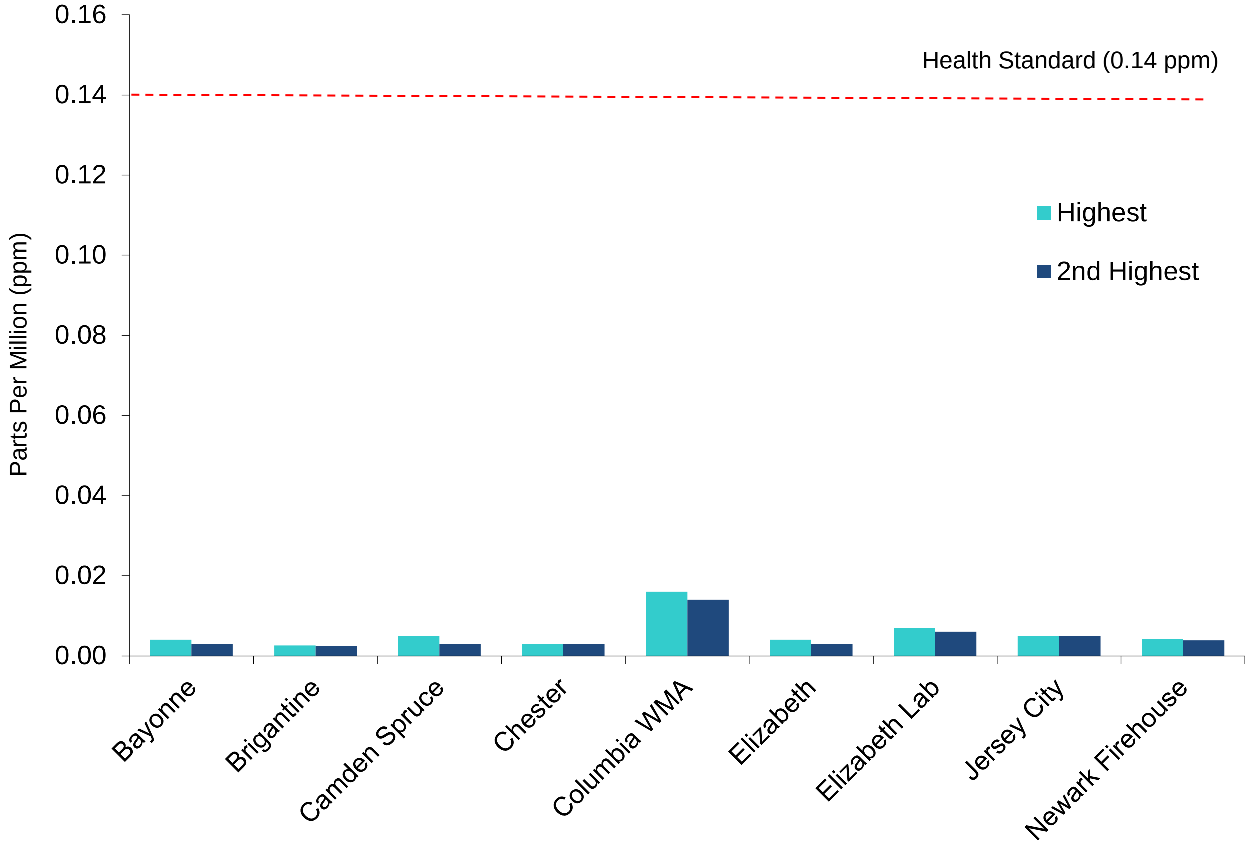


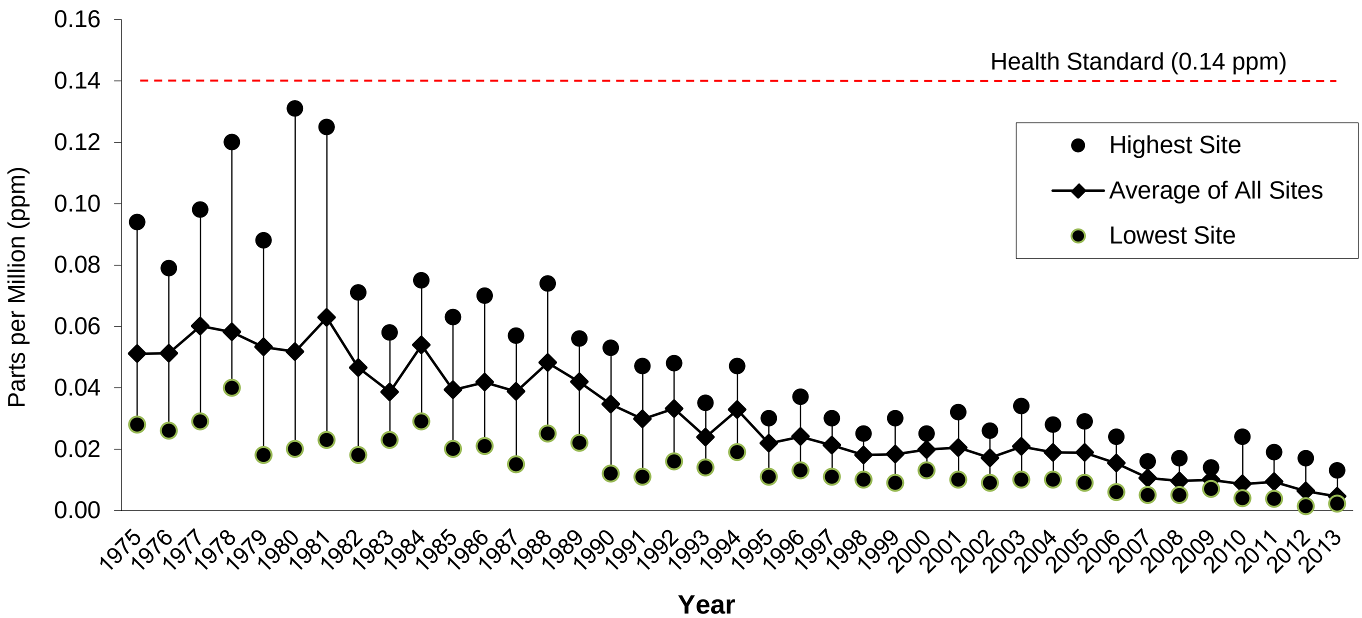
Figure 6
2013 Sulfur Dioxide Concentrations
Highest and 2nd Highest 24-Hour Averages
Parts Per Million (ppm)



TREND FOR 24-HOUR SO_2 STANDARD

Since the implementation of Federal regulations requiring the use of lower sulfur fuels nationwide, SO_2 concentrations have improved significantly. The last time an exceedance of the 3-hour, 24-hour, or 12-month NAAQS for SO_2 was recorded in the state was in 1980. A trend graph of SO_2 levels showing the daily average concentrations recorded in each year since 1975 from the highest site, average of all sites, and lowest site is provided in Figure 7 (page 8). The graph uses the second highest daily average.

Figure 7
1975 - 2013 Sulfur Dioxide Concentrations
Second Highest Daily Average
Parts Per Million (ppm)



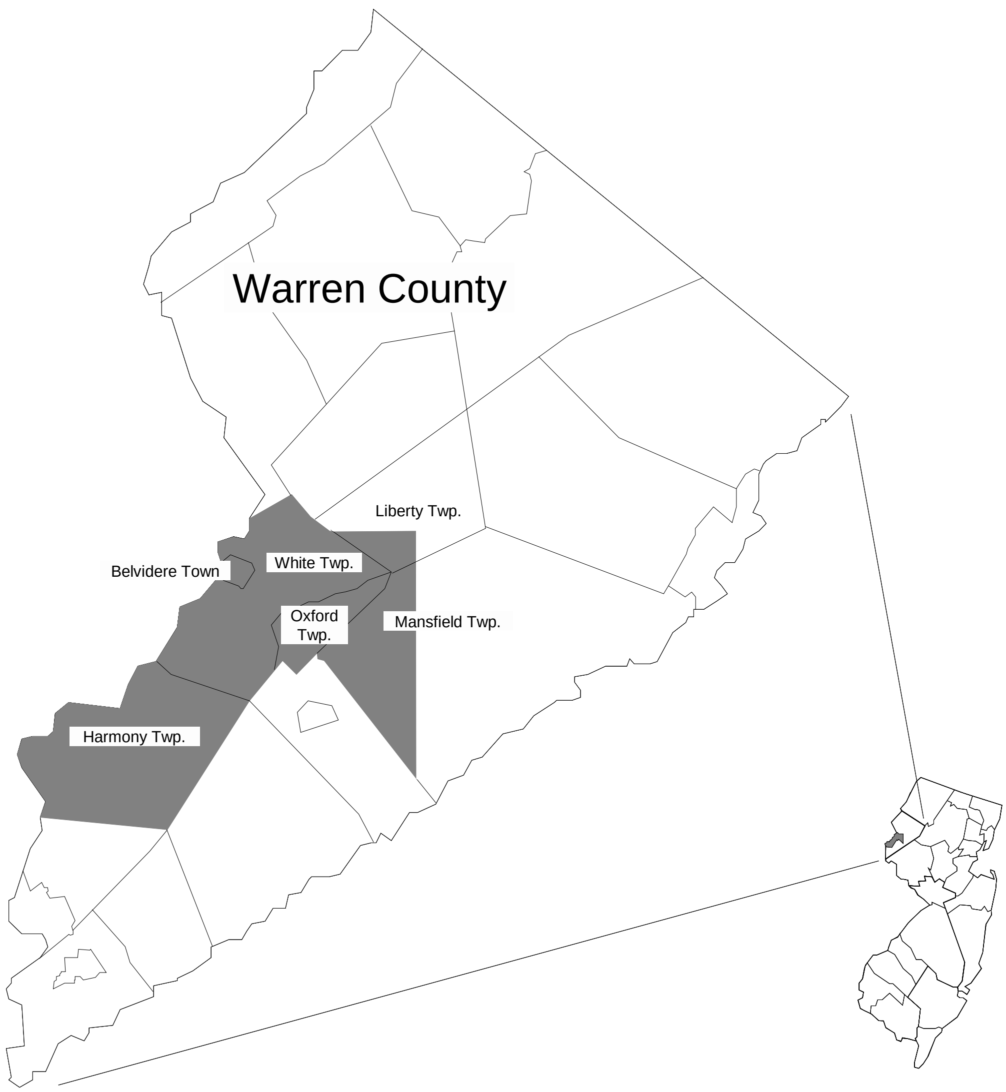
COMPLIANCE WITH THE SO_2 STANDARDS IN NEW JERSEY

There is still a small portion of New Jersey that is classified as a non-attainment area for SO_2 based on the 1971 12-month and 24-hour average ambient air quality primary standards. This is the result of air quality modeling studies that predicted non-attainment of these standards within an area of Warren County. The sources that were causing the predicted high levels no longer exist, or do not emit SO_2 at the rates they did in the past. The state is working with EPA to get the area re-designated to attainment. The area is shown in Figure 8.

On June 2, 2010, the USEPA revised the air quality standards for SO_2, establishing a new standard based on maximum 1-hour average concentrations. In September 2010, New Jersey petitioned the USEPA under Section 126 of the Clean Air Act, to take action against the Portland Power Plant in Pennsylvania as a large area of New Jersey is being influenced by SO_2 emissions from the plant and it is likely causing violations of the new 1-hour standard. This area includes all of Warren County and portions of Sussex, Morris, and Hunterdon counties. A detailed map of the affected areas can be found at http://www.state.nj.us/dep/baqp/docs/SO2%20package.pdf.

In support of this petition, the NJDEP established an SO_2 monitoring station in the Columbia Wildlife Management Area (WMA) in Knowlton Township, Warren County in September 2010. In October 2011, the USEPA finalized a rule to grant New Jersey's petition. This final rule requires the Portland Power Plant to reduce its SO_2 emissions such that the plant's contribution to predicted air quality standard violations will be lowered within one year, and completely eliminated within 3 years. Since the Portland Power Plant has reduced its emissions and has signed a court order to cease operations by July 2014, it is expected that Warren County and its vicinity will be able to attain the new SO_2 standard.

Figure 8
Sulfur Dioxide Non-attainment Areas* in New Jersey



Legend

Sulfur Dioxide Nonattainment Area
(includes Belvidere Town; Harmony Township; Oxford Township; White Township; the portion of Liberty Township south of UTM northing 4,255,000 and west of UTM easting 505,000; and the portion of Mansfield Township west of UTM easting 505,000).

*Nonattainment of the National Primary (Health) and Secondary (Welfare) Standards

REFERENCES

Air Quality Criteria for Particulate Matter and Sulfur Oxides (1982): Assessment of New Findings on Sulfur Dioxide Acute Exposure Health Effects in Asthmatic Individuals, Supplement to the Second Addendum (1986), U.S. Environmental Protection Agency, Office of Health and Environmental Assessment, Research Triangle Park, NC, 1994.

Draft Guideline Document for Ambient Monitoring of 5-minute SO2 Concentrations, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, July 20, 2000.

Horstman, D., Roger, L. J., Kehrl, H. and Hazucha, M., Airway Sensitivity of Asthmatics to Sulfur Dioxide, EPA-600/J-86-282, Health Effects Research Lab, Research Triangle Park, NC, Clinical Research Branch, Environmental Monitoring and Services, Inc., Chapel Hill, NC, North Carolina University at Chapel Hill, NC, Prepared for USEPA, Research Triangle Park, NC, 1986.

How Sulfur Dioxide Affects the Way We Live, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, June 2009, URL: http://www.epa.gov/air/urbanair/SO2

International Agency for Research on Cancer (IARC). 1992, IARC Monographs; Vol 54.

Latest Findings on National Air Quality: 2000 Status and Trends, EPA-454/K-01-002, USEPA , Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 2001, URL: http://www.epa.gov/air/airtrends/aqtrnd00/brochure/00brochure.pdf.

National Air Quality and Emissions Trend Report, 1999, EPA-454/R-01-004, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 2001, URL: http://www.epa.gov/air/airtrends/aqtrnd99/.

National Ambient Air Quality Standards, United States Environmental Protection Agency (USEPA), Air and Radiation, 2010. URL: http://www.epa.gov/air/criteria.html

National Primary Ambient Air Quality Standards for Sulfur Dioxide, 40 CFR 50.4, US Government Printing Office, Washington DC, July 2001.

National Secondary Ambient Air Quality Standards for Sulfur Dioxide, 40 CFR 50.5, US Government Printing Office, Washington DC, July 2001.

Sittig, M., Handbook of Toxic and Hazardous Chemicals and Carcinogens Third Edition, Volume 2, Noyes Publications, Park Ridge, NJ, 1991.

“Revisions to Final Response to Petition From New Jersey Regarding SO2 Emissions From the Portland Generating Station.” Federal Register 76 (2011 December 22): 79574-79578.

ToxFaQs for Sulfur Dioxide, CAS# 7446-09-5, U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, June1999, URL: http://www.atsdr.cdc.gov/tfacts116.pdf.

2013 Air Toxics Summary

New Jersey Department of Environmental Protection

INTRODUCTION

Air pollutants can be divided into two categories: the 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) 2013 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.state.nj.us/dep/airtoxics .

HEALTH EFFECTS

People exposed to significant amounts of air toxics may have an increased chance of getting 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. 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 plants and animals which are later consumed by humans.

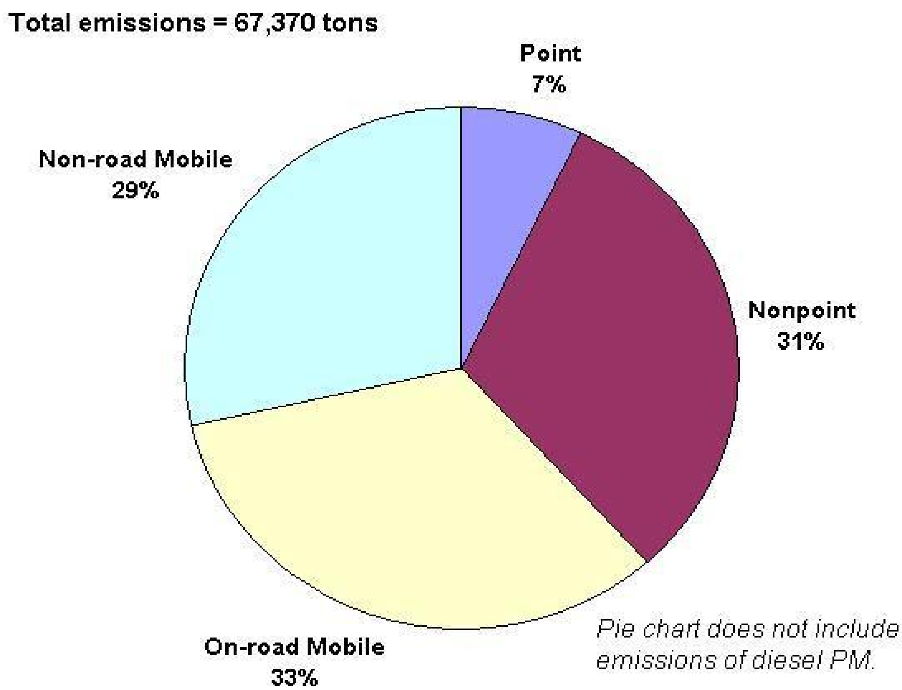
The effects on human health resulting from exposure to specific air toxics can be estimated by using chemical-specific health benchmarks. These are based on toxicity values developed by the USEPA and other agencies, using chemical-specific health studies. For carcinogens (chemicals suspected of causing 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 air toxics monitored in New Jersey are listed in Tables 6 through 9. If ambient air concentrations exceed the health benchmarks then some action, such as a reduction in emissions, should be considered.

SOURCES OF AIR TOXICS

A number of years ago, USEPA began the National-Scale Air Toxics Assessment (NATA). Starting with the year 1996, they set out on a three-year cycle to determine people's exposure to air toxics around the country. To do this, USEPA first prepares a comprehensive inventory of air toxics emissions from all man-made sources. The emissions inventory is reviewed and updated by each state. Although there are likely to be some errors in the details of such a massive undertaking, the emissions inventory still gives us a reasonable indication of the most important sources of air toxic emissions in our state. The pie chart in Figure 1, based on the most recent NATA (for 2005) emissions estimates, shows that mobile sources are the largest contributors of air toxics emissions in New Jersey.

On-road mobile sources (cars and trucks) account for 33% of the air toxics emissions, and non-road mobile sources (airplanes, trains, construction equipment, lawnmowers, boats, dirt bikes, etc.) contribute an additional 20%. Nonpoint sources (residential, commercial, and small industrial sources) represent 31% of the inventory, and point sources (such as factories and power plants) account for the remaining 7%.

Figure 1
2005 Air Toxics Emissions Source
Estimates for New Jersey

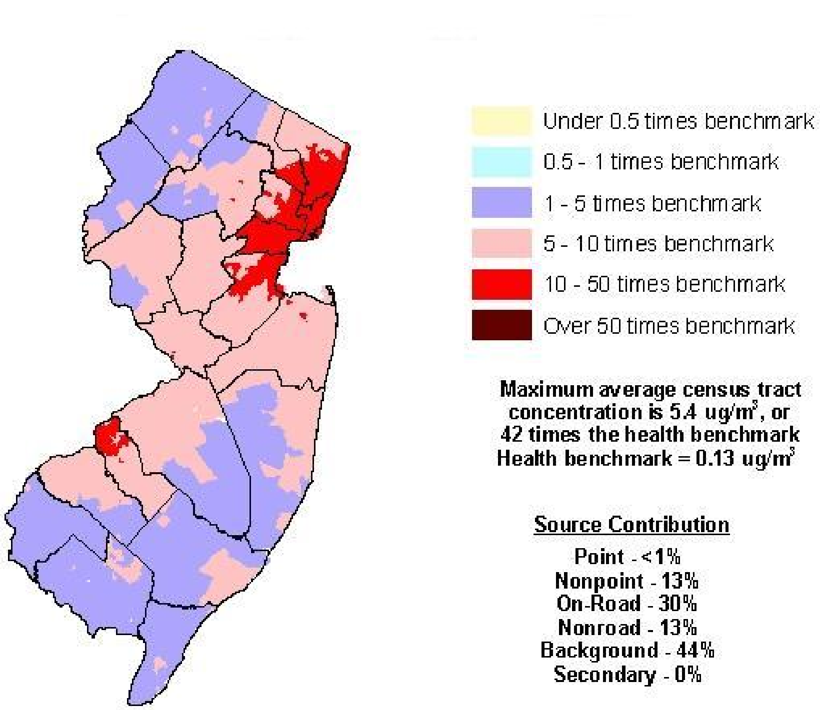


ESTIMATING AIR TOXICS EXPOSURE

There are a limited number of air toxics monitors located throughout the country, because of costs and logistics. In order to estimate air toxics concentrations in areas across the U.S., especially those areas with no monitors, USEPA's NATA project uses its emissions inventory in an air dispersion model that predicts ambient annual average concentrations. (A comparison of NATA estimates with monitoring data is presented in Figure 19).

The map in Figure 2 shows the NATA-predicted concentrations of benzene throughout New Jersey. The high concentration areas tend to overlap the more densely populated areas of the state, following the pattern of emissions. Not all air toxics follow this pattern, as some are more closely associated with individual point sources or air transport, but in general, higher population densities result in greater emissions of, and exposure to, air toxics. Maps for other air toxics can be found at www.nj.gov/dep/airtoxics/nataest05.htm.

Figure 2
BENZENE - 2005 NATA Predicted
Concentrations for New Jersey



Analysis of the NATA state and county average air toxics concentrations indicates that twenty-three chemicals were predicted to exceed their health benchmarks, or level of concern, in one or more counties in 2005. Twenty-two of these chemicals were evaluated based on their cancer potency, and one (acrolein) was based on non-cancer effects. Estimated air concentrations of these 23 pollutants vary around the state, depending on the types of sources that emit them. This is summarized in Table 1.

Table 1
Air Toxics of Greatest Concern in New Jersey
Based on 2005 National-Scale Air Toxics Assessment

Pollutant of Concern	Number of Counties Above Health Benchmark	Primary Source of Emissions
Acetaldehyde	Statewide	Background, secondary
Acrolein	Statewide	Background, nonpoint
Acrylonitrile	2 (Bergen & Essex)	Point, nonpoint
Arsenic Compounds	19	Background, secondary
Benzene	Statewide	Background, mobile
1,3-Butadiene	Statewide	Background, mobile
Cadmium Compounds	1 (Warren)	Nonpoint, background
Carbon Tetrachloride	Statewide	Background
Chloroform	Statewide	Nonpoint, background
Chromium (hexavalent)	20	Background, point
Cobalt Compounds	7	Point
1,4-Dichlorobenzene	8	Nonpoint, background
1,3-Dichloropropene	1 (Hudson)	Nonpoint
Diesel Particulate Matter	Statewide	Mobile
Ethylbenzene	6	Mobile, nonpoint
Ethylene Oxide	6	Background, nonpoint
Formaldehyde	Statewide	Background, secondary
Methyl Chloride	Statewide	Background
Naphthalene	20	Nonpoint, mobile
Nickel compounds	1 (Hudson)	Nonpoint, point
PAH/POM	18	Nonpoint
Tetrachloroethylene	8	Nonpoint, background
1,1,2-Trichloroethane	1 (Salem)	Nonpoint

NEW JERSEY AIR TOXICS MONITORING PROGRAM RESULTS FOR 2013

NJDEP has four air toxics monitoring sites for volatile organic compounds (VOCs) around the state (located in Camden, Chester, Elizabeth, and New Brunswick), and five for toxic metals (Camden, Chester, Elizabeth, New Brunswick, and Newark).

The Chester monitoring site is in rural Morris County, away from known sources, and serves as kind of a “background” monitor. The New Brunswick monitoring station is in a suburban setting, and the Elizabeth monitor is located next to the Exit 13 tollbooths on the New Jersey Turnpike. The Camden monitor is located in an industrial urban setting, while the Newark monitoring site is in an urban residential area. More information about the air monitoring sites can be found in the annual Air Quality Report at www.njaqinow.net/Default.ltr.aspx.

A previous monitoring site in Camden (officially called the Camden Lab site) was shut down on September 29, 2008, because NJDEP lost access to the location. The Camden Lab site had been measuring several toxics since 1989. The new monitoring site in Camden (formally called the Camden Spruce Street site) became operational in 2013. The Elizabeth air toxics site (formally called the Elizabeth Lab site) began measuring VOCs in 2000, and the New Brunswick and Chester sites started in July 2001. Analysis of toxic metals at these sites also began in 2001, with the Newark Firehouse site added in 2010. Data for some of the toxic metals will be discussed below.

New Jersey's VOC monitors are part of the Urban Air Toxics Monitoring Program (UATMP), sponsored by the U.S. Environmental Protection Agency. A 24-hour integrated air sample is collected in a canister every six days, and then sent to the EPA contract laboratory (ERG, located in North Carolina) to be analyzed for VOCs and carbonyls (a subset of VOCs that includes formaldehyde and acetaldehyde).

2013 air toxic monitoring results for VOCs are shown in Table 2. 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 6 through 9, 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 for monitoring results, while $\mu g/m^3$ units are generally used in modeling and health studies. Many of the compounds that were analyzed were below the detection limit of the method used. These are listed separately in Table 10.

Chemicals with reported averages based on data with less than 50% of the samples above the detection limit should be viewed with caution. Median values (the value of the middle sample value when the results are ranked) are reported in Tables 6 through 9 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 concentration significantly, but would have less effect on the median value. In such cases, the median value may be a better indicator of long-term exposures (the basis for the air toxics health benchmarks).

The Chester site had the lowest concentrations for the bulk of the prevalent air toxics. The highest concentrations for many compounds were found in Camden.

USEPA has recently determined that the methods used to collect and analyze **acrolein** in ambient air are not producing reliable results. More information is available at www.epa.gov/schoolair/acrolein.html . Although we are including the 2013 New Jersey acrolein data in this report, the concentrations are highly uncertain and should be viewed with caution.

This report includes results for toxic metals from the particulate speciation monitors in Camden, Chester, Elizabeth, New Brunswick, and Newark. The data is collected every three days. Monitoring data for other speciated particulate can be found in Appendix B (Fine Particulate Speciation Summary) of the annual Air Quality Report (www.njaqinow.net/Default.ltr.aspx). Table 3 presents the annual average concentrations for pollutants which have a health benchmark, along with estimated risk ratios. (For more information see the section on "Estimating Health Risk" below.) Chromium and nickel have health benchmarks that are based on carcinogenicity of specific compounds. Since the monitoring method only measures total chromium or nickel and cannot distinguish between different types of compounds, cancer risk ratios are not calculated with those benchmarks. However, risk ratios are calculated for nickel based on noncancer effects.

Table 2

2013 Summary of Toxic Volatile Organic Compounds Monitored in New Jersey

Annual Average Concentration
micrograms per cubic meter (μg/m^3)

Pollutant	Synonym	HAP	CAS No.	Camden	Chester	Elizabeth	New Brunswick
Acetaldehyde		*	75-07-0	2.776	1.305	2.598	1.651
Acetone			67-64-1	3.278	2.005	2.631	2.337
Acetonitrile		*	75-05-8	0.824	0.674	0.558	16.026
Acetylene			74-86-2	0.781	0.381	0.889	0.587
Acrolein[a]		*	107-02-8	1.122	1.027	1.039	1.124
Acrylonitrile		*	107-13-1	0.060	*0.101*	0.756	1.161
tert-Amyl Methyl Ether			994-05-8	0.002	*0.003*	*0.002*	*0.005*
Benzaldehyde			100-52-7	1.142	0.064	0.124	0.086
Benzene		*	71-43-2	0.852	0.490	0.803	0.650
Bromochloromethane			74-97-5	ND	ND	ND	ND
Bromodichloromethane			75-27-4	0.003	*0.007*	*0.002*	*0.008*
Bromoform		*	75-25-2	0.013	*0.011*	*0.011*	*0.014*
Bromomethane	Methyl bromide	*	74-83-9	0.518	0.053	0.047	0.056
1,3-Butadiene		*	106-99-0	0.097	0.038	0.113	0.070
Butyraldehyde			123-72-8	0.541	0.157	0.379	0.244
Carbon Disulfide		*	75-15-0	2.729	2.515	9.010	17.782
Carbon Tetrachloride		*	56-23-5	0.605	0.612	0.624	0.614
Chlorobenzene		*	108-90-7	0.001	*0.003*	ND	*0.002*
Chloroethane	Ethyl chloride	*	75-00-3	0.037	*0.026*	*0.008*	*0.022*
Chloroform		*	67-66-3	0.132	0.104	0.133	0.131
Chloromethane	Methyl chloride	*	74-87-3	1.362	1.223	1.137	1.154
Chloroprene	2-Chloro-1,3-butadiene	*	126-99-8	ND	ND	ND	ND
Crotonaldehyde			123-73-9	0.412	0.362	0.372	0.331
Dibromochloromethane			124-48-1	0.033	0.032	*0.024*	0.037
1,2-Dibromoethane	Ethylene dibromide	*	106-93-4	0.001	ND	ND	*0.002*
m-Dichlorobenzene	1,3-Dichlorobenzene		541-73-1	0.098	0.066	*0.002*	*0.003*
o-Dichlorobenzene	1,2-Dichlorobenzene		95-50-1	0.005	*0.004*	*0.003*	*0.006*
p-Dichlorobenzene	1,4-Dichlorobenzene	*	106-46-7	0.040	*0.015*	*0.028*	*0.024*
Dichlorodifluoromethane			75-71-8	2.570	2.433	2.518	2.536
1,1-Dichloroethane	Ethylidene dichloride	*	75-34-3	ND	*0.001*	ND	ND
1,2-Dichloroethane	Ethylene dichloride	*	107-06-2	0.089	0.073	0.074	0.086
1,1-Dichloroethylene	Vinylidene chloride	*	75-35-4	0.001	*0.003*	ND	*0.003*
cis-1,2-Dichloroethylene	cis-1,2-Dichloroethene		156-59-2	ND	ND	ND	ND
trans-1,2-Dichloroethylene	trans-1,2-Dichloroethene		156-60-5	0.002	ND	ND	ND
Dichloromethane	Methylene chloride	*	75-09-2	1.167	0.956	0.819	0.691

- *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 2 (continued)

2013 Summary of Toxic Volatile Organic Compounds Monitored in New Jersey

Annual Average Concentration
micrograms per cubic meter (μg/m^3)

Pollutant	Synonym	HAP	CAS No.	Camden	Chester	Elizabeth	New Bruns-wick
1,2-Dichloropropane	Propylene dichloride	*	78-87-5	ND	ND	ND	ND
cis-1,3-Dichloropropene	cis-1,3-Dichloropropylene	*	542-75-6	ND	ND	ND	ND
trans-1,3-Dichloropropene	trans-1,3-Dichloropropylene	*	542-75-6	ND	ND	ND	ND
Dichlorotetrafluoroethane	Freon 114		76-14-2	0.124	0.121	0.121	0.129
2,5-Dimethylbenzaldehyde			5799-94-2	ND	ND	ND	ND
Ethyl Acrylate		*	140-88-5	ND	ND	ND	ND
Ethyl tert-Butyl Ether	tert-Butyl ethyl ether		637-92-3	0.205	0.198	0.277	*0.086*
Ethylbenzene		*	100-41-4	0.304	0.123	0.431	0.250
Formaldehyde		*	50-00-0	4.957	2.130	4.886	2.236
Hexachloro-1,3-butadiene	Hexachlorobutadiene	*	87-68-3	0.021	*0.020*	*0.016*	*0.024*
Hexaldehyde	Hexanaldehyde		66-25-1	0.537	0.065	0.177	0.100
Isovaleraldehyde			590-86-3	ND	ND	ND	ND
Methyl Ethyl Ketone	MEK		78-93-3	0.554	0.317	0.489	0.368
Methyl Isobutyl Ketone	MIBK	*	108-10-1	0.194	0.119	0.189	0.163
Methyl Methacrylate		*	80-62-6	0.036	*0.002*	*0.049*	*0.007*
Methyl tert-Butyl Ether	MTBE	*	1634-04-4	0.743	3.148	0.155	*0.084*
n-Octane			111-65-9	0.272	0.217	0.328	0.160
Propionaldehyde		*	123-38-6	0.598	0.223	0.490	0.293
Propylene			115-07-1	1.054	0.430	2.489	0.599
Styrene		*	100-42-5	1.296	0.062	0.121	0.129
1,1,2,2-Tetrachloroethane		*	79-34-5	0.009	*0.011*	*0.106*	*0.150*
Tetrachloroethylene	Perchloroethylene	*	127-18-4	0.132	0.060	0.127	0.086
Tolualdehydes				0.363	0.066	0.131	0.051
Toluene		*	108-88-3	4.126	1.534	2.478	1.782
1,2,4-Trichlorobenzene		*	102-82-1	0.002	ND	ND	*0.004*
1,1,1-Trichloroethane	Methyl chloroform	*	71-55-6	0.047	0.035	0.046	0.045
1,1,2-Trichloroethane		*	79-00-5	ND	ND	ND	ND
Trichloroethylene		*	79-01-6	0.048	*0.005*	*0.024*	*0.015*
Trichlorofluoromethane			75-69-4	2.002	1.377	1.450	1.458
Trichlorotrifluoroethane	1,1,2-Trichloro-1,2,2-trifluoroethane		76-13-1	0.642	0.644	0.637	0.646
1,2,4-Trimethylbenzene			95-63-6	0.461	0.125	0.400	0.170
1,3,5-Trimethylbenzene			108-67-8	0.174	0.098	0.141	0.076
Valeraldehyde			110-62-3	0.329	0.050	0.158	0.086
Vinyl chloride		*	75-01-4	0.010	*0.001*	ND	*0.001*
m,p-Xylene		*	1330-20-7	0.739	0.256	1.065	0.558
o-Xylene		*	95-47-6	0.338	0.115	0.457	0.269

- *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.

Table 3
2013 New Jersey Toxic Metals Summary & Risk Ratios

Pollutant	HAP[a]	Annual average concentration (µg/m³)[b]					Health Bench-mark (µg/m³)[c]	Risk Ratio[d]				
		Camden	Chester	Elizabeth	New Bruns-wick	Newark		Camden	Chester	Elizabeth	New Bruns-wick	Newark
Antimony	*	0.0179	0.0219	0.0199	0.0186	0.0190	0.2	0.1	0.1	0.1	0.1	0.1
Arsenic	*	*0.0009*	*0.0005*	*0.0005*	*0.0005*	*0.0004*	*2.30E-04*	4	2	2	2	2
Cadmium	*	*0.0019*	*0.0022*	*0.0015*	*0.0016*	*0.0018*	*2.40E-04*	8	9	6	7	7
Chlorine	*	0.1836	0.0070	0.0236	0.0148	0.0171	0.2	0.9	0.04	0.1	0.1	0.1
Chromium[e]	*	0.0040	0.0070	0.0077	0.0124	0.0062	*8.30E-05*	See "e" below				
Cobalt	*	0.0010	0.0007	0.0008	0.0007	0.0008	*1.10E-04*	9	6	7	7	7
Lead	*	0.0088	*0.0010*	*0.0010*	*0.0012*	0.0013	0.15	0.06	0.01	0.01	0.01	0.01
Manganese	*	0.0036	*0.0007*	0.0016	0.0016	0.0011	0.05	0.07	0.01	0.03	0.03	0.02
Nickel	*	0.0028	0.0009	0.0024	0.0026	0.0018	0.05	0.06	0.02	0.05	0.05	0.04
Nickel[f]	*	0.0028	0.0009	0.0024	0.0026	0.0018	*2.10E-03*	See "f" below				
Phosphorus	*	0.0055	0.0055	0.0057	0.0056	0.0059	0.07	0.1	0.1	0.1	0.1	0.1
Selenium	*	0.0011	0.0011	0.0011	0.0011	0.0010	20	0.0001	0.0001	0.0001	0.0001	0.0001
Silicon		0.0631	0.0370	0.0667	0.0399	0.0603	3	0.02	0.01	0.02	0.01	0.02
Vanadium		0.0023	0.0016	0.0020	0.0016	0.0020	0.1	0.02	0.02	0.02	0.02	0.02

[a] HAP = Hazardous air pollutant listed in the Clean Air Act.

[b] Annual average concentrations in italics are based on less than 50% of the samples above the detection limit.

[c] The health benchmark is defined as the chemical-specific air concentration above which there may be human health concerns. Toxicity values are not available for all chemicals. For more information, go to www.nj.gov/dep/aqpp/risk.html.
Health benchmarks in italics have a cancer endpoint.
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.

[d] The risk ratio for a chemical is a comparison of the annual mean air concentration to the health benchmark. A risk ratio greater than one may be of concern. If the annual mean is 0, then the risk ratio cannot be calculated.

[e] Chromium - The health benchmark is based on carcinogenicity of hexavalent chromium (Cr^{+6}). It is not known how much of the chromium measured by the monitor is hexavalent.

[f] Nickel - The cancer-based health benchmark for nickel is based on specific nickel compounds. It is not known how much of the nickel measured by the monitor is in that form.

More information on speciated fine particulate matter measured in New Jersey can be found in the NJDEP's 2013 Air Quality Report, Appendix B - Fine Particulate Speciation Summary, at www.njaqinow.net/Default.ltr.aspx.

ESTIMATING HEALTH RISK

A simplified way to determine whether the ambient concentration of an air toxic could pose a potential human health risk is to compare the air concentration to a health benchmark. The number that we get when we divide the concentration by the benchmark is called 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 4. In addition to the toxic VOCs and carbonyls, speciated metals were also evaluated for risk. Elizabeth had fourteen pollutants with annual average concentrations that exceeded their health benchmarks, New Brunswick had thirteen, and Camden and Chester had twelve. The toxic VOCs with risk ratios greater than one at all sites are acetaldehyde, acrylonitrile, benzene, 1,3-butadiene, carbon tetrachloride, chloroform, chloromethane (methyl chloride), 1,2-dichloroethane, and formaldehyde. Toxic metals that had risk ratios greater than one at the five monitoring sites were arsenic, cadmium, and cobalt.

Although the mean concentrations of acrolein exceeded the health benchmark at all sites (see Tables 6 through 9), they are not included here because of problems with the sampling method. Formaldehyde contributed the highest risks, but note that the risks varied substantially from site to site. Ethylbenzene was over the level of concern only at Elizabeth, but just barely. Risk ratios for 1,1,2,2-tetrachloroethane were of concern only at Elizabeth and New Brunswick, but these are based on detection levels of less than 50%. Details for each site, including health benchmarks used to calculate risk ratios, can be found in Tables 6 through 9.

Table 4 can be compared with the risk results predicted by NATA in Table 5. Chromium and nickel cancer risk cannot be estimated from monitoring data because the sampling method measures total chromium and total nickel concentrations; the amounts that are in the carcinogenic form cannot be determined. 1,3-Dichlopropene and 1,1,2-trichloroethane samples were mostly below the detection limits, so no annual average concentration could be calculated. Ethylene oxide and naphthalene are not sampled at the New Jersey sites. PAH/POM are polycyclic aromatic hydrocarbons/polycyclic organic matter, a broad class of compounds that are not measured in New Jersey because of a lack of a practical sampling method. On the other hand, acrylonitrile is measured in New Jersey at levels higher than estimated by NATA.

NATA estimates show concentrations of diesel particulate matter (DPM) in New Jersey that are at levels that potentially pose a higher cancer risk than the other air toxics combined. However, actually measuring diesel in the ambient air is problematic. It is difficult to distinguish particulate matter emitted by diesel engines from other types of particulate matter. Diesel emissions consist of agglomerated and condensed fine particles and gases, onto which are adsorbed potentially hundreds of compounds formed by incomplete combustion, such as polycyclic aromatic hydrocarbons (PAHs) and nitrated PAHs. Some of these very specific compounds have been suggested as indicators for DPM, but sampling technologies and costs continue to be obstacles. Elemental carbon is sometimes assumed to be an indicator for diesel emissions. See Figure 3 for a comparison of DPM concentrations from NATA with monitored concentrations of elemental carbon. For more information about diesel, see www.nj.gov/dep/airtoxics/diesemis.htm.

Table 4
Monitored Toxic Air Pollutants with Risk Ratios Greater Than One in NJ for 2013

	POLLUTANT	Risk Ratio: Camden	Chester	Elizabeth	New Brunswick	Newark
1	Acetaldehyde	6	3	6	4	
2	Acrylonitrile	*4*	*7*	50	77	
3	Arsenic	4	2	2	2	2
4	Benzene	7	4	6	5	
5	1,3-Butadiene	3	1.2	3	2	
6	Cadmium	8	9	6	7	7
7	Carbon Tetrachloride	9	9	9	9	
8	Chloroform	3	2	3	3	
9	Chloromethane	2	2	2	2	
10	Cobalt	9	6	7	7	7
11	1,2-Dichloroethane	2	2	2	2	
12	Ethylbenzene	0.8	0.3	1.1	0.6	
13	Formaldehyde	64	28	63	29	
14	1,1,2,2-Tetrachloroethane	*0.5*	*0.6*	*6*	*9*	

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

Figure 3. Comparison of Elemental Carbon Monitoring Data
with NATA 2005 Predicted Concentrations for Diesel PM

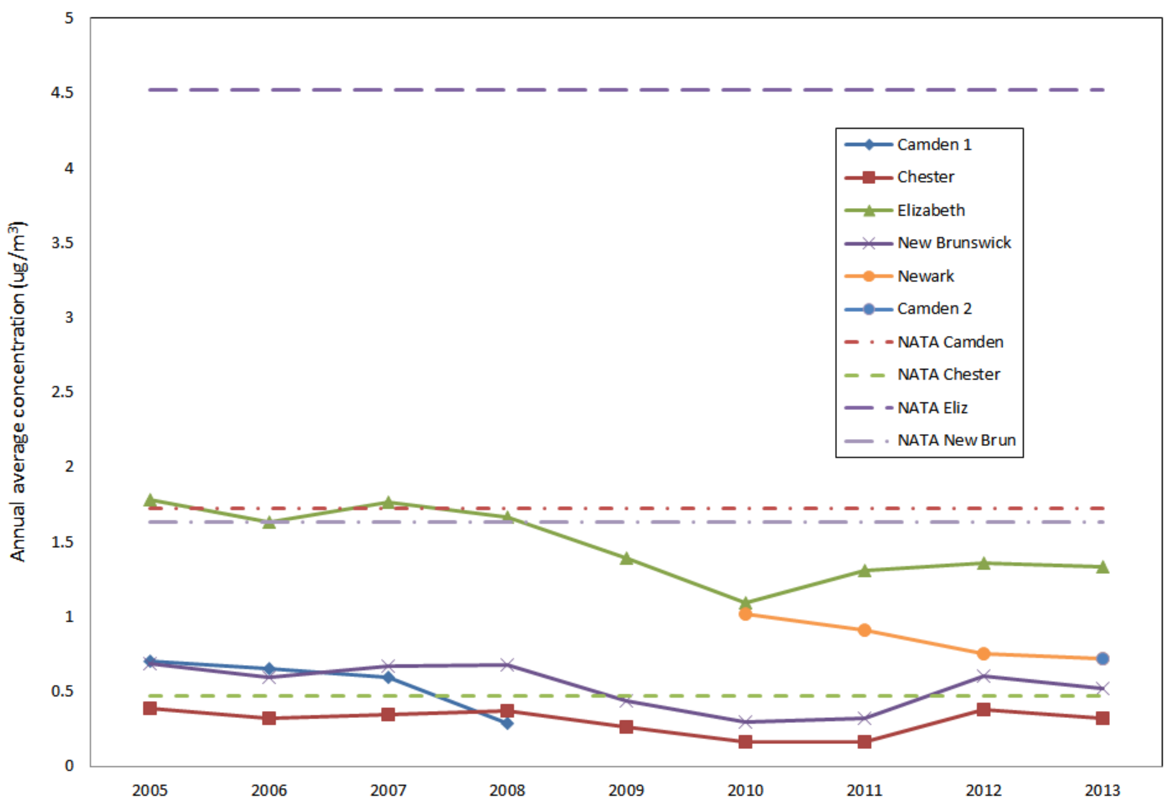


Table 5
2005 NATA Modeled Air Concentrations Compared to Health Benchmarks
New Jersey Statewide Averages

Pollutant	Modeled Air Concentration (μg/m^3)	Health Benchmark (μg/m^3)	Risk Ratio	% Contribution from Major Sources	Area Sources	On-Road Mobile Sources	Nonroad Mobile Sources	Background & Secondary Formation
Acetaldehyde	1.9	0.45	**4.3**	<1%	4%	6%	3%	87%*
Acrolein	0.062	*0.020*	**3.1**	<1%	22%	14%	9%	55%*
Arsenic compounds	0.00053	0.00023	**2.3**	3%	13%	5%	5%	74%
Benzene	1.3	0.13	**10**	<1%	13%	30%	13%	44%
1,3-Butadiene	0.095	0.033	**2.9**	<1%	<1%	40%	17%	43%
Cadmium compounds	0.00011	0.00024	0.5	12%	44%	0%	1%	43%
Carbon tetrachloride	0.61	0.17	**3.6**	0%	<1%	0%	0%	100%
Chloroform	0.13	0.043	**3.1**	<1%	54%	0%	0%	46%
Chromium (hexavalent form)	0.00024	0.000083	**2.9**	29%	10%	4%	1%	56%
Cobalt Compounds	0.000093	0.00011	0.8	93%	7%	0%	0%	0%
1,4-Dichlorobenzene	0.12	0.091	**1.3**	<1%	58%	0%	0%	42%
1,3-Dichloropropene	0.14	0.25	0.5	0%	100%	0%	0%	0%
Diesel particulate matter	1.1	0.0033	**327**	0%	0%	47%	53%	0%
Ethylbenzene	0.34	0.40	0.9	1%	30%	45%	24%	0%
Ethylene oxide	0.011	0.011	**1.0**	12%	18%	0%	0%	70%
Formaldehyde	2.2	0.077	**28**	<1%	3%	9%	6%	82%*
Methyl chloride	1.2	0.56	**2.2**	<1%	1%	0%	0%	99%
Naphthalene	0.13	0.029	**4.6**	1%	48%	26%	4%	21%
Nickel Compounds	0.0012	0.0021	0.6	36%	37%	2%	10%	15%
PAH/POM**	0.012	0.0072*	**1.6**	1%	79%	8%	12%	0%
Tetrachloroethylene	0.25	0.17	**1.4**	<1%	61%	0%	0%	39%
1,1,2-Trichloroethane	0.0066	0.063	0.1	<1%	100%	0%	0%	0%

- For information on risk ratios see section on "Estimating Health Risk" above.
- Chemicals with risk ratios greater than or equal to 1 are in bold.
- Risk ratios based on noncarcinogenic effects are in *italics*.
- For diesel particulate matter, onroad and nonroad concentrations include a model-estimated background concentration.
- *Acetaldehyde, acrolein and formaldehyde concentration estimates include secondary formation, which is the process by which chemicals in the air are transformed into other chemicals.
- **PAH/POM is "polycyclic aromatic hydrocarbons/polycyclic organic matter." These define a broad class of compounds. The chemicals making up this class were broken up into 8 groups based on toxicity, and each group was assigned a cancer-weighted toxicity estimate. 0.0072 μg/m^3 is the health benchmark average across the 8 groups.

Trends and Comparisons

Monitoring of air toxics in New Jersey has been going on for over a decade, although it continues to evolve, with improvements in the ability to detect given chemicals at lower concentrations. Figures 4 through 13 show 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 4 through 13 as “Camden 1.” The new Camden site, located about two miles from the old site, is designated “Camden 2.”

According to USEPA’s National Air Toxics Assessment (NATA), **acetaldehyde** concentrations in New Jersey (Figure 4) are primarily influenced by secondary formation, a process in which chemicals in the air are transformed into other chemicals by chemical reactions. 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 in both Camden and New Brunswick, high levels of acetaldehyde were measured over a number of weeks. Note the similarity with the formaldehyde graph (Figure 12).

Acrylonitrile concentrations (Figure 5) are impacted by nonpoint sources and background. In 2013, Elizabeth and New Brunswick samples were consistently higher than Camden and Chester (which were mostly below the detection limit). The high concentration in 2008 in Elizabeth is the result of a number of high sample values that year. Data for New Brunswick for 2012 were invalidated because of problems with the sampler.

Figure 6 shows a decrease in **benzene** concentrations over the past decade. Most benzene now comes from mobile and area sources, and is also transported from other regions (background). Sources of **1,3-butadiene** (Figure 7) are similar to those of benzene.

Some of the increase in **chloroform** concentrations shown in Figure 8 is believed to be from improvements in the detection limit. Nonpoint sources and background are the major contributors to ambient chloroform levels.

Chloromethane (also known as methyl chloride) levels are influenced primarily by background. Figure 9 shows that concentrations have remained relatively stable from year to year, and that all sites show similar levels.

1,4-Dichlorobenzene (Figure 10) is emitted primarily from nonpoint sources. It is used in products such as pesticides, disinfectant, mothballs and toilet deodorizer blocks. There is also a significant background level. The high annual average for New Brunswick in 2005 is attributable to an exceptionally high reading on July 27th that may be a lab error.

Ethylbenzene is associated with mobile sources, which is probably why it is higher at the Elizabeth monitoring site and lower at Chester (Figure 11). 2001 data for Chester and New Brunswick have been omitted from the graph because of problems encountered when sampling was begun that May.

Formaldehyde (Figure 12) 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 on-road mobile sources, although secondary formation and transport contribute significantly to high outdoor concentrations. As with acetaldehyde, a number of very high samples were measured at Camden and New Brunswick, in 2004.

Tetrachloroethylene (also known as perchloroethylene) (Figure 13) is used as an industrial solvent and in dry cleaning. It is a common contaminant of hazardous waste sites because of a tendency in the 20th century to dispose of it improperly. Production and demand for it by industry has been declining.

Figure 4
ACETALDEHYDE – New Jersey Monitored Concentrations

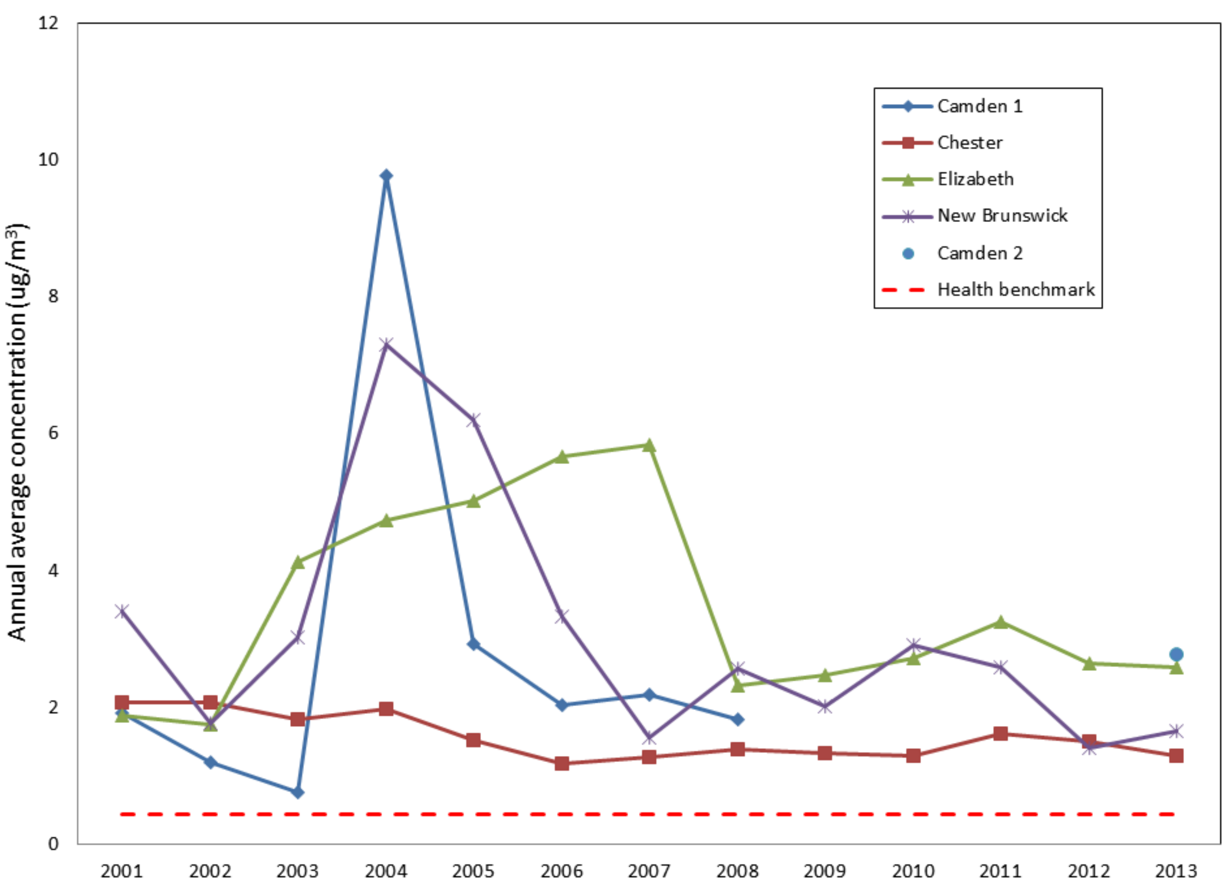


Figure 5
ACRYLONITRILE – New Jersey Monitored Concentrations

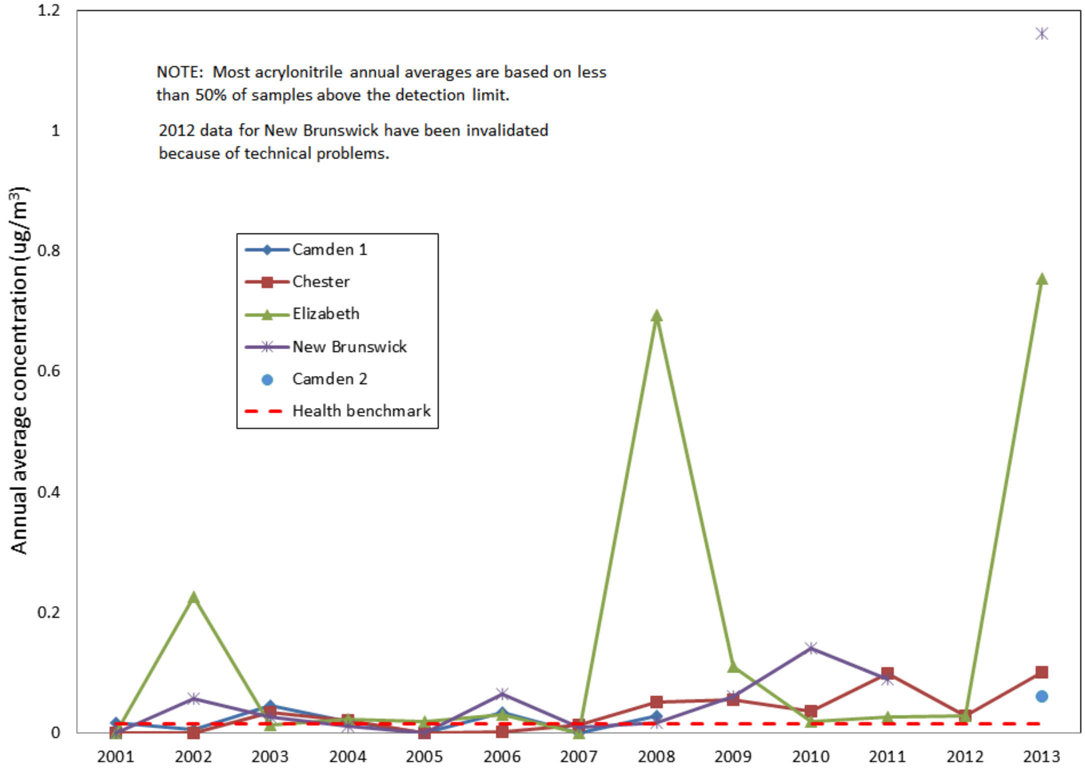


Figure 6
BENZENE – New Jersey Monitored Concentrations

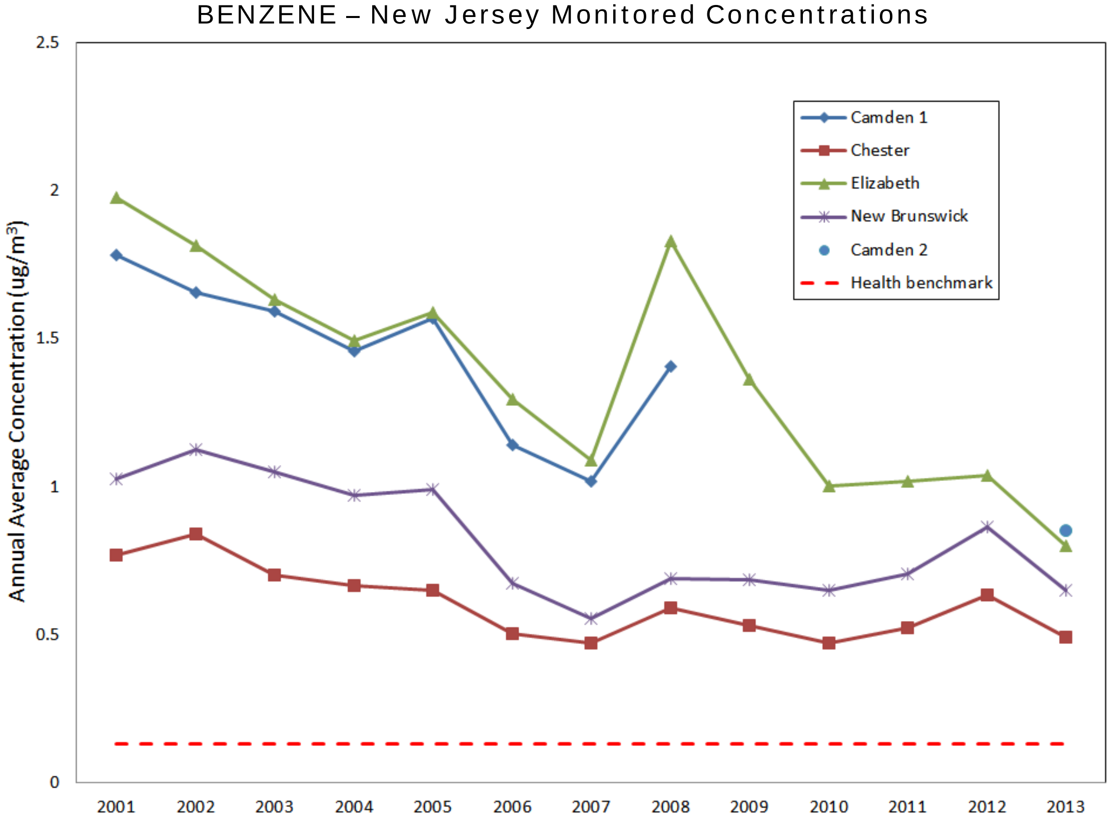


Figure 7

1,3-BUTADIENE – New Jersey Monitored Concentrations

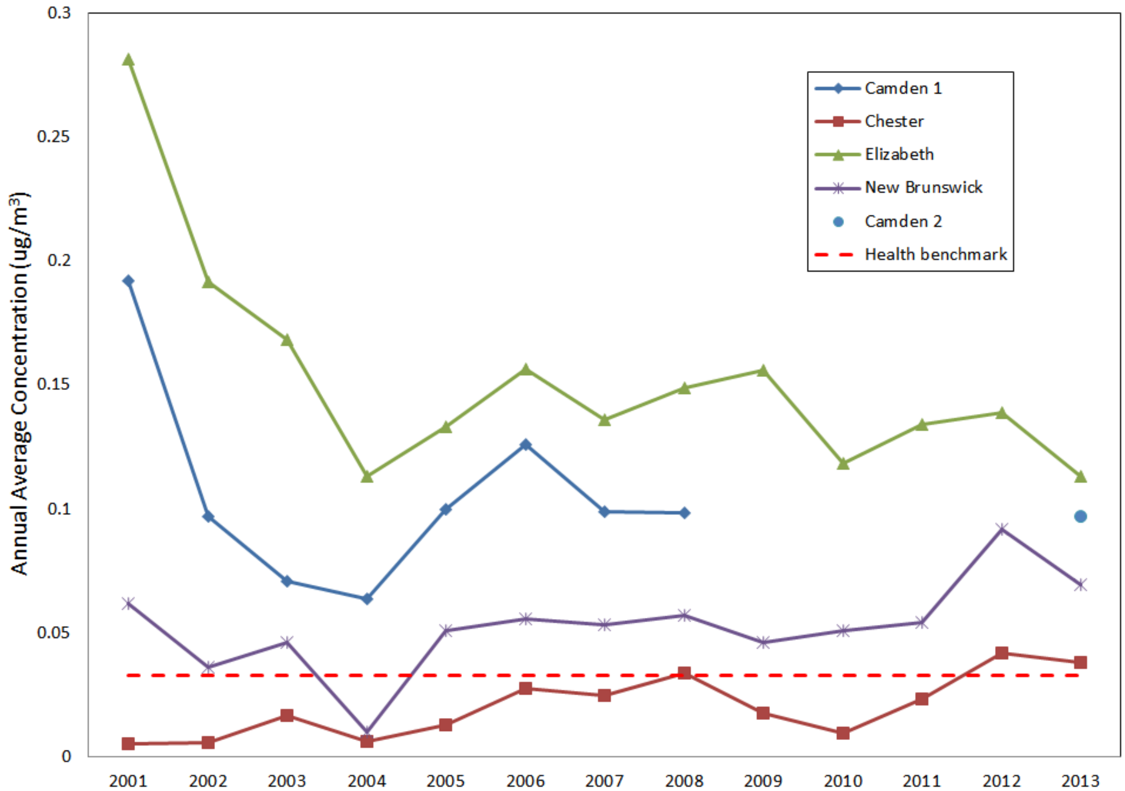


Figure 8

CHLOROFORM – New Jersey Monitored Concentrations

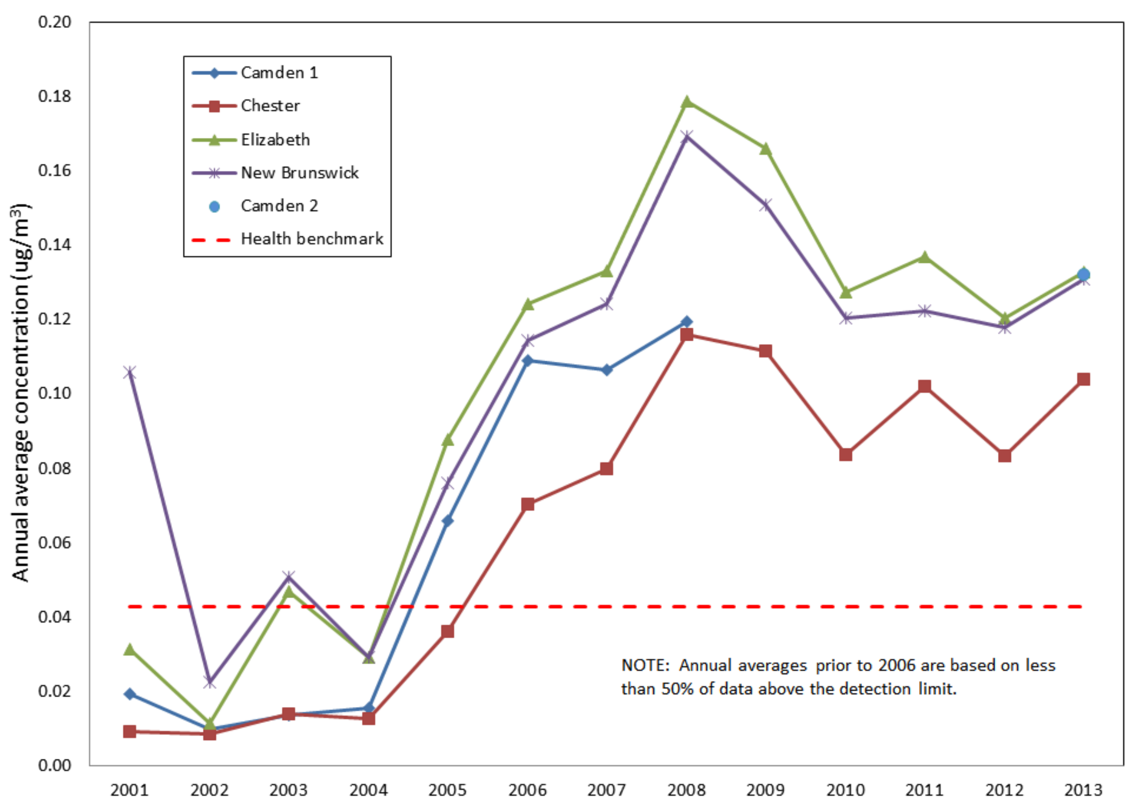


Figure 9

CHLOROMETHANE (Methyl chloride) – New Jersey Monitored Concentrations

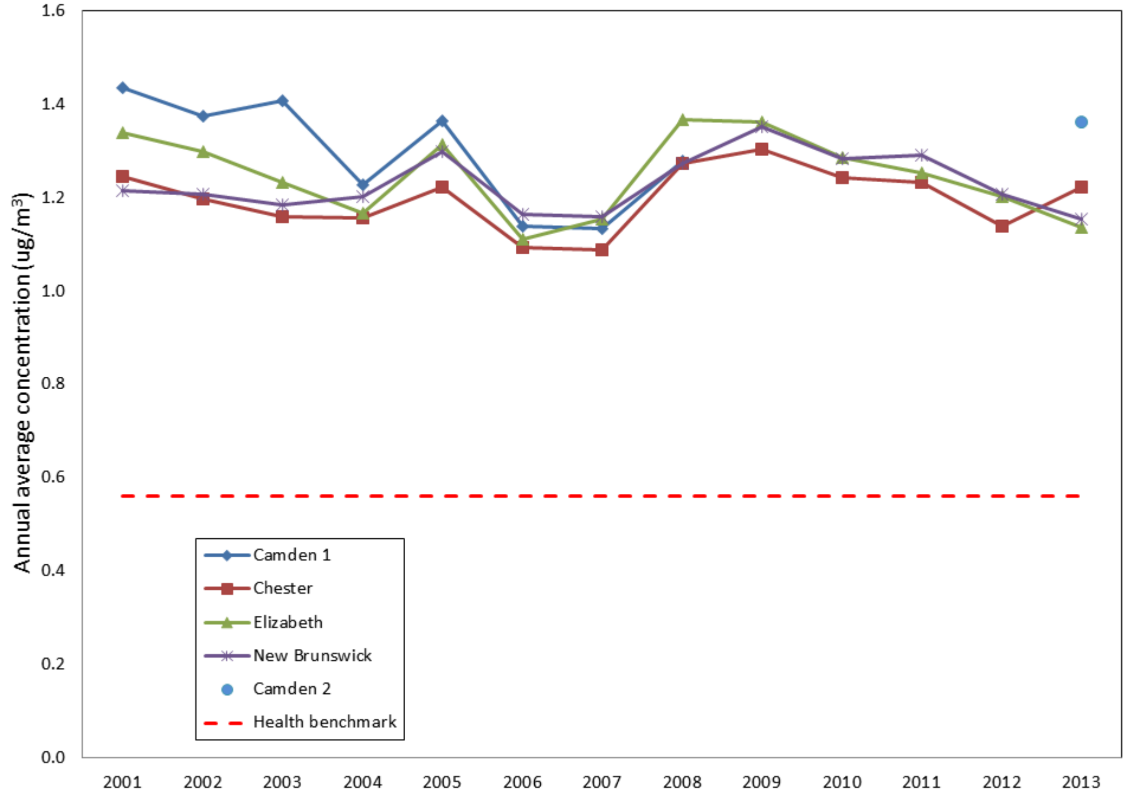


Figure 10

1,4-DICHLOROBENZENE – New Jersey Monitored Concentrations

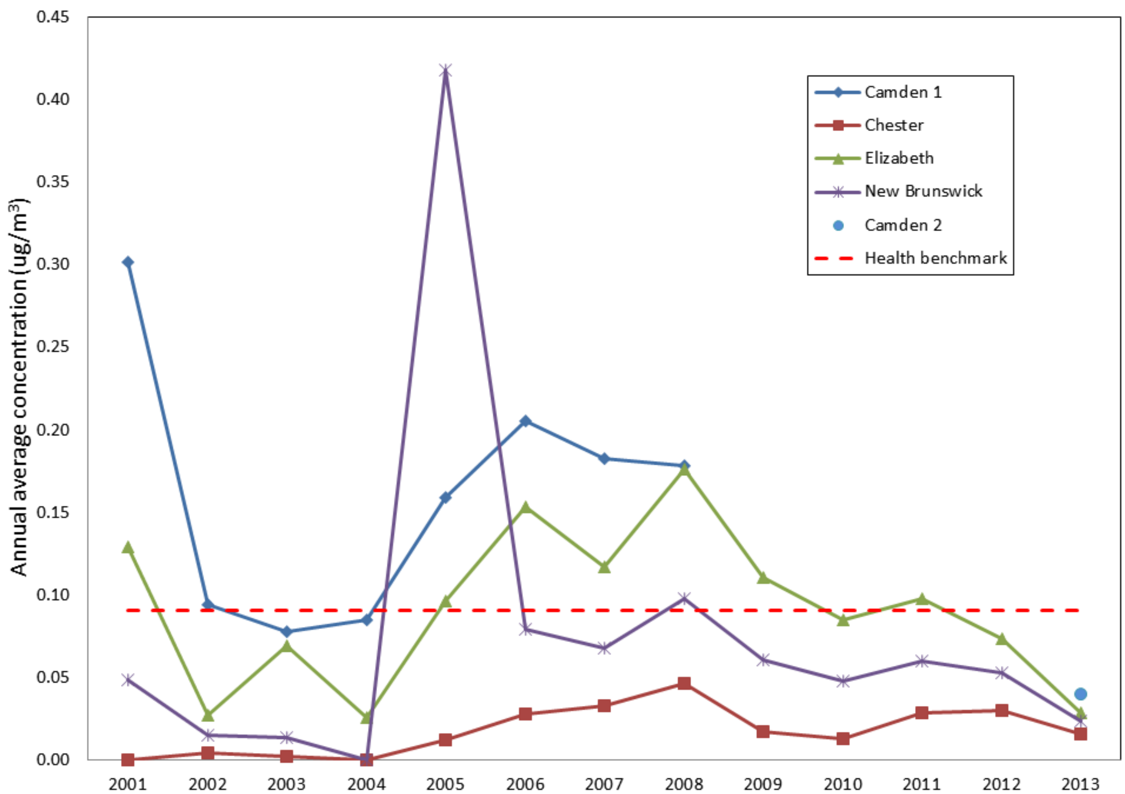


Figure 11
ETHYLBENZENE – New Jersey Monitored Concentrations

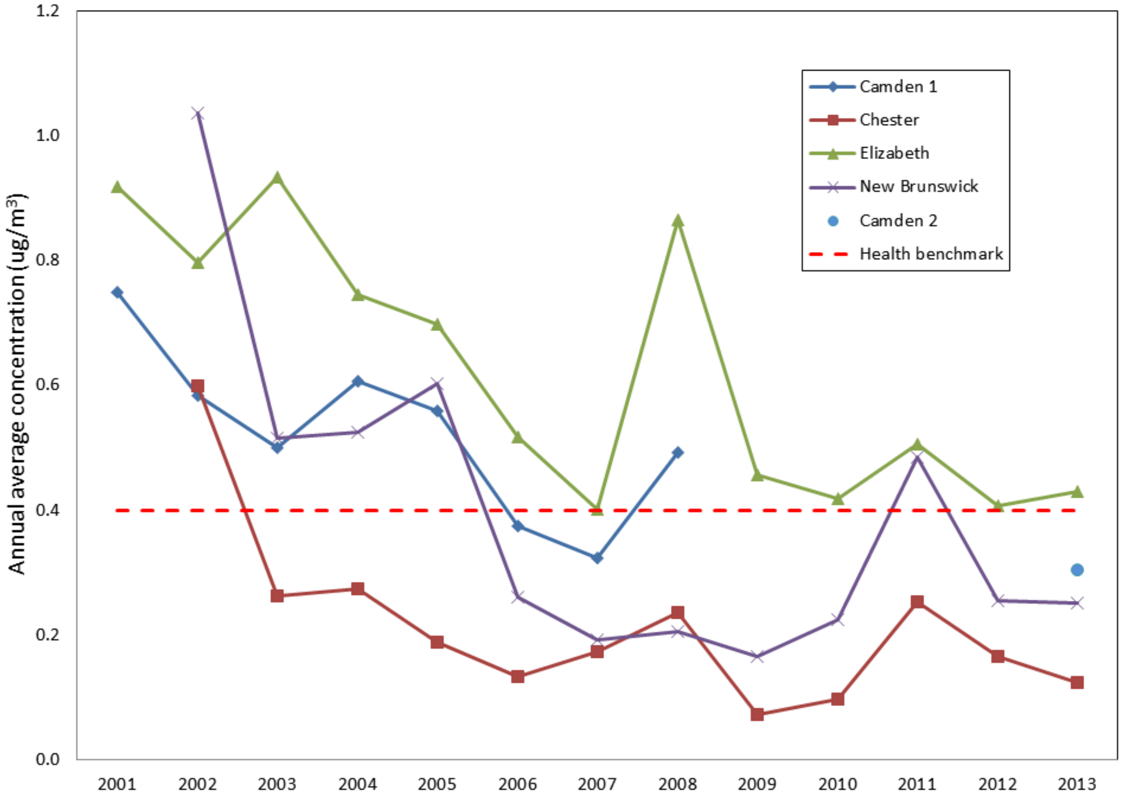


Figure 12
FORMALDEHYDE – New Jersey Monitored Concentrations

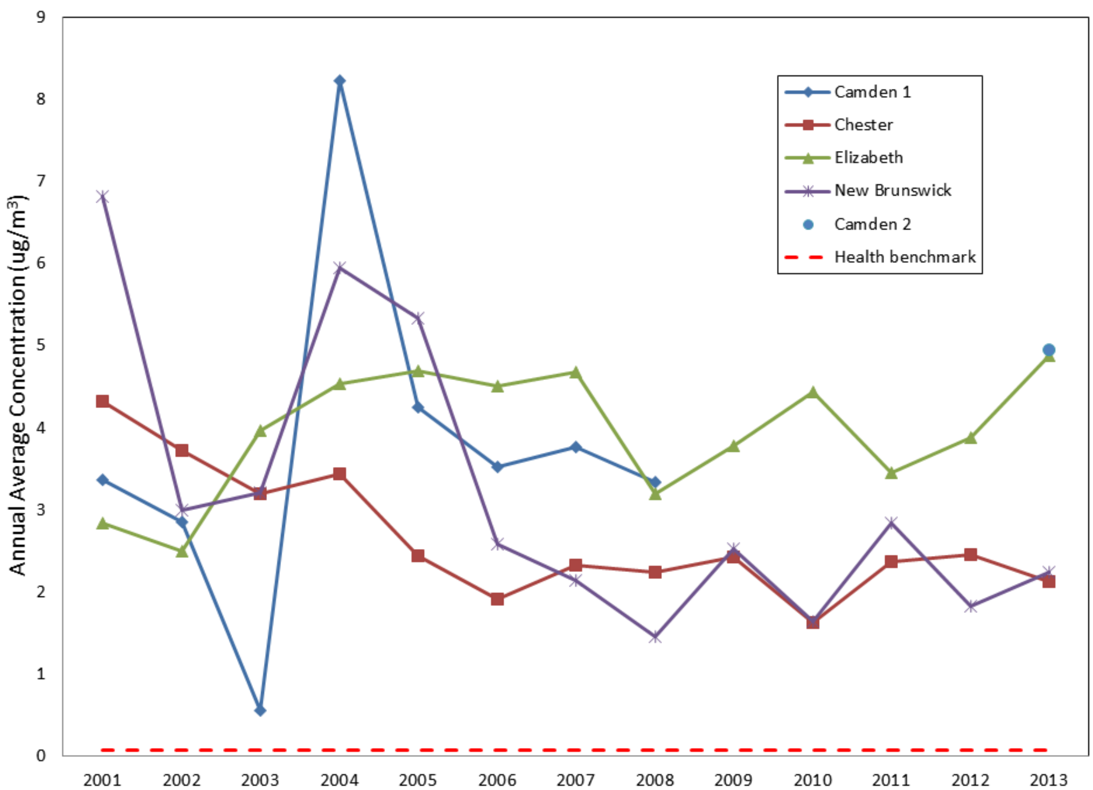
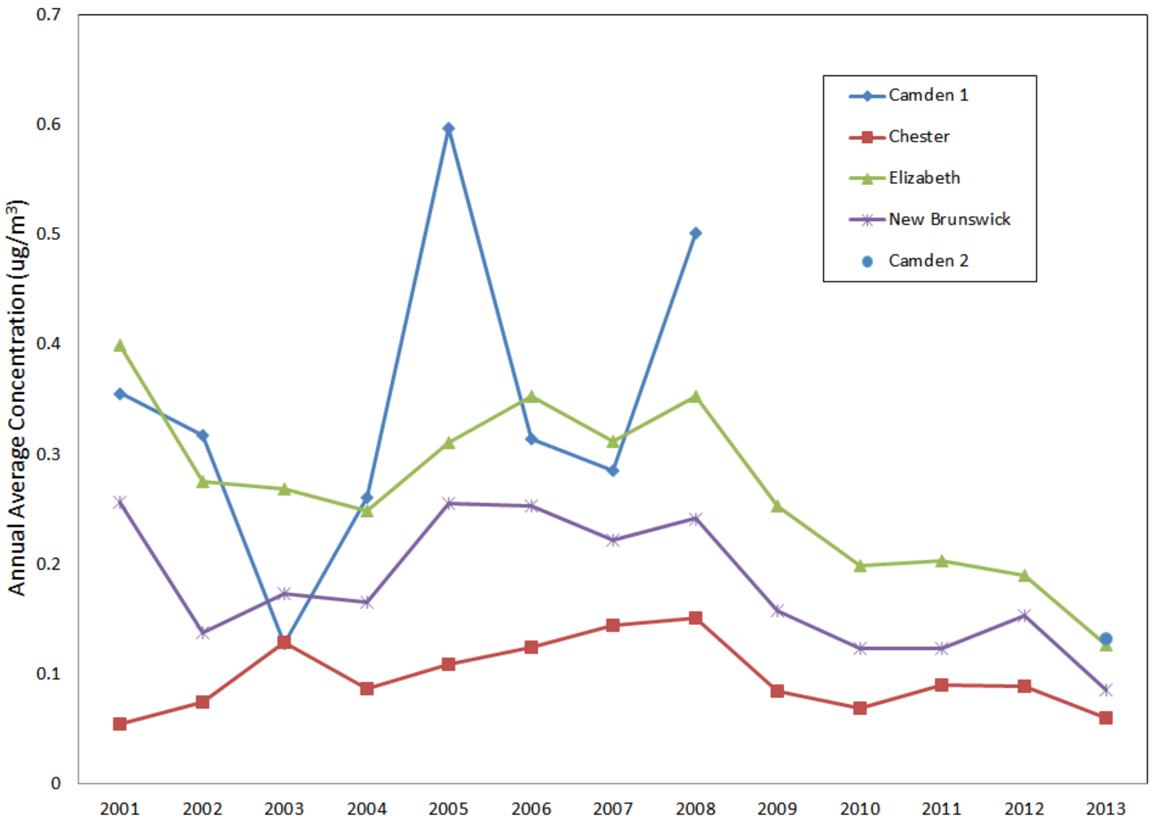


Figure 13

TETRACHLOROETHYLENE – New Jersey Monitored Concentrations



Toxic metals data are presented in Figures 14 through 18, taken from the $PM_{2.5}$ speciation monitors around the state. The Newark site became operational in 2010, and a new Camden site was established in 2013.

Chromium and nickel are shown here because NATA 2005 indicated that there are levels of their carcinogenic forms in the air above the one-in-a-million cancer risk level. The data in Figures 16 and 18 are for total chromium and nickel. The specific carcinogenic compounds cannot be measured with available monitoring methods.

Arsenic, cadmium, and cobalt concentrations are all influenced by combustion, industrial processes, and transport.

Note that in a few of the graphs some of the years are marked with an asterisk, indicating that less than 50% of the samples used to calculate the annual average were above the detection limit. Values below the detection limit are considered to be zero.

Figure 14
ARSENIC – New Jersey Monitored Concentrations

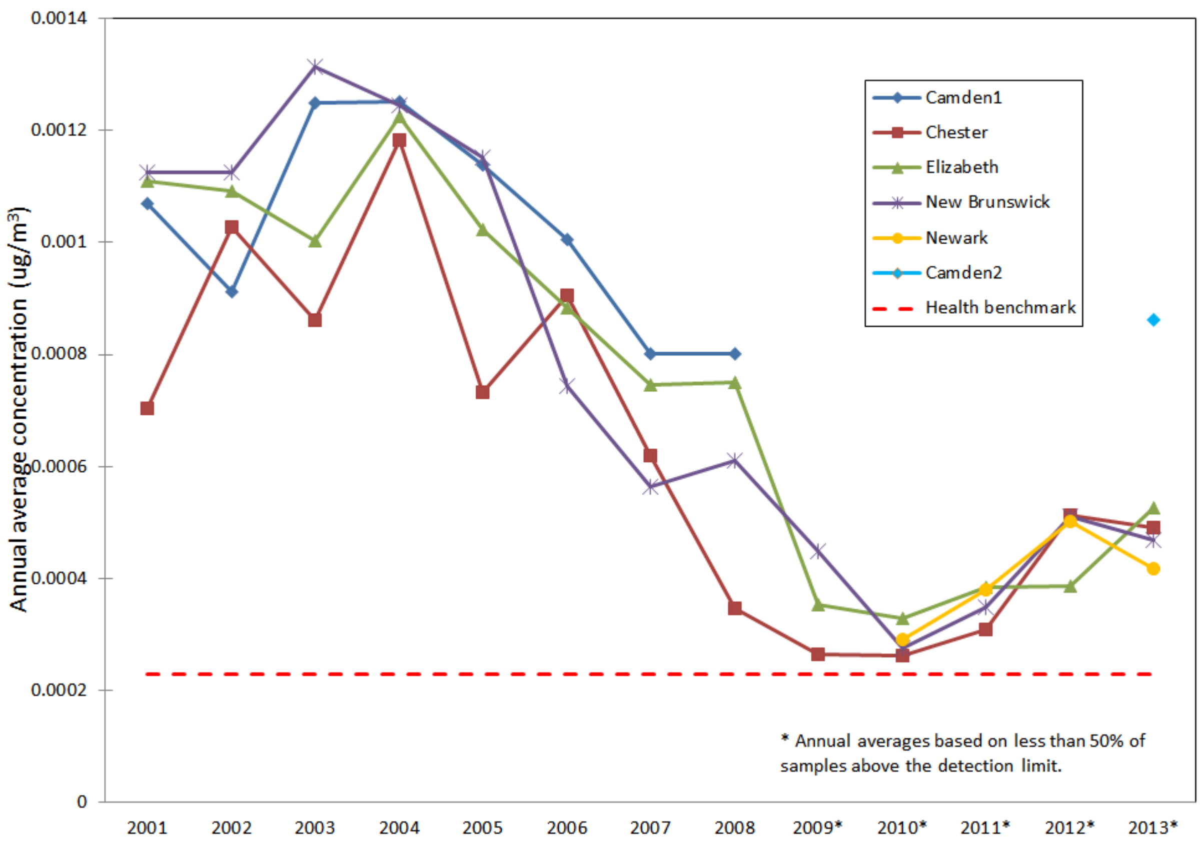


Figure 15
CADMIUM – New Jersey Monitored Concentrations

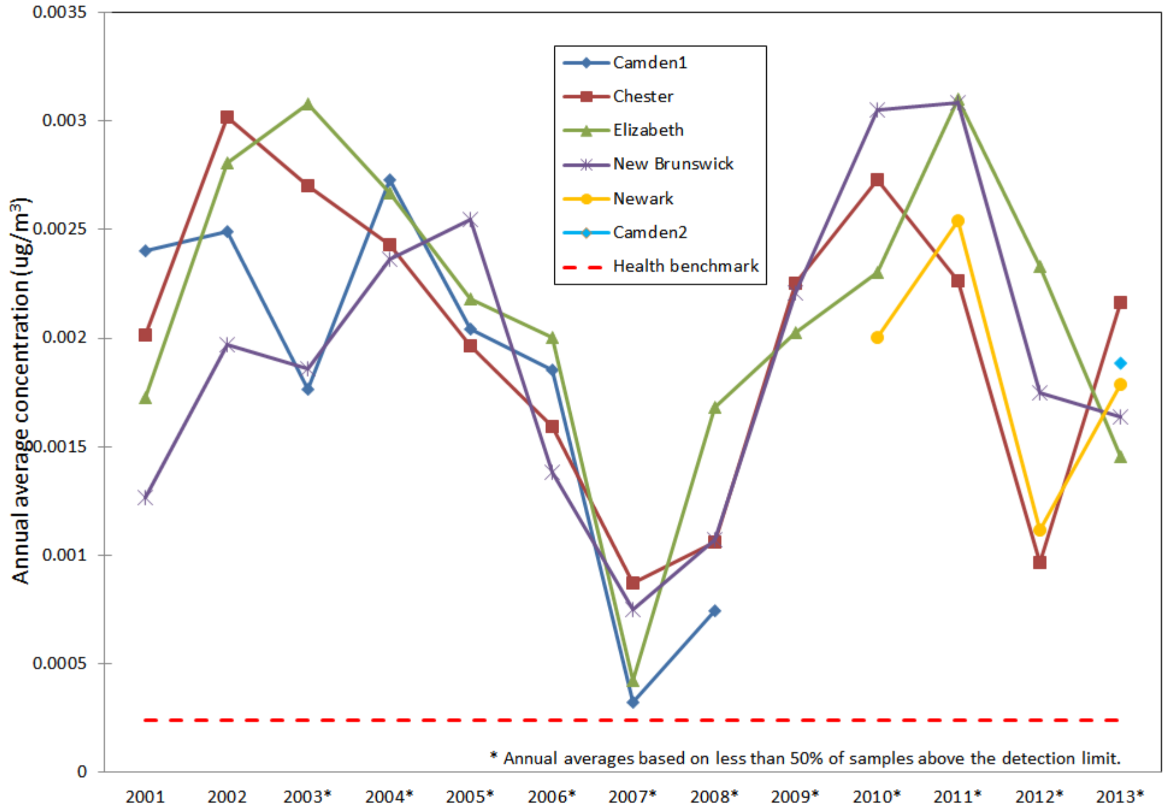


Figure 16
CHROMIUM – New Jersey Monitored Concentrations

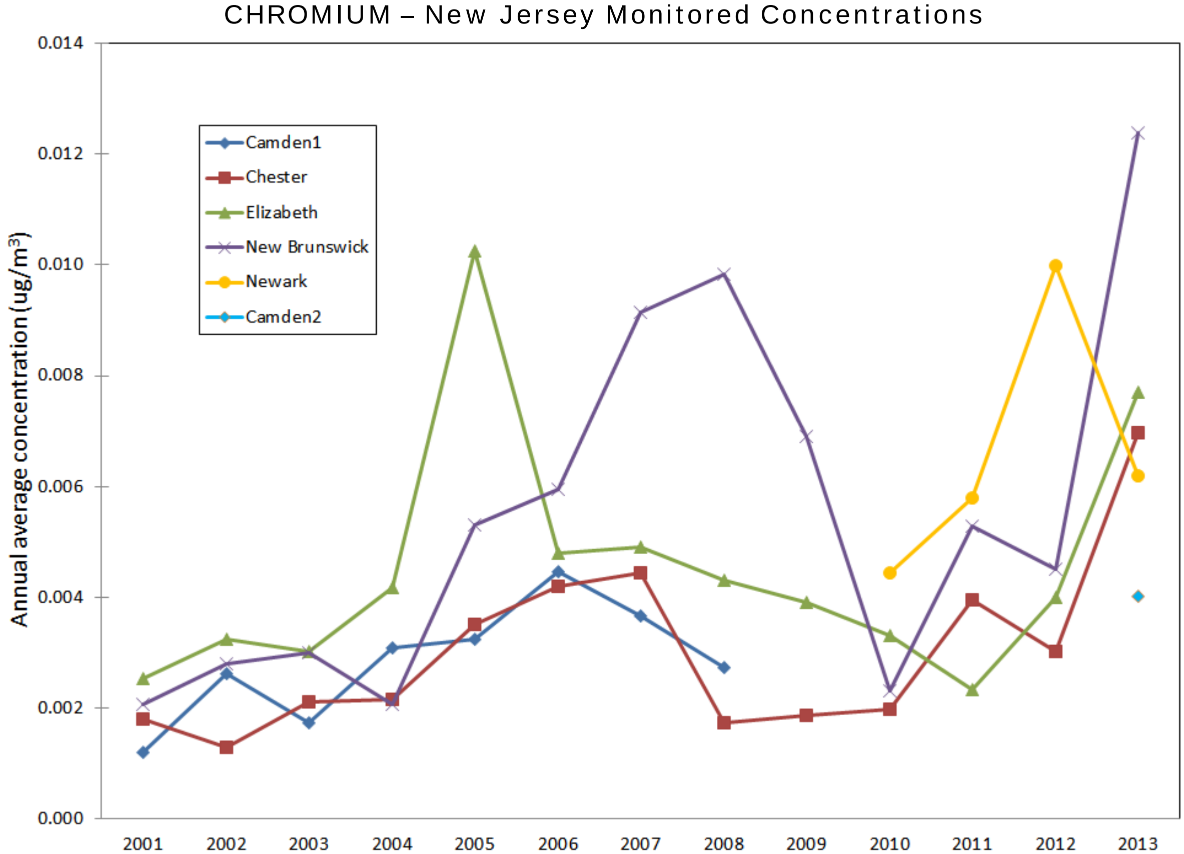


Figure 17
COBALT – New Jersey Monitored Concentrations

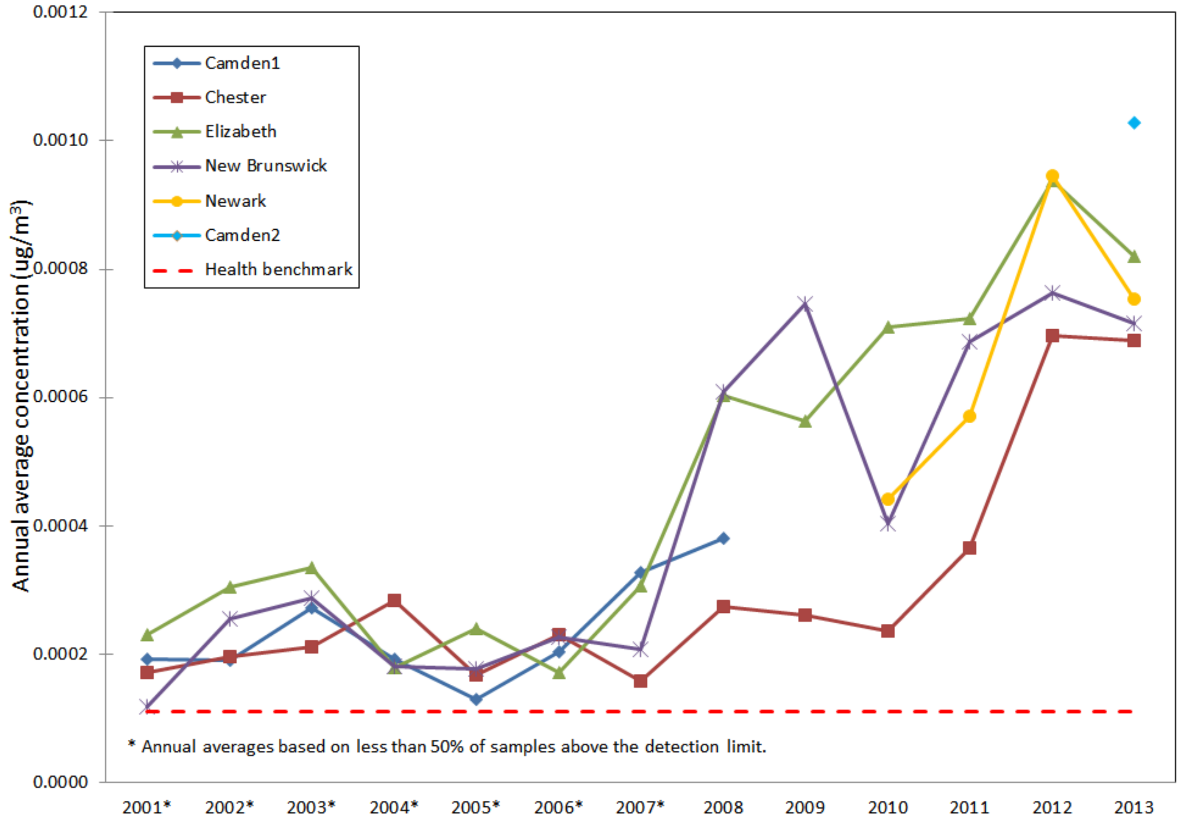


Figure 18
NICKEL – New Jersey Monitored Concentrations

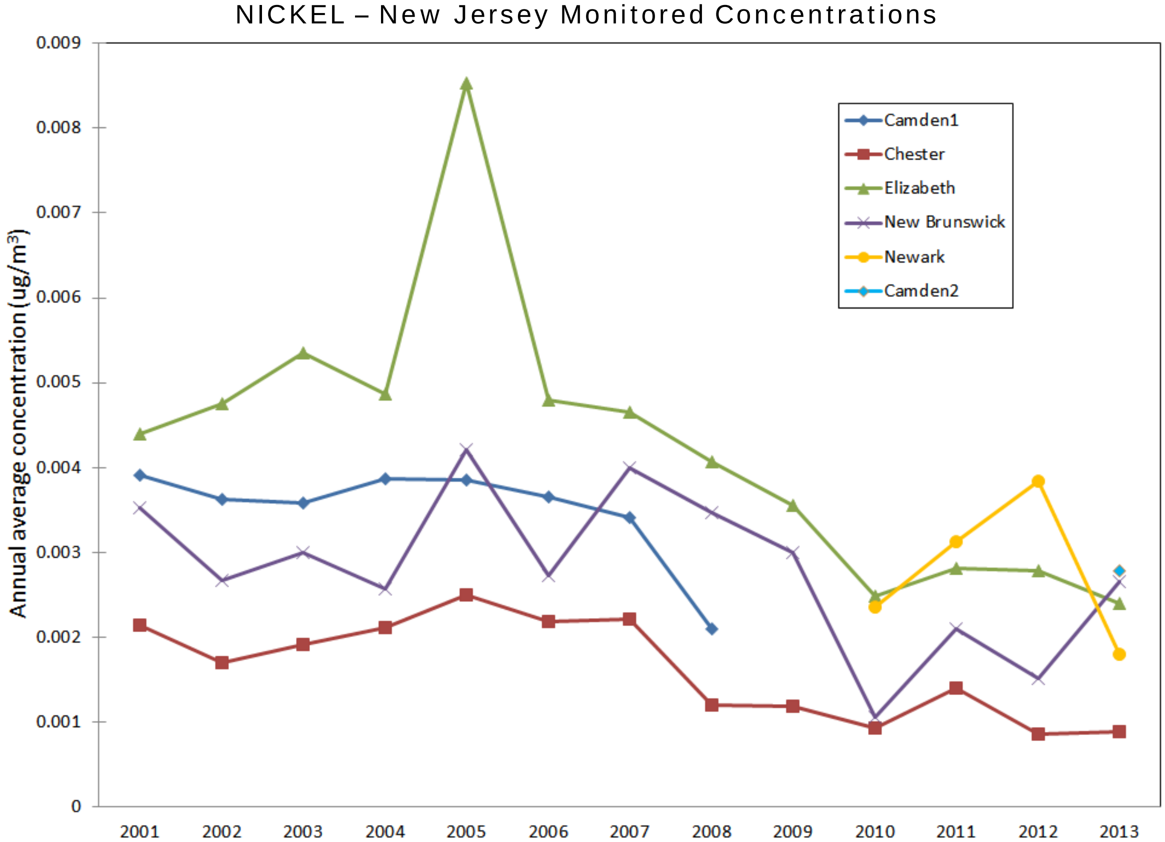
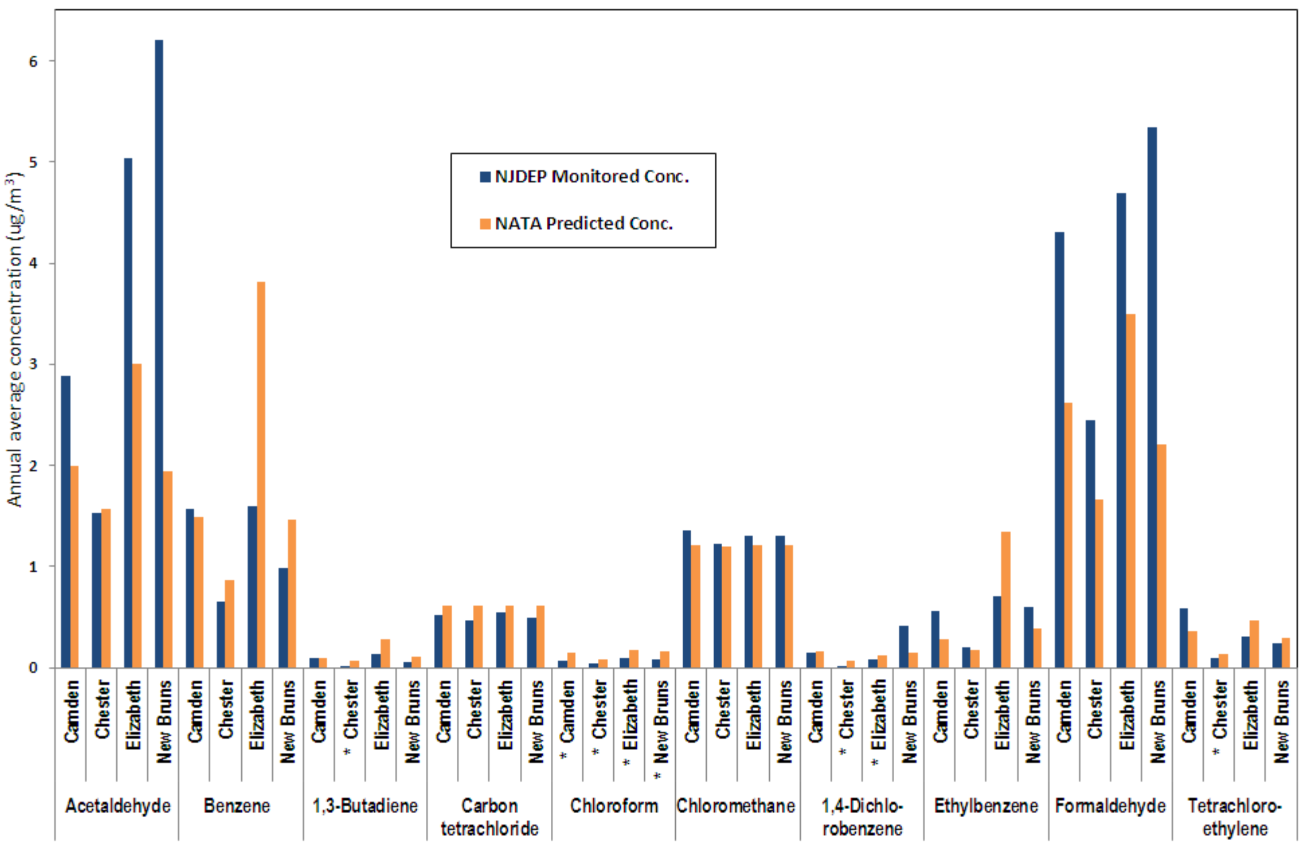


Figure 19 below shows a comparison of annual average concentrations measured at New Jersey's four air toxics monitoring sites in 2005 with annual average concentrations predicted by USEPA's 2005 NATA (at the monitoring site census tract). Most of the pollutants show agreement within a factor of 2 or less, although acetaldehyde and formaldehyde appear to be underestimated by NATA.

Figure 19
2005 New Jersey Monitored Concentrations Compared
to 2005 NATA Predicted Concentrations



* Monitoring data average is based on less than 50% of samples above the detection limit.

Table 6

CAMDEN NJ 2013 Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[d]	24-Hour Max. (ppbv)	Annual Mean ($\mu g/m^3$)[c,d]	Annual Median ($\mu g/m^3$)[d]	24-Hour Max. ($\mu g/m^3$)	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	1.541	1.420	3.560	2.776	2.558	6.414	0.45	**6**	0.007	100
Acetone	67-64-1	1.380	1.100	3.940	3.278	2.613	9.359	31000	0.0001	0.014	100
Acetonitrile	75-05-8	0.491	0.290	8.270	0.824	0.487	13.88	60	0.01	0.012	100
Acetylene	74-86-2	0.734	0.639	1.860	0.781	0.680	1.979			0.078	100
Acrolein[g]	107-02-8	0.489	0.448	0.973	1.122	1.027	2.231	0.02	56[g]	0.165	100
Acrylonitrile	107-13-1	*0.028*	0	0.313	*0.060*	0	0.679	0.015	**4**	0.130	21
tert-Amyl Methyl Ether	994-05-8	*0.0004*	0	0.008	*0.002*	0	0.033			0.067	5
Benzaldehyde	100-52-7	0.263	0.057	1.820	1.142	0.247	7.900			0.087	100
Benzene	71-43-2	0.267	0.244	0.636	0.852	0.780	2.032	0.13	**7**	0.010	100
Bromochloromethane	74-97-5	0	0	0	0	0	0			0.323	0
Bromodichloromethane	75-27-4	*0.0005*	0	0.011	*0.003*	0	0.074			0.094	5
Bromoform	75-25-2	*0.001*	0	0.012	*0.013*	0	0.124	0.91	0.01	0.217	14
Bromomethane	74-83-9	0.133	0.018	3.370	0.518	0.070	13.09	5	0.1	0.078	93
1,3-Butadiene	106-99-0	0.044	0.039	0.093	0.097	0.086	0.206	0.033	**3**	0.024	98
Butyraldehyde	123-72-8	0.184	0.167	0.422	0.541	0.493	1.245			0.035	100
Carbon Disulfide	75-15-0	0.876	0.927	1.580	2.729	2.887	4.920	700	0.004	0.009	100
Carbon Tetrachloride	56-23-5	0.096	0.098	0.140	0.605	0.617	0.881	0.17	**9**	0.088	100
Chlorobenzene	108-90-7	*0.0002*	0	0.012	*0.001*	0	0.055	1000	0.000001	0.110	2
Chloroethane	75-00-3	*0.014*	0	0.096	*0.037*	0	0.253	10000	0.000004	0.066	42
Chloroform	67-66-3	0.027	0.028	0.057	0.132	0.137	0.278	0.043	**3**	0.083	96
Chloromethane	74-87-3	0.660	0.597	3.390	1.362	1.233	7.000	0.56	**2**	0.029	100
Chloroprene	126-99-8	0	0	0	0	0	0	7		0.119	0
Crotonaldehyde	123-73-9	0.144	0.048	0.707	0.412	0.138	2.027			0.043	100
Dibromochloromethane	124-48-1	0.003	0.003	0.012	0.033	0.030	0.119			0.030	54
1,2-Dibromoethane	106-93-4	*0.0001*	0	0.008	*0.001*	0	0.061	0.0017	0.6	0.131	2
m-Dichlorobenzene	541-73-1	0.016	0.016	0.042	0.098	0.096	0.253			0.222	86
o-Dichlorobenzene	95-50-1	*0.001*	0	0.011	*0.005*	0	0.066	200	0.00003	0.126	11
p-Dichlorobenzene	106-46-7	0.007	0.006	0.029	0.040	0.036	0.174	0.091	0.4	0.114	53
Dichlorodifluoromethane	75-71-8	0.520	0.519	0.730	2.570	2.567	3.610	200	0.01	0.089	100
1,1-Dichloroethane	75-34-3	0	0	0	0	0	0	0.63	0	0.061	0
1,2-Dichloroethane	107-06-2	0.022	0.022	0.049	0.089	0.089	0.198	0.038	**2**	0.065	93
1,1-Dichloroethylene	75-35-4	*0.0002*	0	0.007	*0.001*	0	0.028	200	0.000004	0.056	4
cis-1,2-Dichloroethylene	156-59-2	0	0	0	0	0	0			0.048	0
trans-1,2-Dichloroethylene	156-60-5	*0.0005*	0	0.017	*0.002*	0	0.067			0.048	4
Dichloromethane	75-09-2	*0.336*	0	3.710	*1.167*	0	12.89	2.1	0.6	0.080	48

[a] See page 32 for footnotes.

Table 6 (continued)

CAMDEN NJ 2013 Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[d]	24-Hour Max. (ppbv)	Annual Mean (µg/m³)[c,d]	Annual Median (µg/m³)[d]	24-Hour Max. (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	0	0	0	0	0	0.1		0.088	0
cis-1,3-Dichloropropene	542-75-6	0	0	0	0	0	0			0.082	0
trans-1,3-Dichloropropene	542-75-6	0	0	0	0	0	0			0.073	0
Dichlorotetrafluoroethane	76-14-2	0.018	0.017	0.025	0.124	0.119	0.175			0.161	100
2,5-Dimethylbenzaldehyde	5799-94-2	0	0	0	0	0	0			0.016	0
Ethyl Acrylate	140-88-5	0	0	0	0	0	0	2		0.049	0
Ethyl tert-Butyl Ether	637-92-3	0.049	0.016	0.894	0.205	0.067	3.736			0.059	60
Ethylbenzene	100-41-4	0.070	0.063	0.166	0.304	0.274	0.721	0.40	0.8	0.048	100
Formaldehyde	50-00-0	4.036	3.750	9.460	4.957	4.605	11.62	0.077	**64**	0.028	100
Hexachloro-1,3-butadiene	87-68-3	*0.002*	0	0.013	*0.021*	0	0.139	0.045	0.5	0.085	25
Hexaldehyde	66-25-1	0.131	0.084	0.612	0.537	0.344	2.507			0.090	100
Isovaleraldehyde	590-86-3	0	0	0	0	0	0			0.007	0
Methyl Ethyl Ketone	78-93-3	0.188	0.170	0.501	0.554	0.501	1.475	5000	0.0001	0.071	100
Methyl Isobutyl Ketone	108-10-1	0.047	0.045	0.118	0.194	0.184	0.483	3000	0.0001	0.061	100
Methyl Methacrylate	80-62-6	*0.010*	0	0.171	*0.036*	0	0.602	700	0.0001	0.088	30
Methyl tert-Butyl Ether	1634-04-4	0.206	0.099	1.380	0.743	0.357	4.975	3.8	0.2	0.040	96
n-Octane	111-65-9	0.058	0.059	0.125	0.272	0.276	0.584			0.093	98
Propionaldehyde	123-38-6	0.252	0.234	0.614	0.598	0.556	1.459	8	0.1	0.007	100
Propylene	115-07-1	0.612	0.539	1.510	1.054	0.928	2.599	3000	0.0004	0.057	100
Styrene	100-42-5	0.304	0.191	3.660	1.296	0.814	15.59	1.8	0.7	0.102	100
1,1,2,2-Tetrachloroethane	79-34-5	*0.001*	0	0.009	*0.009*	0	0.062	0.017	0.5	0.124	18
Tetrachloroethylene	127-18-4	0.019	0.019	0.050	0.132	0.129	0.339	0.17	0.8	0.136	91
Tolualdehydes		0.074	0.040	0.460	0.363	0.197	2.260			0.025	100
Toluene	108-88-3	1.095	1.000	3.680	4.126	3.768	13.87	5000	0.001	0.170	100
1,2,4-Trichlorobenzene	102-82-1	*0.0003*	0	0.018	*0.002*	0	0.134	4	0.001	0.163	2
1,1,1-Trichloroethane	71-55-6	0.009	0.009	0.017	0.047	0.049	0.093	1000	0.00005	0.109	88
1,1,2-Trichloroethane	79-00-5	0	0	0	0	0	0	0.063		0.115	0
Trichloroethylene	79-01-6	*0.009*	0	0.061	*0.048*	0	0.328	0.5	0.1	0.118	40
Trichlorofluoromethane	75-69-4	0.356	0.304	1.690	2.002	1.708	9.496	700	0.003	0.084	100
Trichlorotrifluoroethane	76-13-1	0.084	0.084	0.101	0.642	0.644	0.774	30000	0.00002	0.130	100
1,2,4-Trimethylbenzene	95-63-6	0.094	0.084	0.316	0.461	0.413	1.553			0.123	98
1,3,5-Trimethylbenzene	108-67-8	0.035	0.032	0.102	0.174	0.157	0.501			0.108	98
Valeraldehyde	110-62-3	0.093	0.076	0.293	0.329	0.268	1.032			0.011	100
Vinyl chloride	75-01-4	*0.004*	0	0.078	*0.010*	0	0.199	0.11	0.1	0.028	21
m,p-Xylene	1330-20-7	0.170	0.154	0.530	0.739	0.669	2.301	100	0.01	0.009	100
o-Xylene	95-47-6	0.078	0.066	0.189	0.338	0.287	0.821	100	0.003	0.087	100

[a] See page 32 for footnotes.

Table 7

CHESTER NJ 2013 Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[d]	24-Hour Max. (ppbv)	Annual Mean ($\mu g/m^3$)[c,d]	Annual Median ($\mu g/m^3$)[d]	24-Hour Max. ($\mu g/m^3$)	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	0.724	0.654	2.230	1.305	1.178	4.018	0.45	**3**	0.007	100
Acetone	67-64-1	0.844	0.772	2.050	2.005	1.834	4.870	31000	0.00006	0.014	100
Acetonitrile	75-05-8	0.401	0.271	7.990	0.674	0.455	13.41	60	0.01	0.012	100
Acetylene	74-86-2	0.358	0.284	0.949	0.381	0.302	1.010			0.078	100
Acrolein[g]	107-02-8	0.448	0.447	0.965	1.027	1.025	2.213	0.02	51[g]	0.165	100
Acrylonitrile	107-13-1	*0.047*	0	0.262	*0.101*	0	0.569	0.015	**7**	0.130	44
tert-Amyl Methyl Ether	994-05-8	*0.001*	0	0.011	*0.003*	0	0.046			0.067	8
Benzaldehyde	100-52-7	0.015	0.012	0.053	0.064	0.052	0.230			0.087	100
Benzene	71-43-2	0.154	0.134	0.901	0.490	0.428	2.878	0.13	**4**	0.010	100
Bromochloromethane	74-97-5	0	0	0	0	0	0			0.323	0
Bromodichloromethane	75-27-4	*0.001*	0	0.013	*0.007*	0	0.087			0.094	11
Bromoform	75-25-2	*0.001*	0	0.011	*0.011*	0	0.114	0.91	0.01	0.217	13
Bromomethane	74-83-9	0.014	0.015	0.037	0.053	0.058	0.144	5	0.01	0.078	85
1,3-Butadiene	106-99-0	0.017	0.018	0.052	0.038	0.040	0.115	0.033	**1.2**	0.024	72
Butyraldehyde	123-72-8	0.053	0.049	0.153	0.157	0.145	0.451			0.035	100
Carbon Disulfide	75-15-0	0.808	1.060	1.760	2.515	3.301	5.481	700	0.004	0.009	100
Carbon Tetrachloride	56-23-5	0.097	0.097	0.134	0.612	0.610	0.843	0.17	**9**	0.088	100
Chlorobenzene	108-90-7	*0.001*	0	0.015	*0.003*	0	0.069	1000	0.000003	0.110	5
Chloroethane	75-00-3	*0.010*	0	0.057	*0.026*	0	0.150	10000	0.000003	0.066	33
Chloroform	67-66-3	0.021	0.021	0.083	0.104	0.103	0.405	0.043	**2**	0.083	90
Chloromethane	74-87-3	0.592	0.578	1.230	1.223	1.194	2.540	0.56	**2**	0.029	100
Chloroprene	126-99-8	0	0	0	0	0	0	7		0.119	0
Crotonaldehyde	123-73-9	0.126	0.032	1.200	0.362	0.092	3.440			0.043	100
Dibromochloromethane	124-48-1	0.003	0.003	0.012	0.032	0.030	0.119			0.030	52
1,2-Dibromoethane	106-93-4	0	0	0	0	0	0	0.0017		0.131	0
m-Dichlorobenzene	541-73-1	0.011	0.013	0.038	0.066	0.078	0.228			0.222	69
o-Dichlorobenzene	95-50-1	*0.001*	0	0.010	*0.004*	0	0.060	200	0.00002	0.126	8
p-Dichlorobenzene	106-46-7	*0.003*	0	0.013	*0.015*	0	0.078	0.091	0.2	0.114	30
Dichlorodifluoromethane	75-71-8	0.492	0.508	0.634	2.433	2.512	3.136	200	0.01	0.089	100
1,1-Dichloroethane	75-34-3	*0.0002*	0	0.011	*0.001*	0	0.045	0.63	0.001	0.061	2
1,2-Dichloroethane	107-06-2	0.018	0.019	0.039	0.073	0.077	0.158	0.038	**2**	0.065	85
1,1-Dichloroethylene	75-35-4	*0.001*	0	0.009	*0.003*	0	0.036	200	0.00002	0.056	11
cis-1,2-Dichloroethylene	156-59-2	0	0	0	0	0	0			0.048	0
trans-1,2-Dichloroethylene	156-60-5	0	0	0	0	0	0			0.048	0
Dichloromethane	75-09-2	0.275	0.127	3.240	0.956	0.441	11.26	2.1	0.5	0.080	88

[a] See page 32 for footnotes.

Table 7 (continued)

CHESTER NJ 2013 Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[d]	24-Hour Max. (ppbv)	Annual Mean (µg/m³)[c,d]	Annual Median (µg/m³)[d]	24-Hour Max. (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	0	0	0	0	0	0.1		0.088	0
cis-1,3-Dichloropropene	542-75-6	0	0	0	0	0	0			0.082	0
trans-1,3-Dichloropropene	542-75-6	0	0	0	0	0	0			0.073	0
Dichlorotetrafluoroethane	76-14-2	0.017	0.017	0.025	0.121	0.119	0.175			0.161	100
2,5-Dimethylbenzaldehyde	5799-94-2	0	0	0	0	0	0			0.016	0
Ethyl Acrylate	140-88-5	0	0	0	0	0	0	2		0.049	0
Ethyl tert-Butyl Ether	637-92-3	0.047	0.035	0.164	0.198	0.146	0.685			0.059	79
Ethylbenzene	100-41-4	0.028	0.021	0.180	0.123	0.091	0.782	0.40	0.3	0.048	100
Formaldehyde	50-00-0	1.735	1.48	4.340	2.130	1.818	5.330	0.077	**28**	0.028	100
Hexachloro-1,3-butadiene	87-68-3	*0.002*	0	0.015	*0.020*	0	0.160	0.045	0.5	0.085	23
Hexaldehyde	66-25-1	0.016	0.013	0.098	0.065	0.053	0.401			0.090	90
Isovaleraldehyde	590-86-3	0	0	0	0	0	0			0.007	0
Methyl Ethyl Ketone	78-93-3	0.108	0.097	0.328	0.317	0.286	0.966	5000	0.00006	0.071	100
Methyl Isobutyl Ketone	108-10-1	0.029	0.027	0.094	0.119	0.111	0.385	3000	0.00004	0.061	100
Methyl Methacrylate	80-62-6	*0.001*	0	0.010	*0.002*	0	0.035	700	0.000003	0.088	7
Methyl tert-Butyl Ether	1634-04-4	0.873	0.142	7.190	3.148	0.512	25.92	3.8	0.8	0.040	97
n-Octane	111-65-9	0.046	0.039	0.264	0.217	0.182	1.233			0.093	98
Propionaldehyde	123-38-6	0.094	0.087	0.260	0.223	0.207	0.618	8	0.03	0.007	100
Propylene	115-07-1	0.250	0.236	0.478	0.430	0.406	0.823	3000	0.0001	0.057	100
Styrene	100-42-5	0.014	0.010	0.140	0.062	0.043	0.596	1.8	0.03	0.102	56
1,1,2,2-Tetrachloroethane	79-34-5	*0.002*	0	0.013	*0.011*	0	0.089	0.017	0.6	0.124	18
Tetrachloroethylene	127-18-4	0.009	0.010	0.035	0.060	0.068	0.237	0.17	0.4	0.136	67
Tolualdehydes		0.013	0.011	0.078	0.066	0.054	0.383			0.025	71
Toluene	108-88-3	0.407	0.363	3.140	1.534	1.368	11.83	5000	0.0003	0.170	100
1,2,4-Trichlorobenzene	102-82-1	0	0	0	0	0	0	4	0	0.163	0
1,1,1-Trichloroethane	71-55-6	0.006	0.008	0.015	0.035	0.044	0.082	1000	0.00004	0.109	70
1,1,2-Trichloroethane	79-00-5	0	0	0	0	0	0	0.063	0	0.115	0
Trichloroethylene	79-01-6	*0.001*	0	0.014	*0.005*	0	0.075	0.5	0.01	0.118	10
Trichlorofluoromethane	75-69-4	0.245	0.246	0.312	1.377	1.382	1.753	700	0.002	0.084	100
Trichlorotrifluoroethane	76-13-1	0.084	0.084	0.111	0.644	0.644	0.851	30000	0.00002	0.130	100
1,2,4-Trimethylbenzene	95-63-6	0.025	0.020	0.188	0.125	0.098	0.924			0.123	95
1,3,5-Trimethylbenzene	108-67-8	0.020	0.016	0.088	0.098	0.079	0.433			0.108	82
Valeraldehyde	110-62-3	0.014	0.013	0.054	0.050	0.046	0.190			0.011	96
Vinyl chloride	75-01-4	*0.0003*	0	0.011	*0.001*	0	0.028	0.11	0.008	0.028	3
m,p-Xylene	1330-20-7	0.059	0.041	0.484	0.256	0.178	2.101	100	0.003	0.009	100
o-Xylene	95-47-6	0.027	0.019	0.210	0.115	0.082	0.912	100	0.001	0.087	98

[a] See page 32 for footnotes.

Table 8

ELIZABETH NJ 2013 Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[d]	24-Hour Max. (ppbv)	Annual Mean (µg/m³)[c,d]	Annual Median (µg/m³)[d]	24-Hour Max. (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	1.442	1.360	2.870	2.598	2.450	5.171	0.45	**6**	0.007	100
Acetone	67-64-1	1.108	1.010	3.180	2.631	2.399	7.554	31000	0.0001	0.014	100
Acetonitrile	75-05-8	0.333	0.202	1.600	0.558	0.339	2.686	60	0.01	0.012	100
Acetylene	74-86-2	0.835	0.700	2.830	0.889	0.745	3.012			0.078	100
Acrolein[g]	107-02-8	0.453	0.412	0.975	1.039	0.945	2.236	0.02	52[g]	0.165	100
Acrylonitrile	107-13-1	0.348	0.355	1.450	0.756	0.770	3.147	0.015	**50**	0.130	66
tert-Amyl Methyl Ether	994-05-8	*0.0004*	0	0.009	*0.002*	0	0.038			0.067	5
Benzaldehyde	100-52-7	0.029	0.026	0.119	0.124	0.113	0.517			0.087	100
Benzene	71-43-2	0.251	0.234	0.503	0.803	0.748	1.607	0.13	**6**	0.010	100
Bromochloromethane	74-97-5	0	0	0	0	0	0			0.323	0
Bromodichloromethane	75-27-4	*0.0002*	0	0.008	*0.002*	0	0.054			0.094	3
Bromoform	75-25-2	*0.001*	0	0.01	*0.011*	0	0.103	0.91	0.01	0.217	13
Bromomethane	74-83-9	0.012	0.014	0.050	0.047	0.054	0.194	5	0.01	0.078	77
1,3-Butadiene	106-99-0	0.051	0.046	0.113	0.113	0.102	0.250	0.033	**3**	0.024	100
Butyraldehyde	123-72-8	0.129	0.123	0.344	0.379	0.363	1.015			0.035	100
Carbon Disulfide	75-15-0	2.893	3.840	6.440	9.010	11.96	20.05	700	0.01	0.009	100
Carbon Tetrachloride	56-23-5	0.099	0.097	0.135	0.624	0.610	0.849	0.17	**9**	0.088	100
Chlorobenzene	108-90-7	0	0	0	0	0	0	1000	0	0.110	0
Chloroethane	75-00-3	*0.003*	0	0.050	*0.008*	0	0.132	10000	0.000001	0.066	10
Chloroform	67-66-3	0.027	0.029	0.056	0.133	0.142	0.273	0.043	**3**	0.083	87
Chloromethane	74-87-3	0.551	0.546	0.681	1.137	1.128	1.406	0.56	**2**	0.029	100
Chloroprene	126-99-8	0	0	0	0	0	0	7		0.119	0
Crotonaldehyde	123-73-9	0.130	0.051	1	0.372	0.146	2.867			0.043	100
Dibromochloromethane	124-48-1	*0.002*	0	0.010	*0.024*	0	0.099			0.030	41
1,2-Dibromoethane	106-93-4	0	0	0	0	0	0	0.0017		0.131	0
m-Dichlorobenzene	541-73-1	*0.0003*	0	0.007	*0.002*	0	0.042			0.222	5
o-Dichlorobenzene	95-50-1	*0.001*	0	0.008	*0.003*	0	0.048	200	0.00002	0.126	10
p-Dichlorobenzene	106-46-7	*0.005*	0	0.017	*0.028*	0	0.102	0.091	0.3	0.114	46
Dichlorodifluoromethane	75-71-8	0.509	0.511	0.722	2.518	2.527	3.571	200	0.01	0.089	100
1,1-Dichloroethane	75-34-3	0	0	0	0	0	0	0.63		0.061	0
1,2-Dichloroethane	107-06-2	0.018	0.021	0.037	0.074	0.085	0.150	0.038	**2**	0.065	77
1,1-Dichloroethylene	75-35-4	0	0	0	0	0	0	200		0.056	0
cis-1,2-Dichloroethylene	156-59-2	0	0	0	0	0	0			0.048	0
trans-1,2-Dichloroethylene	156-60-5	0	0	0	0	0	0			0.048	0
Dichloromethane	75-09-2	0.236	0.156	2.250	0.819	0.542	7.817	2.1	0.4	0.080	100

[a] See page 32 for footnotes.

Table 8 (continued)

ELIZABETH NJ 2013 Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[d]	24-Hour Max. (ppbv)	Annual Mean ($\mu g/m^3$)[c,d]	Annual Median ($\mu g/m^3$)[d]	24-Hour Max. ($\mu g/m^3$)	Health Bench-mark ($\mu g/m^3$)[e]	Annual Mean Risk Ratio[f]	Detection Limit ($\mu g/m^3$)	% Above Minimum Detection Limit
1,2-Dichloropropane	78-87-5	0	0	0	0	0	0	0.1		0.088	0
cis-1,3-Dichloropropene	542-75-6	0	0	0	0	0	0			0.082	0
trans-1,3-Dichloropropene	542-75-6	0	0	0	0	0	0			0.073	0
Dichlorotetrafluoroethane	76-14-2	0.017	0.017	0.023	0.121	0.119	0.161			0.161	100
2,5-Dimethylbenzaldehyde	5799-94-2	0	0	0	0	0	0			0.016	0
Ethyl Acrylate	140-88-5	0	0	0	0	0	0	2		0.049	0
Ethyl tert-Butyl Ether	637-92-3	0.066	0.064	0.148	0.277	0.267	0.618			0.059	100
Ethylbenzene	100-41-4	0.099	0.092	0.230	0.431	0.399	0.999	0.40	**1.1**	0.048	100
Formaldehyde	50-00-0	3.978	3.380	12.90	4.886	4.151	15.84	0.077	**63**	0.028	100
Hexachloro-1,3-butadiene	87-68-3	*0.002*	0	0.012	*0.016*	0	0.128	0.045	0.4	0.085	21
Hexaldehyde	66-25-1	0.043	0.03	0.324	0.177	0.123	1.327			0.090	100
Isovaleraldehyde	590-86-3	0	0	0	0	0	0			0.007	0
Methyl Ethyl Ketone	78-93-3	0.166	0.145	0.389	0.489	0.426	1.146	5000	0.0001	0.071	100
Methyl Isobutyl Ketone	108-10-1	0.046	0.047	0.108	0.189	0.193	0.442	3000	0.0001	0.061	97
Methyl Methacrylate	80-62-6	*0.014*	0	0.141	*0.049*	0	0.496	700	0.0001	0.088	31
Methyl tert-Butyl Ether	1634-04-4	0.043	0.034	0.215	0.155	0.123	0.775	3.8	0.04	0.040	87
n-Octane	111-65-9	0.070	0.063	0.207	0.328	0.294	0.967			0.093	100
Propionaldehyde	123-38-6	0.206	0.176	0.457	0.490	0.418	1.086	8	0.06	0.007	100
Propylene	115-07-1	1.446	0.998	5.430	2.489	1.718	9.345	3000	0.001	0.057	100
Styrene	100-42-5	0.028	0.025	0.123	0.121	0.106	0.524	1.8	0.07	0.102	92
1,1,2,2-Tetrachloroethane	79-34-5	*0.015*	0	0.105	*0.106*	0	0.721	0.017	**6**	0.124	33
Tetrachloroethylene	127-18-4	0.019	0.018	0.050	0.127	0.122	0.339	0.17	0.7	0.136	89
Tolualdehydes		0.027	0.026	0.076	0.131	0.125	0.373			0.025	94
Toluene	108-88-3	0.658	0.603	1.720	2.478	2.272	6.481	5000	0.0005	0.170	100
1,2,4-Trichlorobenzene	102-82-1	0	0	0	0	0	0	4		0.163	0
1,1,1-Trichloroethane	71-55-6	0.008	0.009	0.036	0.046	0.049	0.196	1000	0.00005	0.109	79
1,1,2-Trichloroethane	79-00-5	0	0	0	0	0	0	0.063		0.115	0
Trichloroethylene	79-01-6	*0.004*	0	0.039	*0.024*	0	0.210	0.5	0.05	0.118	30
Trichlorofluoromethane	75-69-4	0.258	0.253	0.363	1.450	1.422	2.040	700	0.002	0.084	100
Trichlorotrifluoroethane	76-13-1	0.083	0.082	0.099	0.637	0.628	0.759	30000	0.00002	0.130	100
1,2,4-Trimethylbenzene	95-63-6	0.081	0.072	0.243	0.400	0.354	1.195			0.123	100
1,3,5-Trimethylbenzene	108-67-8	0.029	0.025	0.082	0.141	0.123	0.403			0.108	100
Valeraldehyde	110-62-3	0.045	0.038	0.221	0.158	0.132	0.779			0.011	100
Vinyl chloride	75-01-4	0	0	0	0	0	0	0.11		0.028	0
m,p-Xylene	1330-20-7	0.245	0.231	0.566	1.065	1.003	2.458	100	0.01	0.009	100
o-Xylene	95-47-6	0.105	0.102	0.224	0.457	0.443	0.973	100	0.005	0.087	100

[a] See page 32 for footnotes.

Table 9

NEW BRUNSWICK NJ 2013 Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[d]	24-Hour Max. (ppbv)	Annual Mean (µg/m³)[c,d]	Annual Median (µg/m³)[d]	24-Hour Max. (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	0.916	0.882	1.640	1.651	1.588	2.955	0.45	**4**	0.007	100
Acetone	67-64-1	0.984	0.935	1.950	2.337	2.220	4.632	31000	0.0001	0.014	100
Acetonitrile	75-05-8	9.545	0.241	565.0	16.03	0.405	948.6	60	0.3	0.012	100
Acetylene	74-86-2	0.551	0.480	1.600	0.587	0.511	1.703			0.078	100
Acrolein[g]	107-02-8	0.490	0.423	1.010	1.124	0.969	2.316	0.02	56[g]	0.165	100
Acrylonitrile	107-13-1	0.535	0.509	1.380	1.161	1.105	2.995		**77**	0.130	98
tert-Amyl Methyl Ether	994-05-8	*0.001*	0	0.011	*0.005*	0	0.046			0.067	13
Benzaldehyde	100-52-7	0.020	0.016	0.048	0.086	0.069	0.208			0.087	100
Benzene	71-43-2	0.203	0.196	0.390	0.650	0.626	1.246	0.13	**5**	0.010	100
Bromochloromethane	74-97-5	0	0	0	0	0	0			0.323	0
Bromodichloromethane	75-27-4	*0.001*	0	0.013	*0.008*	0	0.087			0.094	13
Bromoform	75-25-2	*0.001*	0	0.014	*0.014*	0	0.145	0.91	0.02	0.217	15
Bromomethane	74-83-9	0.014	0.013	0.114	0.056	0.050	0.443	5	0.01	0.078	84
1,3-Butadiene	106-99-0	0.031	0.031	0.073	0.070	0.069	0.161	0.033	**2**	0.024	95
Butyraldehyde	123-72-8	0.083	0.081	0.153	0.244	0.239	0.451			0.035	100
Carbon Disulfide	75-15-0	5.710	5.820	22.70	17.78	18.12	70.69		0.03	0.009	100
Carbon Tetrachloride	56-23-5	0.098	0.098	0.134	0.614	0.617	0.843	0.17	**9**	0.088	100
Chlorobenzene	108-90-7	*0.0003*	0	0.012	*0.002*	0	0.055	1000	0.000002	0.110	3
Chloroethane	75-00-3	*0.008*	0	0.102	*0.022*	0	0.269	10000	0.000002	0.066	18
Chloroform	67-66-3	0.027	0.026	0.045	0.131	0.127	0.220	0.043	**3**	0.083	95
Chloromethane	74-87-3	0.559	0.545	0.800	1.154	1.125	1.652	0.56	**2**	0.029	100
Chloroprene	126-99-8	0	0	0	0	0	0	7		0.119	0
Crotonaldehyde	123-73-9	0.115	0.037	0.725	0.331	0.106	2.078			0.043	100
Dibromochloromethane	124-48-1	0.004	0.004	0.011	0.037	0.040	0.109			0.030	62
1,2-Dibromoethane	106-93-4	*0.0002*	0	0.012	*0.002*	0	0.092	0.0017	0.9	0.131	2
m-Dichlorobenzene	541-73-1	*0.001*	0	0.008	*0.003*	0	0.048			0.222	8
o-Dichlorobenzene	95-50-1	*0.001*	0	0.011	*0.006*	0	0.066	200	0.00003	0.126	13
p-Dichlorobenzene	106-46-7	*0.004*	0	0.025	*0.024*	0	0.150	0.091	0.3	0.114	43
Dichlorodifluoromethane	75-71-8	0.513	0.528	0.636	2.536	2.611	3.145	200	0.01	0.089	100
1,1-Dichloroethane	75-34-3	0	0	0	0	0	0	0.63		0.061	0
1,2-Dichloroethane	107-06-2	0.021	0.021	0.035	0.086	0.085	0.142	0.038	**2**	0.065	97
1,1-Dichloroethylene	75-35-4	*0.001*	0	0.010	*0.003*	0	0.040	200	0.00001	0.056	10
cis-1,2-Dichloroethylene	156-59-2	0	0	0	0	0	0			0.048	0
trans-1,2-Dichloroethylene	156-60-5	0	0	0	0	0	0			0.048	0
Dichloromethane	75-09-2	0.199	0.150	1.140	0.691	0.521	3.960	2.1	0.3	0.080	100

[a] See page 32 for footnotes.

Table 9 (continued)

NEW BRUNSWICK NJ 2013 Toxic VOCs Monitoring Data[a]

Analyte[b]	CAS No.	Annual Mean (ppbv)[c,d]	Annual Median (ppbv)[d]	24-Hour Max. (ppbv)	Annual Mean ($\mu g/m^3$)[c,d]	Annual Median ($\mu g/m^3$)[d]	24-Hour Max. ($\mu g/m^3$)	Health Bench-mark ($\mu g/m^3$)[e]	Annual Mean Risk Ratio[f]	Detection Limit ($\mu g/m^3$)	% Above Minimum Detection Limit
1,2-Dichloropropane	78-87-5	0	0	0	0	0	0	0.1		0.088	0
cis-1,3-Dichloropropene	542-75-6	0	0	0	0	0	0			0.082	0
trans-1,3-Dichloropropene	542-75-6	0	0	0	0	0	0			0.073	0
Dichlorotetrafluoroethane	76-14-2	0.018	0.018	0.026	0.129	0.126	0.182			0.161	100
2,5-Dimethylbenzaldehyde	5799-94-2	0	0	0	0	0	0			0.016	0
Ethyl Acrylate	140-88-5	0	0	0	0	0	0	2		0.049	0
Ethyl tert-Butyl Ether	637-92-3	*0.021*	0	0.154	*0.086*	0	0.644			0.059	28
Ethylbenzene	100-41-4	0.058	0.056	0.123	0.250	0.243	0.534	0.40	0.6	0.048	100
Formaldehyde	50-00-0	1.820	1.630	4.730	2.236	2.002	5.809	0.077	**29**	0.028	100
Hexachloro-1,3-butadiene	87-68-3	*0.002*	0	0.015	*0.024*	0	0.160	0.045	0.5	0.085	26
Hexaldehyde	66-25-1	0.024	0.021	0.087	0.100	0.084	0.356			0.090	100
Isovaleraldehyde	590-86-3	0	0	0	0	0	0			0.007	0
Methyl Ethyl Ketone	78-93-3	0.125	0.119	0.287	0.368	0.349	0.845	5000	0.0001	0.071	100
Methyl Isobutyl Ketone	108-10-1	0.040	0.037	0.093	0.163	0.152	0.381	3000	0.0001	0.061	97
Methyl Methacrylate	80-62-6	*0.002*	0	0.057	*0.007*	0	0.201	700	0.00001	0.088	10
Methyl tert-Butyl Ether	1634-04-4	*0.023*	0	0.263	*0.084*	0	0.948	3.8	0.02	0.040	49
n-Octane	111-65-9	0.034	0.032	0.185	0.160	0.149	0.864			0.093	100
Propionaldehyde	123-38-6	0.123	0.109	0.260	0.293	0.258	0.618	8	0.04	0.007	100
Propylene	115-07-1	0.348	0.306	0.859	0.599	0.527	1.478	3000	0.0002	0.057	100
Styrene	100-42-5	0.030	0.027	0.171	0.129	0.115	0.728	1.8	0.1	0.102	95
1,1,2,2-Tetrachloroethane	79-34-5	*0.022*	0	0.171	*0.150*	0	1.174	0.017	**9**	0.124	36
Tetrachloroethylene	127-18-4	0.013	0.014	0.040	0.086	0.095	0.271	0.17	0.5	0.136	79
Tolualdehydes		0.010	0.009	0.038	0.051	0.042	0.187			0.025	74
Toluene	108-88-3	0.473	0.420	1.510	1.782	1.583	5.690	5000	0.0004	0.170	100
1,2,4-Trichlorobenzene	102-82-1	*0.0005*	0	0.019	*0.004*	0	0.141	4	0.001	0.163	3
1,1,1-Trichloroethane	71-55-6	0.008	0.008	0.017	0.045	0.044	0.093	1000	0.00005	0.109	85
1,1,2-Trichloroethane	79-00-5	0	0	0	0	0	0	0.063		0.115	0
Trichloroethylene	79-01-6	*0.003*	0	0.039	*0.015*	0	0.210	0.5	0.03	0.118	20
Trichlorofluoromethane	75-69-4	0.259	0.254	0.368	1.458	1.427	2.068	700	0.002	0.084	100
Trichlorotrifluoroethane	76-13-1	0.084	0.083	0.105	0.646	0.636	0.805	30000	0.00002	0.130	100
1,2,4-Trimethylbenzene	95-63-6	0.034	0.030	0.080	0.170	0.147	0.393			0.123	100
1,3,5-Trimethylbenzene	108-67-8	0.015	0.014	0.037	0.076	0.069	0.182			0.108	85
Valeraldehyde	110-62-3	0.024	0.021	0.054	0.086	0.074	0.190			0.011	100
Vinyl chloride	75-01-4	*0.0003*	0	0.008	*0.001*	0	0.020	0.11	0.01	0.028	3
m,p-Xylene	1330-20-7	0.129	0.126	0.303	0.558	0.547	1.316	100	0.01	0.009	100
o-Xylene	95-47-6	0.062	0.062	0.152	0.269	0.269	0.660	100	0.003	0.087	100

[a] See page 32 for footnotes.

Footnotes for Tables 6 through 9

[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] The 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] The 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.

Table 10

Analytes with 100% Non-Detects in 2013

	Analyte	**CAS No.**	**Camden**	**Chester**	**Elizabeth**	**New Brunswick**
1	Bromochloromethane	74-97-5	X	X	X	X
2	Chlorobenzene	108-90-7			X	
3	Chloroprene	126-99-8	X	X	X	X
4	1,2-Dibromoethane	106-93-4		X	X	
5	1,1-Dichloroethane	75-34-3	X		X	X
6	1,1-Dichloroethene	75-35-4			X	
7	cis-1,2-Dichloroethylene	156-59-2	X	X	X	X
8	trans-1,2-Dichloroethylene	156-60-5		X	X	X
9	1,2-Dichloropropane	78-87-5	X	X	X	X
10	cis-1,3-Dichloropropene	542-75-6	X	X	X	X
11	trans-1,3-Dichloropropene	542-75-6	X	X	X	X
12	2,5-Dimethylbenzaldehyde	5799-94-2	X	X	X	X
13	Ethyl Acrylate	140-88-5	X	X	X	X
14	Isovaleraldehyde	590-86-3	X	X	X	X
15	1,2,4-Trichlorobenzene	102-82-1		X	X	
16	1,1,2-Trichloroethane	79-00-5	X	X	X	X
17	Vinyl chloride	75-01-4			X	

In 2013, collected samples of these chemicals were never above the detection limits at the specific monitoring locations. However, they may be present in the air below the detection limit level. Chemical-specific detection limits can be found in Tables 6 through 9.

REFERENCES

2005 National-Scale Air Toxics Assessment, USEPA Office of Air and Radiation, www.epa.gov/ttn/atw/nata2005

Air Pollution and Health Risk, EPA-450/3-90-022, USEPA Office of Air and Radiation, www.epa.gov/ttn/atw/3_90_022.html

Air Toxics in New Jersey, NJDEP, Division of Air Quality (DAQ), www.nj.gov/dep/airtoxics

Air Toxics – Urban Air Toxics Monitoring Program, USEPA, Air Monitoring Technology Information Center, www.epa.gov/ttn/amtic/uatm/html

Clean Air Act Amendments of 1990, Title III – Hazardous Air Pollutants, 101st Congress 2nd Session, Report 101-952, US Government Printing Office, Washington DC, October 1990.

Evaluating Exposures to Toxic Air Pollutants: A Citizen's Guide, EPA-450/3-90-023, USEPA, Office of Air and Radiation, USEPA Office of Air and Radiation, www.epa.gov/ttn/atw/3_90_023.html

Risk Screening Tools, NJDEP, DAQ, Air Quality Permitting Program, www.nj.gov/dep/aqpp/risk.html

Risk Assessment for Toxic Air Pollutants, USEPA Office of Air and Radiation, www.epa.gov/ttn/atw/3_90_024.html

Taking Toxics Out of the Air, EPA-452/K-00-002, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, August 2000, www.epa.gov/oar/oaqps/takingtoxics/airtox.pdf

Toxicity Values for Inhalation Exposure, NJDEP, DAQ, Bureau of Technical Services, Air Quality Evaluation Section (AQEv), August 2011, www.nj.gov/dep/aqpp/permitguide/ToxAll 2011.pdf

2013 Photochemical Assessment Monitoring Stations (PAMS)

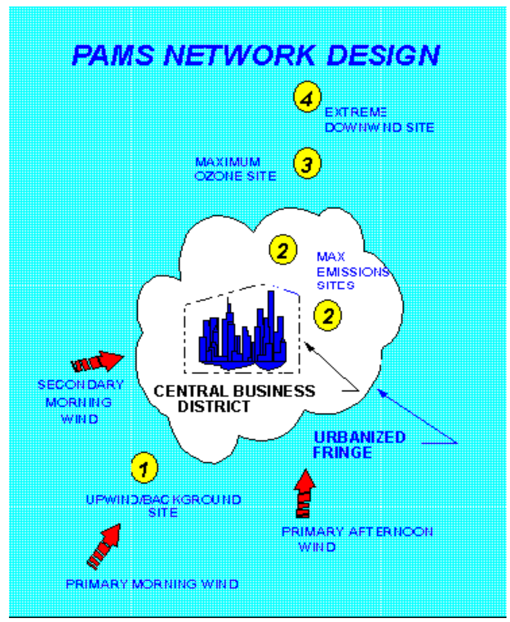
New Jersey Department of Environmental Protection

Photochemical Assessment Monitoring Stations (PAMS)

Most ground-level ozone (O3) is formed as the result of oxides of nitrogen (NOx) and volatile organic compounds (VOCs) reacting in the presence of sunlight. As a result, it is necessary to measure these ozone forming pollutants, also known as precursor pollutants, to effectively evaluate strategies for reducing ozone levels. The Photochemical Assessment Monitoring Stations (PAMS) network was established for this purpose. Data from the PAMS network is used to better characterize the nature and extent of the O3 problem, track VOC and NOx emission inventory reductions, assess air quality trends, and make attainment/nonattainment decisions. PAMS monitor both criteria and non-criteria pollutants including ozone (O3), oxides of nitrogen (NOx), nitric oxide (NO), nitrogen dioxide (NO2), and specific VOCs, including several carbonyls that are important in ozone formation. In addition, the measurement of specific weather parameters (e.g. wind speed/direction, temperature) is required at all PAMS, and upper air weather measurements are required in certain areas. The VOC and carbonyl measurements are only taken during the peak part of the ozone season, from June 1st to August 31st each year.

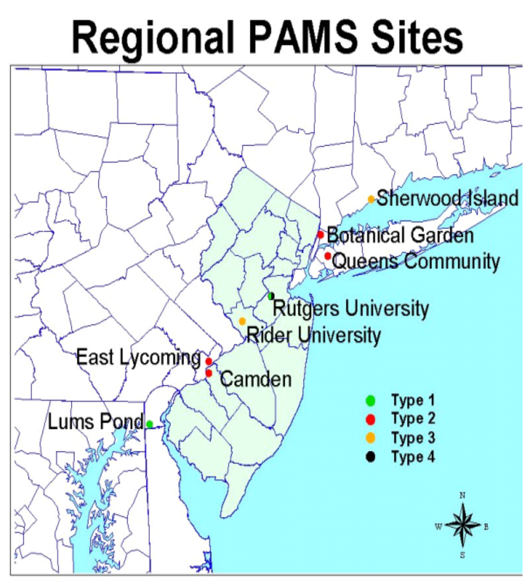
The PAMS network is designed around metropolitan areas where ozone is a significant problem, and each site in the network has a specific purpose as shown in Figure 1. New Jersey is part of both the Philadelphia and New York Metropolitan areas and has historically operated a total of three PAMS sites. A Type 3 maximum ozone site for the Philadelphia area was located at Rider University in Mercer County, a secondary Type 2 (or Type 2A) maximum emissions site was located downwind of the Philadelphia Metropolitan urban area in Camden, and a site at Rutgers University in New Brunswick has been designated both a PAMS Type 1 upwind site for the New York urban area, as well as a Type 4 downwind site for the Philadelphia Metropolitan urban area. An upper air weather monitoring station is also located at the Rutgers University site. All of the PAMS sites for the Philadelphia and New York City areas are shown in Figure 2.

Figure 1



[5] USEPA , PAMS General Information

Figure 2

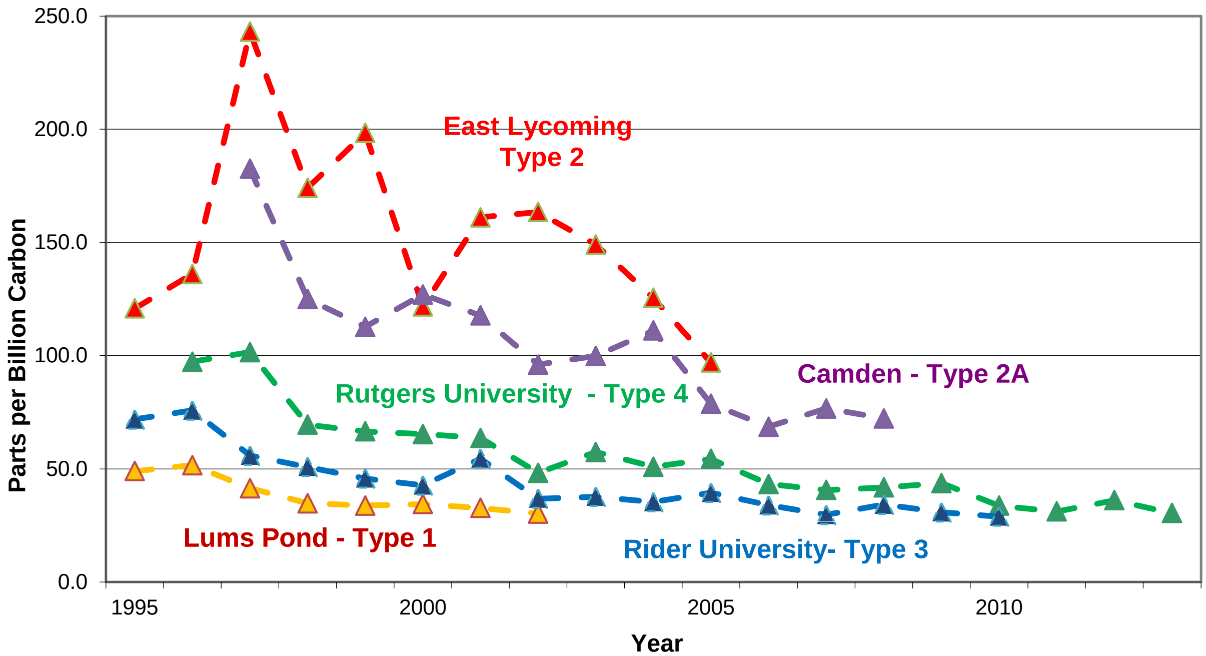


Note: Rutgers University PAMS site is both Type 4 for Philadelphia and Type 1 for New York City.

PHILADELPHIA REGION

Figure 3 shows VOC trends for the PAMS sites in the Philadelphia area. In general, at the Lums Pond (upwind - Type 1), Rider University (maximum ozone concentration - Type 3) and Rutgers University (downwind - Type 4), VOCs have declined over the measurement period. The improvements were initially more dramatic, with more level, though still discernibly declining concentrations, over the last several years. The maximum emissions -Type 2 sites (Camden and East Lycoming) for this area show more variation from year to year, though the trend at both sites is downward since 1997. This greater variability may be due to the fact that Type 2 sites are typically impacted by varied sources, whereas the other sites are mostly impacted by transportation sources.

Figure 3
Philadelphia Region
Total Non-methane Organic Carbon (TNMOC)
Seasonal Average 1995-2013

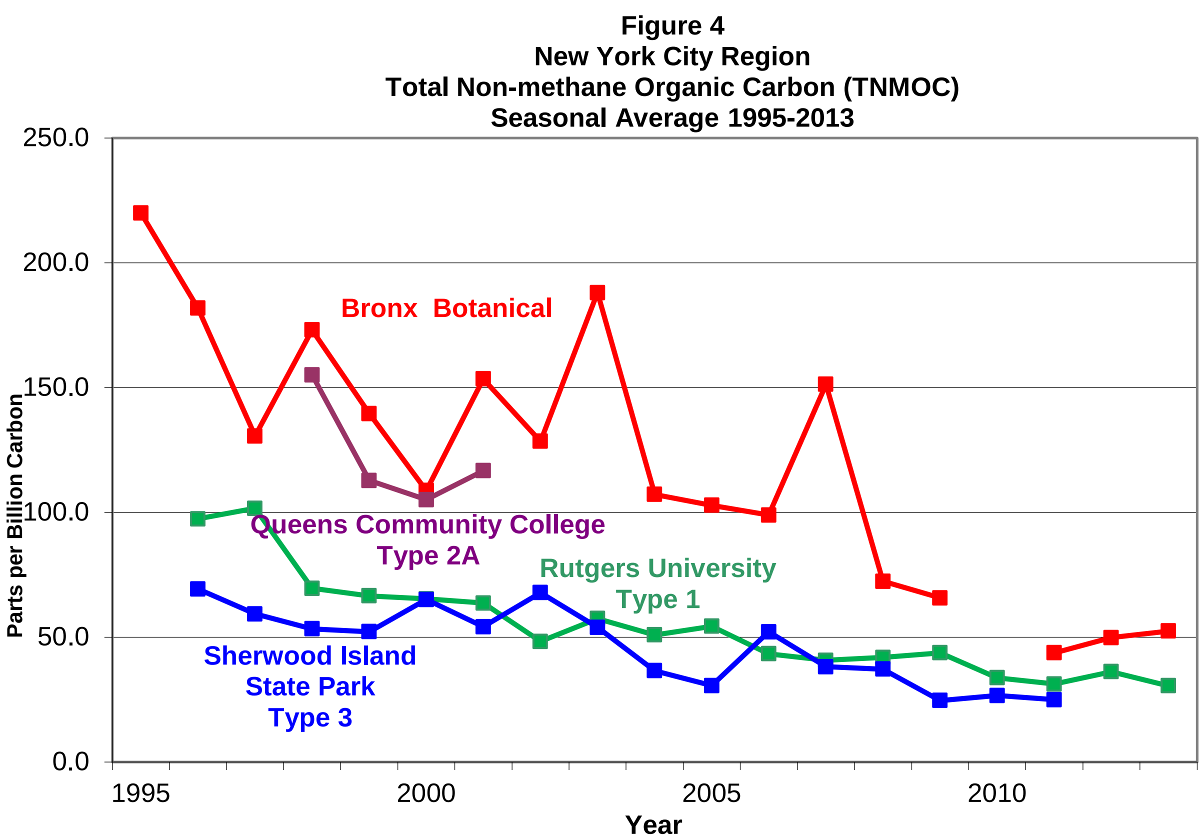


NOTE: Delaware's Department of Natural Resources and Environmental Control (DNREC) discontinued operation of the Lums Pond site after the 2002 season. Philadelphia's Air Management Services Laboratory still operates the PAMS site at their East Lycoming lab, but as of 2006 they no longer report Total Non-Methane Organic Carbon (TNMOC). Our Camden site has not operated since the 2008 season due to our losing access to the site. We have since relocated the site but have not installed a PAMS unit. The Rider University site was removed from the PAMS network following the 2010 season. An evaluation of the site showed this data was not significantly different from the Rutgers University site and it was discontinued as part of an overall restructuring of the monitoring network.

New York Region

Figure 4 shows VOC trends for the PAMS sites in the New York City metropolitan area. In general, observations in the NYC area are similar to those for the Philadelphia area. The Type 2 site in the NY area at the Bronx Botanical Gardens shows even more year to year variability than does the Philadelphia Type 2 site at East Lycoming.

NOTE: Operation of the Queens Community College site was discontinued after the 2001 season. No data was reported for the Bronx Botanical Garden site for 2010 due to equipment problems. The Sherwood Island site began using new equipment in 2012 which doesn't allow for a measure of TNMOC.



SUMMARY

In conclusion, trends for VOC values measured at all PAMS sites in the Philadelphia and New York City areas show an impressive decline over the time period during which these measurements have been made. Mandated changes in gasoline formulation over the period as well as the effect of newer, cleaner vehicles replacing older vehicles in the automotive fleet likely account for some of these reductions. Type 2 sites, though impacted by vehicle emissions, are also affected by urban stationary sources whose emission trends over the measurement period are less clear and these sites seem to show more year to year variability. All sites are also impacted by naturally occurring VOCs such as isoprene, which is emitted by trees. All VOCs are not equal in their contribution to ozone formation and while isoprene levels are generally lower than many other VOCs, isoprene can account for a significant amount of the ozone forming potential, especially in non-urban areas. Isoprene levels are also highest during the middle of the day, when photochemical conditions are most conducive to ozone formation. Isoprene emissions are thought to be influenced by factors that affect tree health and growth, such as rainfall and severe temperatures.

Summaries of results for all of the VOCs measured at the New Jersey PAMS sites are provided in Table 1.

Table 1
Summary of Photochemical Assessment Monitoring (PAMS) Data
June, July, and August, 2013

Parts Per Billion (Volume) – ppbv
Parts Per Billion (Carbon) – ppbC

	Rutgers University			
	ppbv		**ppbC**	
	Average	**Maximum**	**Average**	**Maximum**
Acetylene	0.11	0.99	0.23	1.98
Benzene	0.07	1.63	0.39	9.76
n-Butane	0.20	2.46	0.79	9.83
1-Butene	0.02	0.19	0.10	0.76
cis-2-Butene	0.02	4.86	0.07	19.44
trans-2-Butene	0.02	0.22	0.08	0.88
Cyclohexane	0.03	0.43	0.18	2.60
Cyclopentane	0.02	0.25	0.12	1.27
n-Decane	0.01	0.70	0.13	6.99
m-Diethylbenzene	0.01	0.56	0.09	5.55
p-Diethylbenzene	0.01	0.38	0.06	3.81
2,2-Dimethylbutane	0.02	0.20	0.10	1.22
2,3-Dimethylbutane	0.03	0.46	0.21	2.76
2,3-Dimethylpentane	0.02	0.54	0.15	3.81
2,4-Dimethylpentane	0.02	0.77	0.13	5.40
Ethane	2.34	14.38	4.68	28.75
Ethylbenzene	0.02	0.59	0.16	4.75
Ethylene (Ethene)	0.21	3.18	0.42	6.36
m-Ethyltoluene	0.01	0.56	0.10	5.05
o-Ethyltoluene	0.01	0.34	0.06	3.04
p-Ethyltoluene	0.03	2.59	0.27	23.30

Table 1 (Continued)
Summary of Photochemical Assessment Monitoring (PAMS) Data
June, July, and August, 2013

Parts Per Billion (Volume) – ppbv
Parts Per Billion (Carbon) – ppbC

	Rutgers University			
	ppbv		**ppbC**	
	Average	**Maximum**	**Average**	**Maximum**
n-Heptane	0.04	2.26	0.25	15.84
Hexane	0.08	2.75	0.49	16.51
1-Hexene	0.01	0.20	0.06	1.21
Isobutane	0.49	15.60	1.98	62.41
Isopentane	0.43	7.65	2.17	38.23
Isoprene	0.38	4.75	1.88	23.75
Isopropylbenzene	0.01	0.19	0.07	1.68
Methylcyclohexane	0.03	1.72	0.21	12.04
Methylcyclopentane	0.05	0.68	0.29	4.06
2-Methylheptane	0.01	0.69	0.09	4.15
3-Methylheptane	0.01	0.48	0.08	2.86
2-Methylhexane	0.03	0.87	0.21	6.97
3-Methylhexane	0.03	1.36	0.24	10.89
2-Methylpentane	0.08	0.92	0.54	6.41
3-Methylpentane	0.05	0.54	0.35	3.76
n-Nonane	0.01	0.37	0.12	3.37
n-Octane	0.01	0.34	0.12	2.73
n-Pentane	0.26	6.59	1.29	32.94
1-Pentene	0.02	1.18	0.09	5.89
cis-2-Pentene	0.01	2.08	0.07	10.40
trans-2-Pentene	0.02	0.64	0.10	3.21
Propane	1.11	7.57	3.33	22.72
n-Propylbenzene	0.01	0.70	0.05	6.30
Propylene (Propene)	0.14	0.82	0.42	2.46
Styrene	0.01	0.76	0.09	6.09
Toluene	0.19	22.87	1.32	160.10
1,2,3-Trimethylbenzene	0.06	9.17	0.58	82.50
1,2,4-Trimethylbenzene	0.03	0.99	0.30	8.87
1,3,5-Trimethylbenzene	0.01	0.30	0.06	2.69
2,2,4-Trimethylpentane	0.09	1.90	0.69	15.20
2,3,4-Trimethylpentane	0.03	0.66	0.21	5.30
n-Undecane	0.01	0.35	0.07	3.84
m/p-Xylene	0.06	2.10	0.48	16.76
o-Xylene	0.03	0.89	0.21	7.15

References

1. Ozone: Good Up High, Bad Nearby, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC October 1997, URL: www.epa.gov/oar/oaqps/gooduphigh/

2. USEPA Fact Sheet: Health and Environmental Effects of Ground Level Ozone, USEPA, Office of Air and Radiation, July 1997, URL: www.epa.gov/ttn/oarpg/naaqsfin/o3health.html

3. Ryan, William, Air Quality Forecast Report Philadelphia Forecast Area 2001, Pennsylvania State University, Department of Meteorology, University Park, PA, March 2002, URL: http://www.meteo.psu.edu/~wfryan/phl_2001_final_report.htm

4. USEPA Ozone Map Archives, URL: www.epa.gov/airnow/maparch.html

5. Enhanced Ozone Monitoring – PAMS General Information, USEPA, 1994, URL: www.epa.gov/air/oaqps/pams/general.html

National Air Quality and Emissions Trend Report, 1999, EPA-454/R-01-004, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 2001, URL: www.epa.gov/oar/aqtrnd99/

Latest Findings on National Air Quality: 2000 Status and Trends, EPA-454/K-01-002, USEPA , Office of Air Quality Planning and Standards, RTP, September 2001, URL: www.epa.gov/oar/aqtrnd00/

Smog – Who Does it Hurt?, EPA-452/K-99-001, USEPA, Air and Radiation, Washington, DC, July 1999, URL: www.epa.gov/airnow/health/

Ozone and Your Health, EPA-152/F-99-000, USEPA, Air and Radiation, Washington, DC, September 1999, URL: www.epa.gov/airnow/brochure.html

Air Quality Guide for Ozone, EPA-456/F-002, Air and Radiation, Washington, DC, July 1999, URL: www.epa.gov/airnow/consumer.html

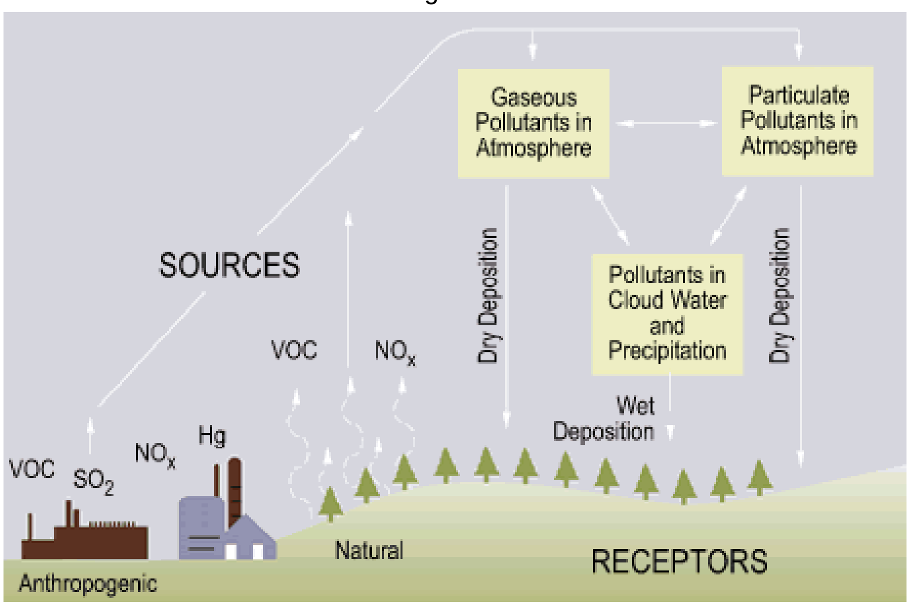
2013 Acid Deposition Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

Atmospheric deposition is a process in which pollutants are deposited on land or water from the air. Deposition is usually the result of pollutants being removed from the atmosphere and deposited by precipitation (wet deposition) or by the settling out of particulates (dry deposition). Dry deposition also includes gaseous pollutants that are absorbed by land or water bodies. Figure 1 shows the basic mechanisms of deposition and the major pollutants of concern. These include sulfur dioxide (SO_2), nitrogen oxides (NO_X), mercury (Hg), and volatile organic compounds (VOCs). SO_2 is a major contributor to acid deposition, which can reduce the ability of water bodies to support certain types of fish and other aquatic organisms. NO_X also contributes to the acid deposition problem and can contribute to eutrophication of water bodies as well. Hg will accumulate in fish by a process known as bio-magnification. Small amounts of Hg in water are concentrated in smaller organisms. These smaller organisms are in turn consumed by larger ones. As the Hg moves up the food chain, it becomes more concentrated. Fish in Hg contaminated water can become contaminated to the point where they are no longer safe for people to eat. For more information on Hg in fish see "A Guide to Health Advisories for Eating Fish and Crabs Caught in New Jersey Waters" which is available at http://www.state.nj.us/dep/dsr/njmainfish.htm. VOCs are a very diverse group of compounds, some of which are toxic, including known carcinogens.

Figure 1



Source: USEPA Clean Air Markets
Web Site: http://www.epa.gov/acidrain/what/index.html

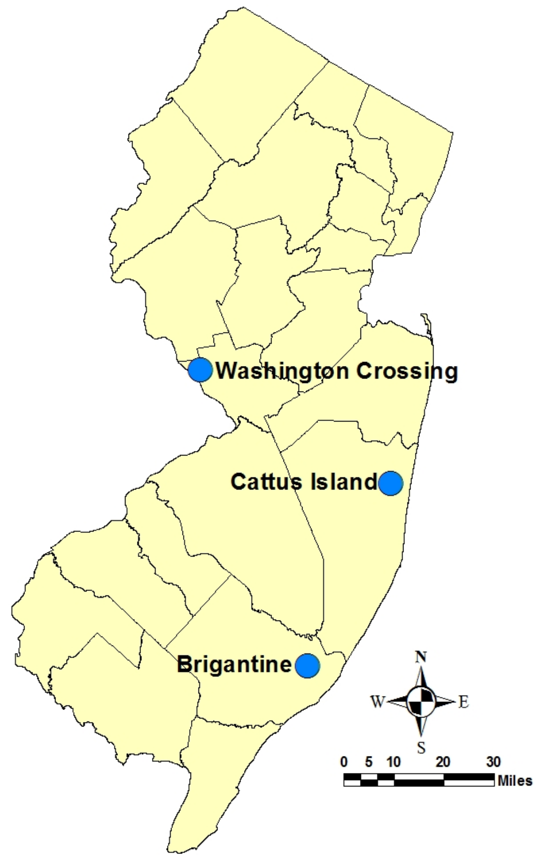
Atmospheric deposition is the result of pollution from a wide variety of sources and in some cases the pollution can travel great distances before being deposited on the land or water. Some known sources of atmospheric deposition are power plants, motor vehicles, incinerators, and certain industries.

MONITORING LOCATIONS

Figure 2 shows the three active deposition monitoring sites in New Jersey for 2013: Washington Crossing State Park, Cattus Island, and the Edwin B. Forsythe National Wildlife Refuge (NWR), also known as Brigantine. Each of the sites has a sampler for collecting wet deposition (rain and snow) and a rain gauge for determining precipitation amounts. The Ancora State Hospital monitoring site was shut down at the end of 2011 and the Cattus Island monitoring site began operation in September 2012.

Washington Crossing State Park, Cattus Island, and the Edwin B. Forsythe (NWR) are part of the National Atmospheric Deposition Program's (NADP) National Trends Network (NTN). A sample is collected every week from each site. The New Jersey Department of Environmental Protection (NJDEP) collects all samples from Washington Crossing and Cattus Island. The United States Fish and Wildlife Service – Air Quality Branch (USFWS-AQB) is responsible for sample collection at the Edwin B. Forsythe NWR or Brigantine. All collected samples are shipped to the Central Analytical Laboratory (CAL) at the Illinois State Water Survey (ISWS) for analysis. The CAL analyzes each sample with the goal of providing data on amounts, trends, and geographic distributions of acids, nutrients, and base cations in precipitation. The resulting data is then used by the U.S. Environmental Protection Agency (USEPA) to assess national deposition patterns and trends. (NADP, 2011)

Figure 2
Acid Precipitation Monitoring Network - 2013



SUMMARY OF 2013 DATA

A summary of the 2013 wet deposition data is provided in Table 1. Raw data was obtained from the NADP website (NADP, 2014). The table shows total deposition, pH, conductivity and concentrations of several important ions. When acidity is reported on the pH scale, neutral is considered a 7 with decreasing pH values corresponding to increasing acidity. Normal rainfall has a pH of approximately 5.6 due to the natural presence of carbonic acid in the air. The mean pH values recorded at the Washington Crossing State Park and Cattus Island weekly samplers was 5.13 and 5.04 respectively. The Edwin B. Forsythe NWR sampler recorded a mean pH of 5.00.

Conductivity is a measure of the total density of ions in the water collected. It is used as an indicator of the total amount of pollution in the sample. Conductivity is the ability of the water to conduct electricity and generally increases as the concentration of ions in water increases.

Concentrations of specific ions considered important because they can affect the chemistry of lakes, streams and other water bodies, are also reported for each site. Summaries are provided for each season of the year along with annual averages in Table 1.

Table 1
Acid Precipitation Monitoring Network - 2013
Annual and Seasonal Averages
Weighted by Precipitation Amount

Ca^{2+}	- Calcium	Cond.	- Specific conductance
Mg^{2+}	- Magnesium	cm	- Centimeter
K^{+}	- Potassium	uS/cm	- MicroSiemens per centimeter
Na^{+}	- Sodium	mg/L	- Milligrams per liter
NH_4^{+}	- Ammonium	<MDL	- Below minimum detection limit
NO_3^{-}	- Nitrate	Winter	- December – February
Cl^{-}	- Chloride	Spring	- March – May
SO_4^{2-}	- Sulfate	Summer	- June – August
–	- No Data	Fall	- September – November

Edwin B. Forsythe National Wildlife Refuge – Weekly

	Precip. cm	pH	Cond. uS/cm	Ca^{2+} mg/L	Mg^{2+} mg/L	K^{+} mg/L	Na^{+} mg/L	NH_4^{+} mg/L	NO_3^{-} mg/L	Cl^{-} mg/L	SO_4^{2-} mg/L
Winter	24.25	4.91	19.89	0.109	0.225	0.076	1.825	0.095	0.576	3.308	0.871
Spring	30.43	5.20	12.18	0.106	0.110	0.053	0.875	0.265	0.603	1.585	0.777
Summer	31.60	4.99	8.82	0.053	0.041	0.028	0.291	0.203	0.641	0.578	0.560
Fall	18.39	4.94	13.09	0.063	0.093	0.045	0.785	0.202	0.619	1.365	0.749
Annual	110.10	5.00	11.11	0.069	0.078	0.039	0.624	0.189	0.603	1.143	0.647

Washington Crossing State Park – Weekly

	Precip. cm	pH	Cond. uS/cm	Ca^{2+} mg/L	Mg^{2+} mg/L	K^{+} mg/L	Na^{+} mg/L	NH_4^{+} mg/L	NO_3^{-} mg/L	Cl^{-} mg/L	SO_4^{2-} mg/L
Winter	23.75	4.95	9.77	0.075	0.043	0.021	0.364	0.186	0.804	0.642	0.597
Spring	20.49	5.28	7.00	0.117	0.035	0.029	0.186	0.274	0.755	0.332	0.600
Summer	51.70	5.09	7.11	0.048	0.015	0.033	0.073	0.275	0.692	0.133	0.499
Fall	16.13	5.30	4.99	0.052	0.020	0.023	0.122	0.148	0.390	0.215	0.350
Annual	109.70	5.13	6.88	0.061	0.021	0.027	0.122	0.231	0.649	0.219	0.488

Cattus Island – Weekly

	Precip. cm	pH	Cond. uS/cm	Ca^{2+} mg/L	Mg^{2+} mg/L	K^{+} mg/L	Na^{+} mg/L	NH_4^{+} mg/L	NO_3^{-} mg/L	Cl^{-} mg/L	SO_4^{2-} mg/L
Winter	33.37	5.06	28.32	0.149	0.390	0.121	3.272	0.089	0.533	5.933	1.141
Spring	21.18	5.14	22.01	0.154	0.285	0.096	2.273	0.204	0.653	4.246	1.119
Summer	40.68	4.95	10.92	0.058	0.061	0.036	0.470	0.228	0.727	0.872	0.724
Fall	11.92	5.18	19.42	0.102	0.258	0.081	2.140	0.090	0.385	3.776	0.834
Annual	101.58	5.04	15.22	0.089	0.158	0.058	1.273	0.167	0.604	2.330	0.797

WET DEPOSITION

Acid deposition is primarily the result of sulfuric and nitric acids and ammonium derived from atmospheric emissions of sulfur dioxide, nitrogen oxides, and ammonia. Excessive deposition of these materials can have significant environmental impacts on both terrestrial and freshwater ecosystems through acidification of soil and water bodies, reducing the diversity of aquatic organisms and stressing native vegetation. (Driscoll et al, 2003)

Sulfate, for example, can alter soil and water chemistry, and a deposition level of 20 kilograms per hectare per year has been generally accepted as the limit above which damage to sensitive natural resources is likely to occur (i.e. Aquatic Effect Level). Deposition in rain and snow is often expressed as mass per unit land area over time (NJCRP, 2003).

Figures 3 and 4 show the change in the amount of sulfate ion deposited over the last several years at the sites in Washington Crossing State Park and the Edwin B. Forsythe NWR, respectively. Figures 5 and 6 show the change in the amount of ammonium ion deposited at these sites, and Figures 7 and 8 shows the change in the amount of nitrate ion deposited. All figures below show “wet deposition” only. They do not include dry particulate deposited when no precipitation was occurring. Therefore, the total deposition is higher than what is shown here.

The year to year variations in the charts below are a function of both the concentrations of sulfate, nitrate, and ammonium in air and cloud droplets, and the total amount of precipitation that occurs each year. For example, in 1991 and 1992, both the sulfate concentrations and the total precipitation were below normal, while they were high in 1993 and 1994. Since the data is in the form of annual totals, it is also sensitive to loss of samples due to contamination or other factors.

According to the New Jersey Comparative Risk Project Ecological Technical Work Group, streams and lakes with significant buffering capacity are somewhat protected from the effects of acid deposition. It is for this reason that actual risk assessments are primarily based on the direct observation of pH in streams and lakes, and on actual observed effects on aquatic species, rather than on deposition measurements alone (NJCRP, 2003).

To convert the values shown in Figure 3 through Figure 8 to pounds per acre per year, multiply by 0.89 (since one kilogram equals 2.21 pounds and one hectare equals 2.47 acres).

Note that the Cattus Island site is not included in the trend charts below because there is only one complete year of valid data available.

Figure 3 through 8 Data Legend	
●	Met Criteria
▲	Did Not Meet Criteria
All Raw Data for Figure 3 through Figure 8 were obtained from the NADP website. NADP criteria requirements can also be found at http://nadp.isws.illinois.edu/.	

Figure 3
Sulfate (SO4) NADP/NTN Site NJ99 (Washington Crossing State Park)
Annual Wet Deposition (1981-2013)
Kilograms Per Hectare (kg/ha)

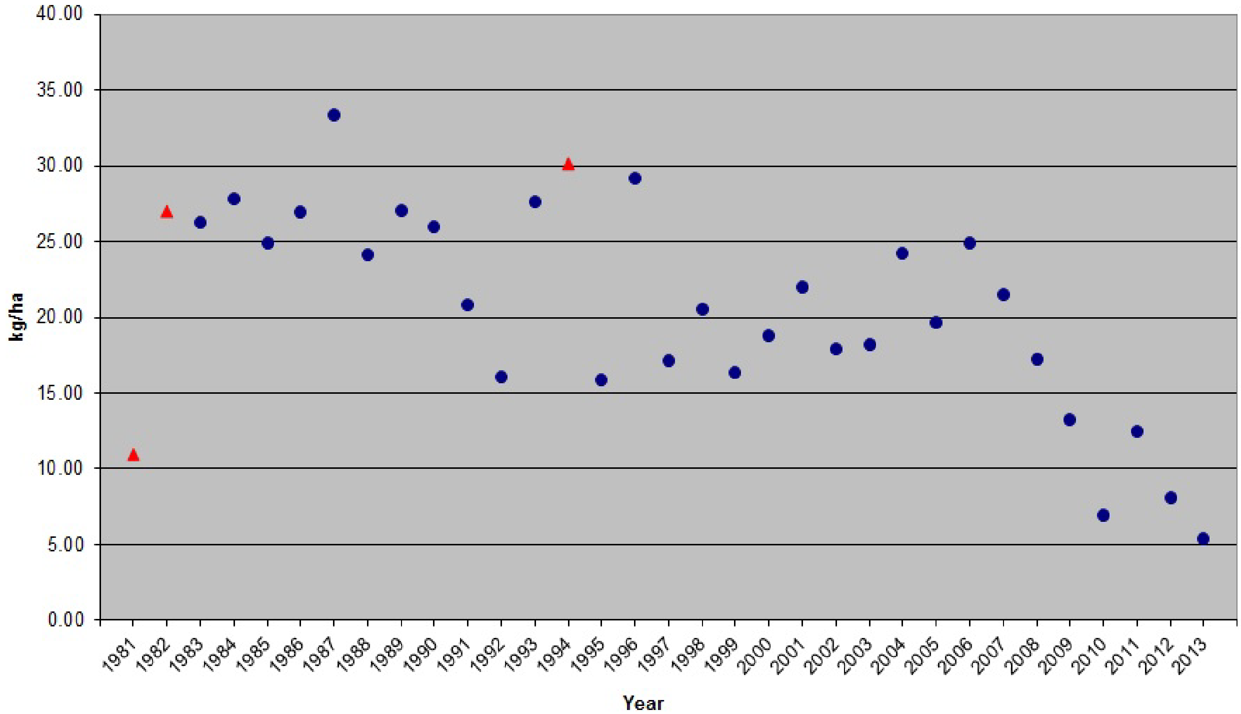


Figure 4
Sulfate (SO4) NADP/NTN Site NJ00 (Edwin B. Forsythe National Wildlife Refuge)
Annual Wet Deposition (1998-2013)
Kilograms Per Hectare (kg/ha)

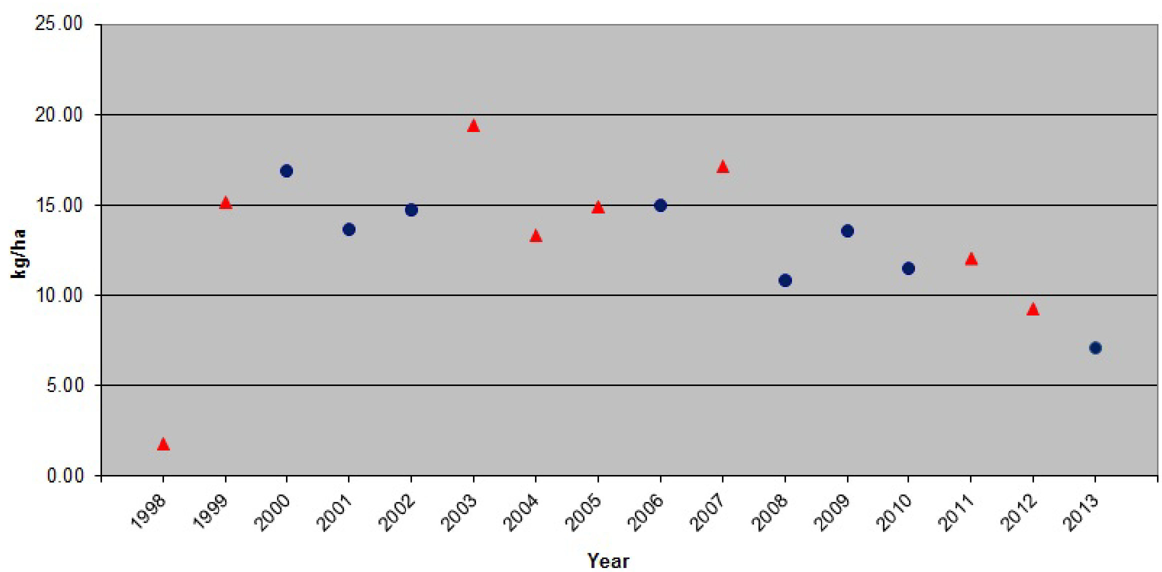


Figure 5
Ammonium (NH4) NADP/NTN Site NJ99 (Washington Crossing State Park)
Annual Wet Deposition (1981-2013)
Kilograms Per Hectare (kg/ha)

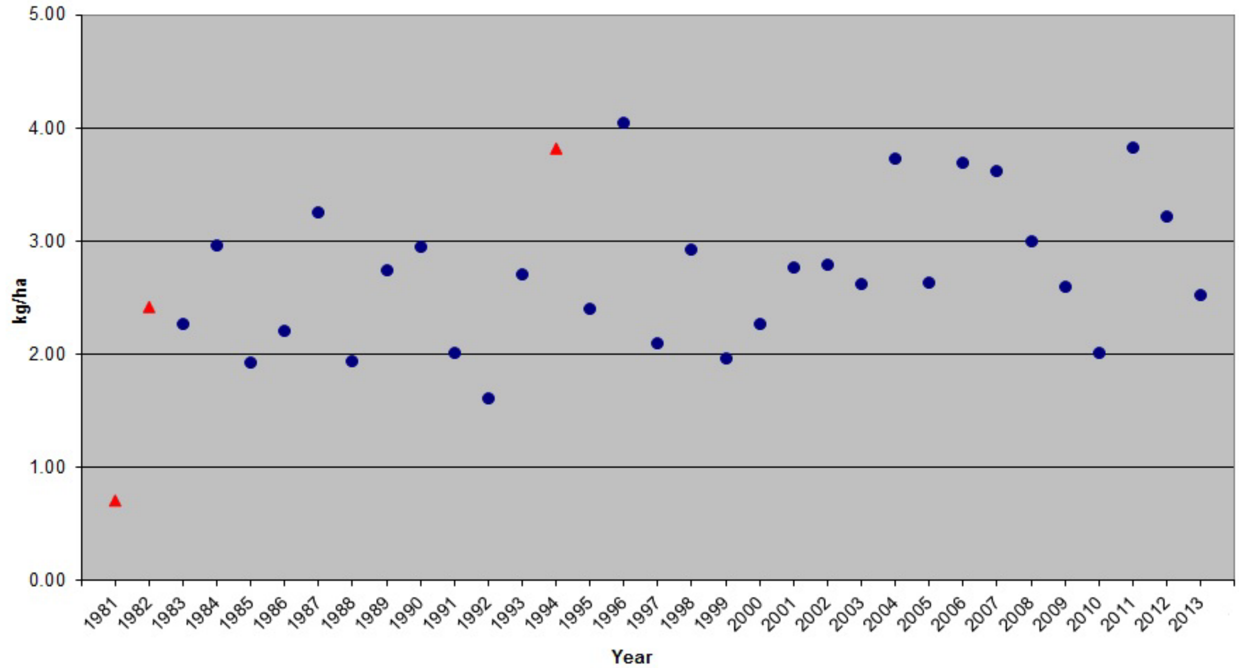


Figure 6
Ammonium (NH4) NADP/NTN Site NJ00 (Edwin B. Forsythe National Wildlife Refuge)
Annual Wet Deposition (1998-2013)
Kilograms Per Hectare (kg/ha)

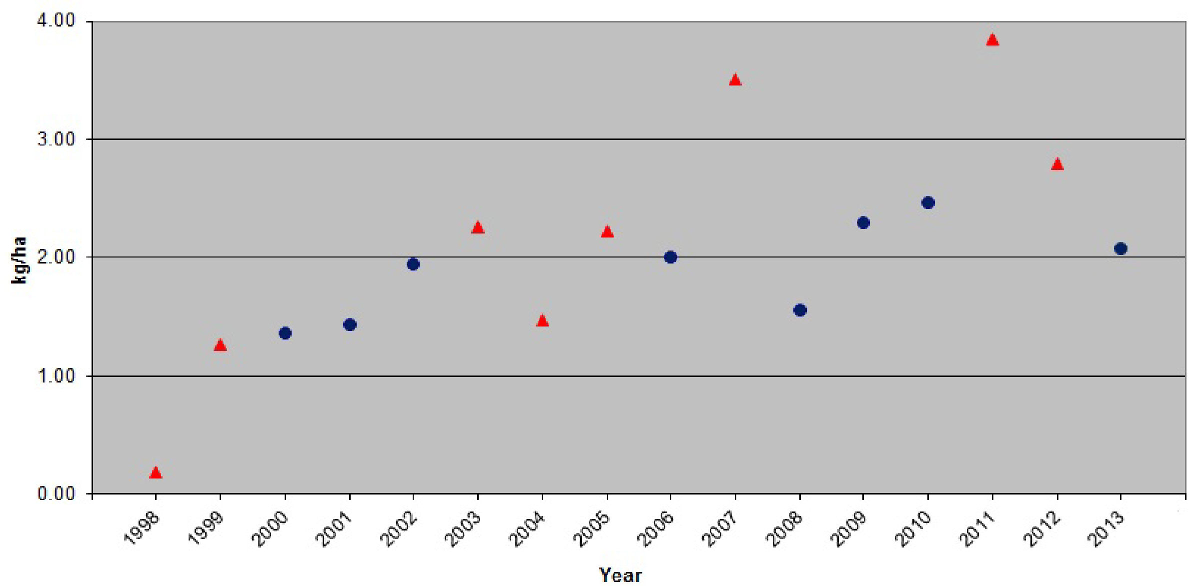


Figure 7
Nitrate (NO3) NADP/NTN Site NJ99 (Washington Crossing State Park)
Annual Wet Deposition (1981-2012)
Kilograms Per Hectare (kg/ha)

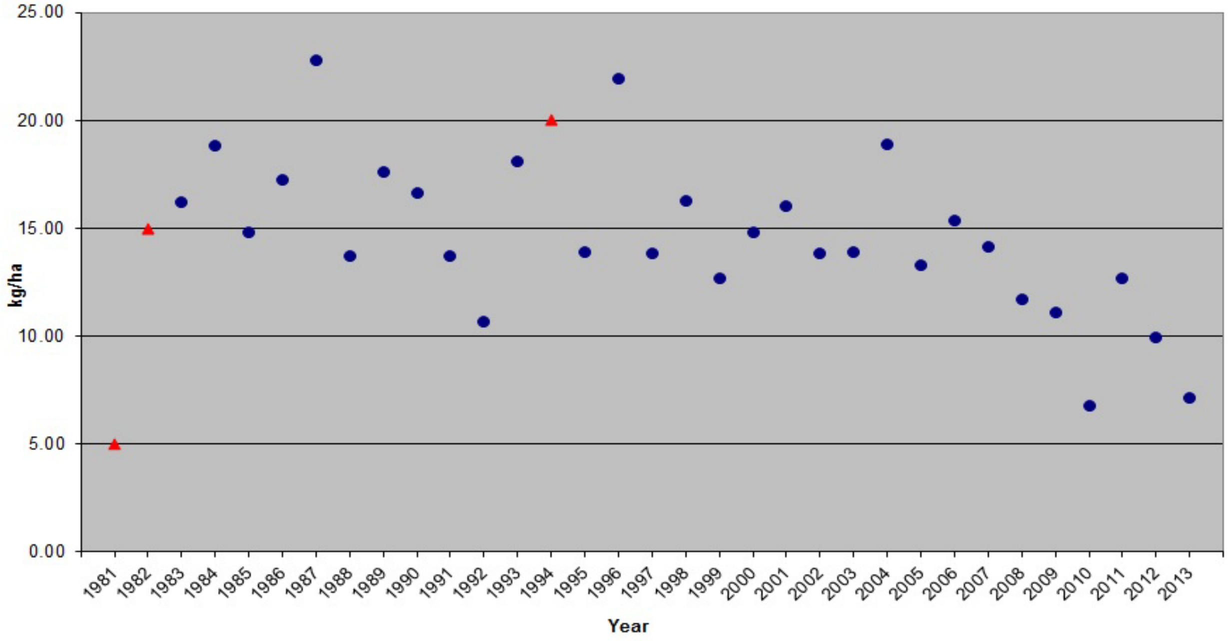
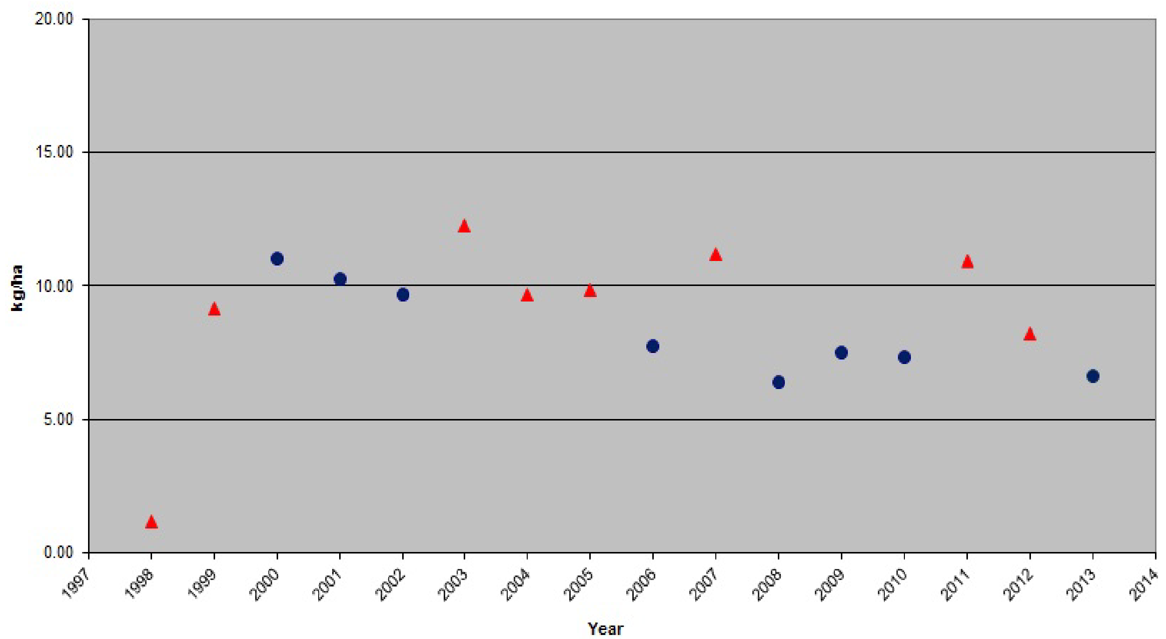


Figure 8
Nitrate (NO3) NADP/NTN Site NJ00 (Edwin B. Forsythe National Wildlife Refuge)
Annual Wet Deposition (1998-2012)
Kilograms Per Hectare (kg/ha)



REFERENCES

Driscoll, C.T., Driscoll, K.M., Mitchell, M.J. and D.J. Raynal. 2003. Effects of acidic deposition on forest and aquatic ecosystems in New York State. Environmental Pollution, 123(3):327-336. http://www.esf.edu/hss/HF%20Ref%20PDF/EvnPol.123.327.336.pdf.

FISH SMART, EAT SMART: A Guide to Health Advisories for Eating Fish & Crabs Caught in New Jersey Waters -2006, New Jersey Department of Environmental Protection (NJDEP), Division of Science, Research and Technology, 2006, URL. www.state.nj.us/dep/dsr/njmainfish.htm.

National Atmospheric Deposition Program (NRSP-3). 2010. NADP Program Office, Illinois State Water Survey, 2204 Griffith Dr., Champaign, IL 61820. http://nadp.isws.illinois.edu/

New Jersey Comparative Risk Project, Ecological Technical Work Group, NJDEP, Division of Science, Research and Technology, July 2003, URL: http://www.state.nj.us/dep/dsr/njcrp/.

United States Environmental Protection Agency (USEPA) Clean Air Markets, 2007, URL: http://www.epa.gov/acidrain/what/index.html.

2013 Regional Haze & Visibility Summary

New Jersey Department of Environmental Protection

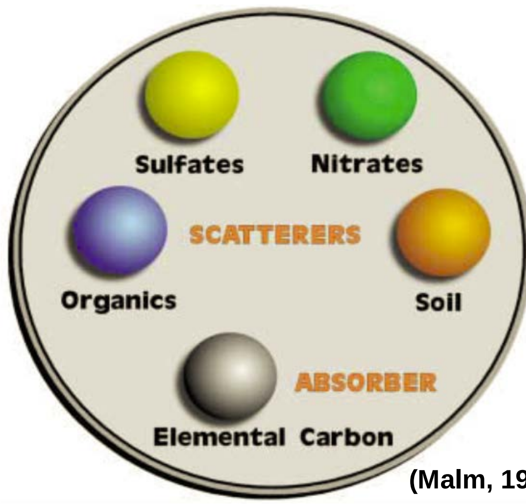
THE BASICS OF HAZE

Haze is a type of visibility impairment usually associated with air pollution, and to a lesser extent, moisture in the atmosphere. Small particles and certain gaseous molecules can cause poor visibility by scattering or absorbing light before it reaches an observer (Figure 1). When high concentrations of such pollutants are well mixed in the atmosphere they form a uniform haze that can obscure distant objects.

Air pollutants come from a variety of natural and man-made sources and can occur at any time of year. Natural sources include small particles from windblown dust and soot from wildfires and volcanoes. Man-made sources, which are the primary cause of visibility impairment, include motor vehicle emissions, electric utility and industrial fuel burning emissions, and manufacturing operations.

Pollution from both natural and man-made sources can be transported over long distances and across state boarders on prevailing winds, contributing to the problem of regional haze.

Figure 1
Contributors to Visibility Impairment



(Malm, 1999)

ANATOMY OF REGIONAL HAZE

The following categories of air pollutants are the major contributors to haze. (Source - www.hazecam.net)

Sulfate particles form in the air from sulfur dioxide gas. Most of this gas is released from coal-burning power plants and other industrial sources, such as smelters, industrial boilers, and oil refineries. Sulfates are the largest contributor to haze in the eastern U.S., due to the large number of coal-fired power plants that affect the region. In humid environments, sulfate particles grow rapidly to a size that is very efficient at scattering light, thereby exacerbating the problem in the East.

Organic carbon particles are emitted directly into the air and are also formed by the reaction of various gaseous hydrocarbons. Sources of direct and indirect organic carbon particles include vehicle exhaust, vehicle refueling, solvent evaporation (e.g., paints), food cooking, and various commercial and industrial sources. Gaseous hydrocarbons are also emitted naturally from trees and from fires, but these sources usually have only a small or short-term effect on overall visibility.

Nitrate particles form in the air from nitrogen oxide gas. This gas is released from virtually all combustion activities, especially those involving cars, trucks, off-road engines (e.g., construction equipment, lawn mowers, and boats), power plants, and other industrial sources. Like sulfates, nitrates scatter more light in humid environments.

Elemental carbon particles are very similar to soot. They are smaller than most other particles and tend to absorb rather than scatter light. The "brown clouds" often seen in winter over urban areas and in mountain valleys can be largely attributed to elemental carbon. These particles are emitted directly into the air from virtually all combustion activities, but are especially prevalent in diesel exhaust and smoke from the burning of wood and wastes.

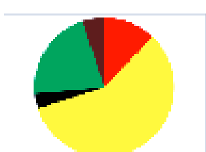
Soil is very similar to dust. It enters the air from dirt roads, fields, and other open spaces as a result of wind, traffic, and other surface activities. Whereas other types of particles form from the condensation and growth of microscopic particles and gasses, crustal material results from the crushing and grinding of larger, earth-born material. Because it is difficult to reduce this material to microscopic sizes, crustal material tends to be larger than other particles and tends to fall from the air sooner, contributing less to the overall formation of haze.

Particles and Visibility

Figure 2 (below) shows the makeup of fine particles collected at the Interagency Monitoring of Protected Visual Environments (IMPROVE) site located north of Atlantic City in the Edwin B. Forsythe National Wildlife Refuge (Brigantine).

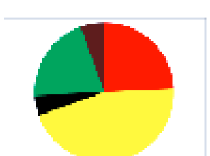
Figure 2
Composition of Fine Particles on Days with Good Visibility Compared to Days with Poor Visibility
Brigantine, NJ
July 2012 – June 2013**

Average Fine Mass Composition on Days with Good Visibility



Ammonium Nitrate	0.22 μg/m³	12.1%
Ammonium Sulfate	1.07 μg/m³	58.0%
Elemental Carbon	0.06 μg/m³	3.5%
Organic Carbon	0.39 μg/m³	21.4%
Soils	0.09 μg/m³	5.1%
Total 1.84 μg/m³		

Average Fine Mass Composition on Days with Poor Visibility



Ammonium Nitrate	2.45 μg/m³	24.2%
Ammonium Sulfate	4.59 μg/m³	45.4%
Elemental Carbon	0.47 μg/m³	4.6%
Organic Carbon	2.05 μg/m³	20.3%
Soils	0.59 μg/m³	5.5%
Total 10.11 μg/m³		

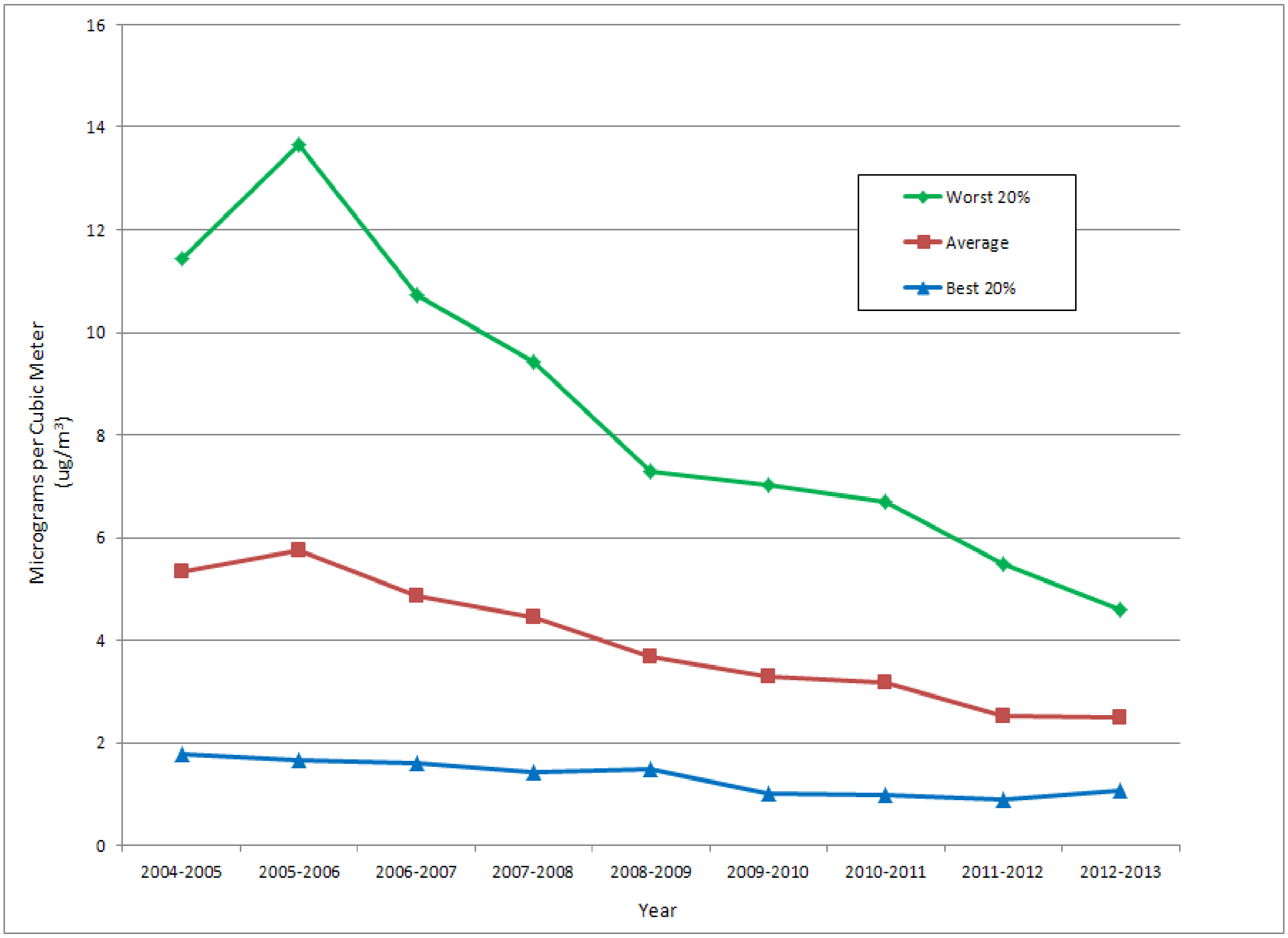
** For this report annual data for a given year is defined as data from July 1st – June 30th of the following year

Most visibility impairment is due to sulfate, which can have a greater effect on light extinction (a measure of visibility impairment), due to its ability to accumulate water and grow in size during humid conditions. Evaluations of the data for 2012-2013 indicate that sulfates accounted for approximately 58% of the total fine particle mass on days with good and approximately 45.4% on bad visibility. Higher sulfate values in the summer can be attributed to the greater photochemical conversion of sulfur dioxide (SO2) to sulfate that result from the increased sunlight during the summertime. (Malm, 1999)

The graph below (Figure 3) represents the annual trend of sulfates expressed in micrograms per cubic meter measured at the Brigantine National Wildlife Refuge.

The graph shows the annual average for each year as well as the average concentration on the days with the best visibility, and the average on the days with the worst visibility, using the upper and lower 20% of the data as a cut off. Sulfate trends have improved over the last few years as a result of more stringent regulations and guidelines from both the United States Environmental Protection Agency (USEPA) and the New Jersey Department of Environmental Protection (NJDEP).

Figure 3
Sulfate Trend Summary**
Brigantine, NJ
2004-2013



**For this report annual data for a given year is defined as data from July 1st – June 30th of the following year

How is Haze Regulated?

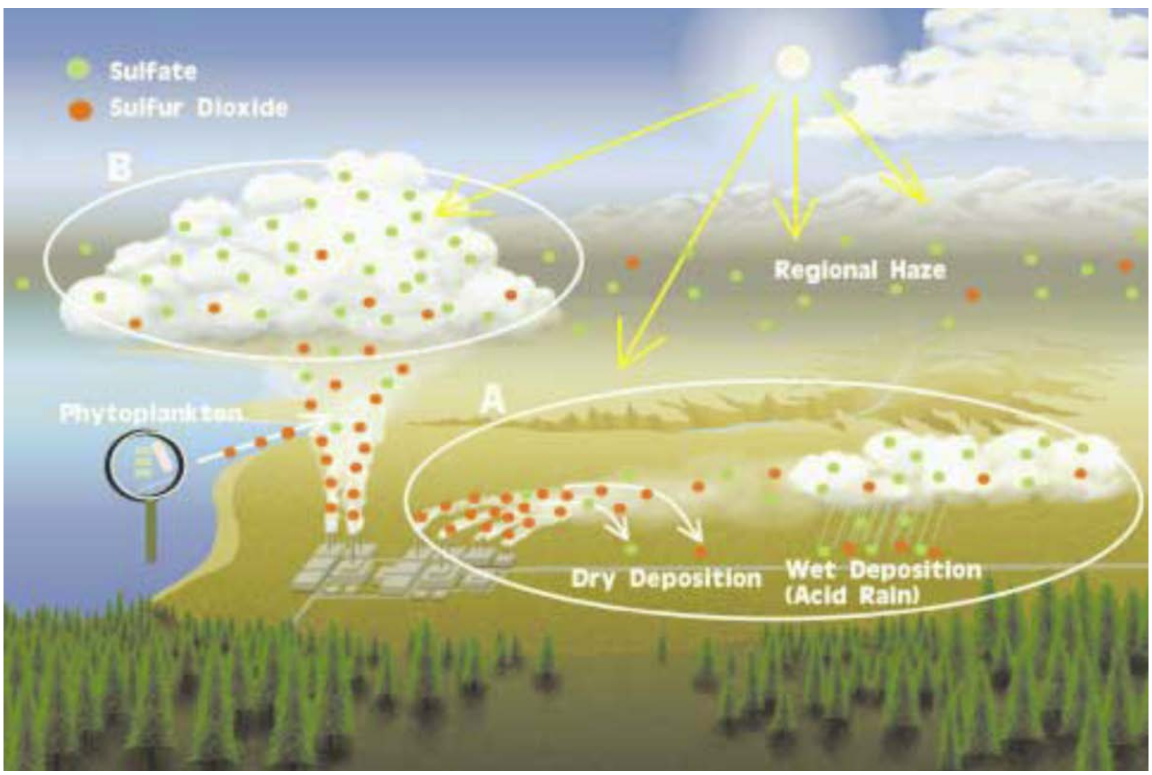
In 1999, the U.S. Environmental Protection Agency announced a major effort to improve air quality in national parks and wilderness areas aimed at achieving national visibility goals by 2064. The Regional Haze Rule calls for state and federal agencies to work together to improve visibility in 156 National Parks and wilderness areas such as the Grand Canyon, Yosemite, the Great Smokies and Shenandoah. This "regional haze rule" addresses the combined visibility effects of numerous pollution sources over a wide geographic region and how they impact Class I areas. Class I areas, as defined by the Clean Air Act, include national parks greater than 6,000 acres, wilderness areas and national memorial parks greater than 5,000 acres, and international parks that existed as of August 1977. This definition includes the

Edwin B. Forsythe National Wildlife Refuge in Brigantine, New Jersey. The rule requires the states, in coordination with the Environmental Protection Agency, the National Park Service, U.S. Fish and Wildlife Service, the U.S. Forest Service, and other interested parties, to develop and implement air quality protection plans to reduce the pollution that causes visibility impairment. The first State plans for regional haze were due in the 2003-2008 timeframe. New Jersey proposed its first plan for the Brigantine Class I area in September 2008 and it was finalized in July 2009.

ENVIRONMENTAL EFFECTS

Regional haze is most closely associated with its effects on prized vistas such as the Grand Canyon, Acadia National Park, and other Class I areas, such as Brigantine. Its impacts may be difficult to quantify but it certainly has a negative overall effect on aesthetics and the outdoors, and how natural areas throughout the nation are enjoyed. Haze also affects urban areas and scenes, and can obscure or eclipse the view of an urban skyline or other important urban landmarks such as the Washington Monument. The pollution that causes regional haze has additional effects on the environment through the acidic makeup of fine particles, such as sulfates. Sulfates eventually make their way into the ecosystem through atmospheric deposition - that is, they are transferred from the air into the water and soils (Figure 4). Too much atmospheric deposition can have adverse environmental effects by upsetting the delicate balance of the ecosystem; thus, causing damage to waterways, plants, soils, and wildlife (see section on Atmospheric Deposition).

Figure 4
Illustration of How Sulfates Enter the
Ecosystem by way of Deposition



MONITORING OF HAZE IN NEW JERSEY

Typical visual range in the eastern U.S. is 15 to 30 miles, or about one-third of what it would be without man-made air pollution. In the West, the typical visual range is 60 to 90 miles, or about one-half of the visual range under natural conditions. Haze diminishes this natural visual range. (www.hazecam.net)

Visibility and haze are monitored in two locations in New Jersey, Newark and Brigantine. The monitor in Newark measures the impact of haze on visibility by using a digital camera. The camera is located inside the New Jersey Transit building and is pointed at the New York City skyline. On clear days the entire skyline, as well as each individual building, is easily distinguishable (Figure 5). The Manhattan skyline appears non-existent when conditions conducive to haze formation occur (Figure 6).

Visibility Camera – New Jersey Transit Building

Figure 5

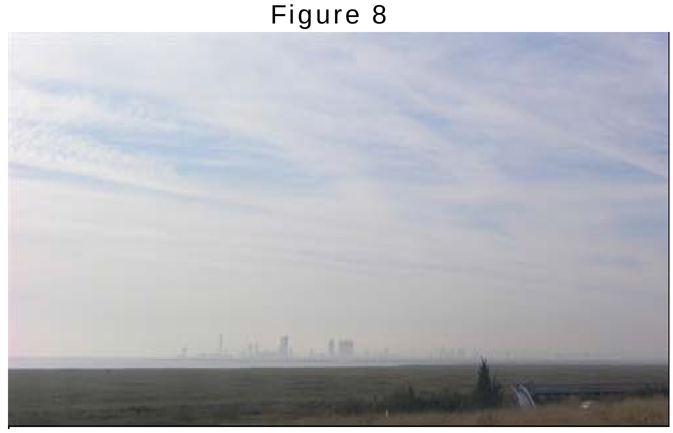
Figure 6

The IMPROVE site located within the Edwin B. Forsythe National Wildlife Refuge in Brigantine also monitors haze and visibility using a digital camera. Figure 7 below is an example of a clear day in Brigantine as the Atlantic City skyline is easily distinguishable along the horizon. The example of a hazy day in Brigantine is illustrated in Figure 8 and the skyline is barely visible.

Visibility Camera – Brigantine National Wildlife Refuge

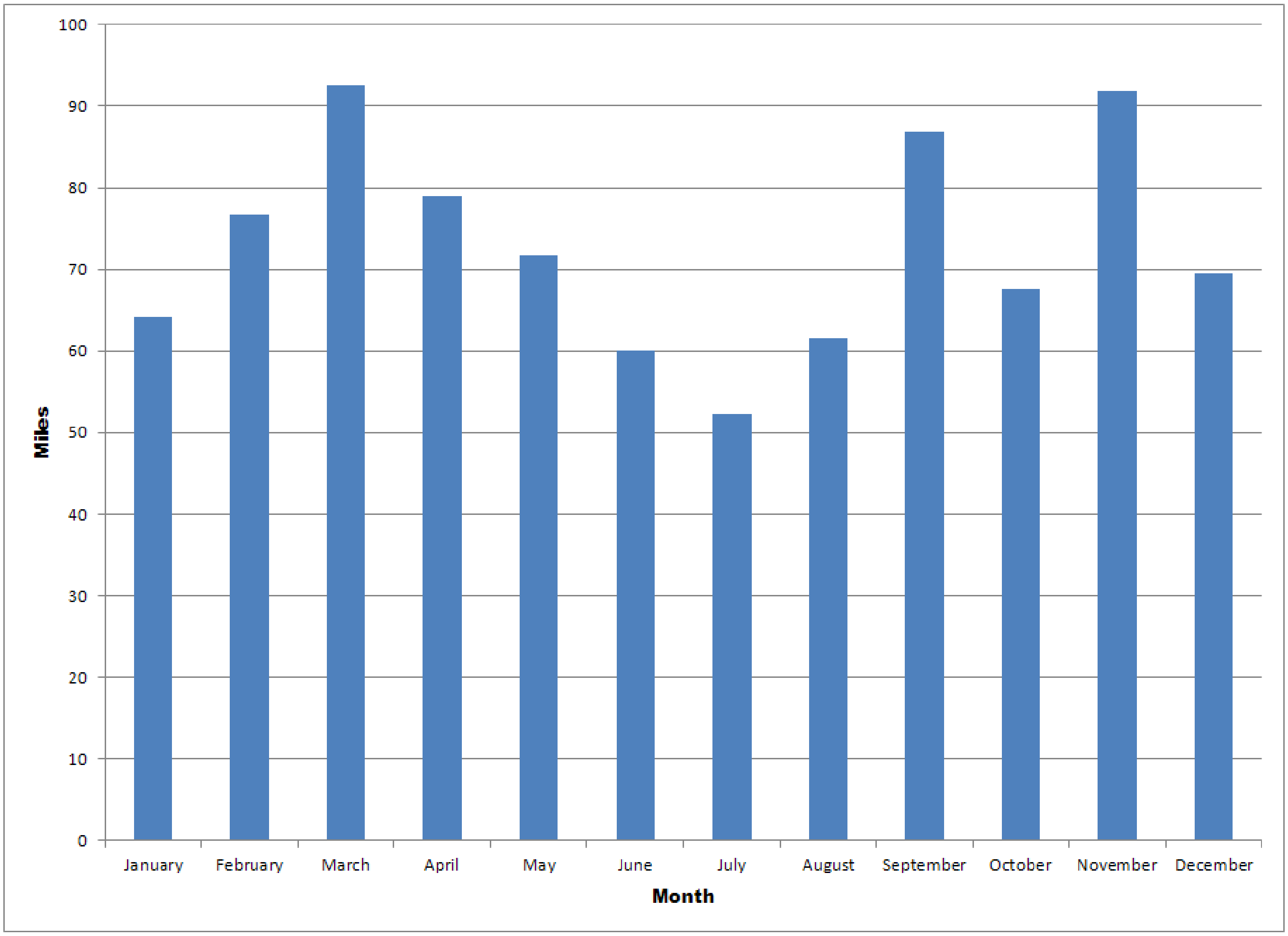
Figure 7

Figure 8



Brigantine also provides a real-time estimate of visibility using a nephelometer which measures the scattering of light by particles in the air. The nephelometer in Brigantine does not measure the moisture in the air and therefore the visual range values reported below (Figure 9) are higher than what is normally reported for the eastern United States. Visual range is most impaired during the summer when warm, hazy, humid conditions are most frequent as illustrated by the following graph. This graph also shows a slight decrease in visibility occurred in October. This change in visibility was due to unusually warmer temperatures, an increase in dew point and humidity, and an increase in sulfate numbers during October, all which have a negative impact on visual range. (RAWS)

Figure 9
Monthly Average Visual Range
Brigantine, NJ



REFERENCES

Federal Land Manager Environmental Database. http://views.cira.colostate.edu/fed/

Malm, William, C., Introduction to Visibility, Air Resources Division, National Park Service, Cooperative Institute for Research in the Atmosphere (CIRA), NPS Visibility Program, Colorado State University, Fort Collins, CO, May, 1999.

National Air Quality and Emissions Trends Report, 1998. http://www.epa.gov/airtrends/aqtrnd98/chapter6.pdf

NESCAUM. Regional Haze: A Resource Guide for Journalist, MANE-VU Media Resource Guide, Washington, D.C., May, 2005.

NESCAUM. Regional Haze and Visibility in the Northeast and Mid-Atlantic States, Northeast States for Coordinated Air Use Management, Boston, MA, January, 2001.

NESCAUM. www.nescaum.org

RAWS US Climate Archives. http://www.raws.dri.edu/

Realtime Air Pollution & Visibility Monitoring (Camnet). www.hazecam.net

2013 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. Weather phenomena, such as precipitation and solar radiation, influence chemical reactions and transformations in the atmosphere that affect air pollutants. 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.

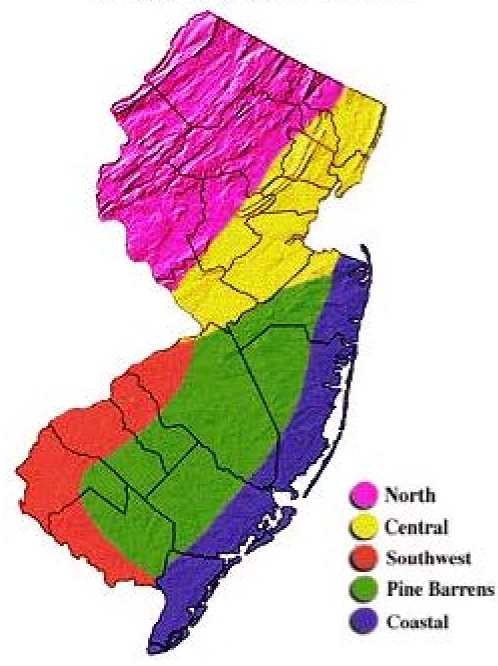
Scientists, engineers, and policy makers can use results of the air pollution models as a screening tool for comparison to the National Ambient Air Quality Standards (NAAQS), to determine the impacts of new and existing air pollution sources, and to design ambient air monitoring networks. The meteorological data collected by the New Jersey Department of Environmental Protection (NJDEP) can assist planners in preparing State Implementation Plans (SIPs), engineers in designing or evaluating air pollution permit applications and scientists in locating 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 zones, their distance from the Atlantic Ocean, and the prevailing atmospheric flow patterns affecting those zones produce distinct variations in the daily weather between each of them. These climate zones are shown in Figure 1.

Figure 1
New Jersey Climate Zones



Source: Office of the New Jersey State Climatologist

Monitoring Locations

The NJDEP maintains a network of nine meteorological monitoring locations. In addition, total weekly precipitation is measured in Washington Crossing and Cattus Island Park. Not all meteorological parameters are measured at each site. Table 1 depicts the meteorological parameters measured at each site and Figure 2 depicts the 2013

Meteorological Monitoring Network. In Table 2, the 2013 meteorological data is summarized by site. Figures 3, 5, 7, 9, 11, 13, and 15 show the monthly maximum, mean, and minimum temperatures at the Camden Spruce Street, Columbia WMA, East Orange, Flemington, Newark Firehouse, Passaic, and Rider University meteorological stations respectively. Figures 4, 6, 8, 10, 12, 14, and 16 depict the observed average monthly temperature difference from the 30-year average monthly temperature, as measured by the State Climatologist, at the Camden Spruce Street, Columbia WMA, East Orange, Flemington, Newark Firehouse, and Rider University meteorological stations respectively. Figures 17 through 24 depict annual wind roses for Camden Spruce Street, Columbia WMA, East Orange, Elizabeth Trailer, Flemington, Newark Firehouse, Passaic and Rider University respectively.

TABLE 1

2013 METEOROLOGICAL MONITORING NETWORK PARAMETER SUMMARY

Measured Parameters

Site Name	Temperature	Relative Humidity	Wind Speed	Wind Direction	Barometric Pressure	Solar Radiation	Precipitation
Camden Spruce Street	X	X	X	X	X		
Cattus Island							X
Chester						X	
Columbia WMA	X	X	X	X	X		
East Orange	X	X	X	X	X		
Elizabeth Lab			X	X			
Flemington	X	X	X	X	X	X	
Newark Firehouse	X	X	X	X	X	X	
Passaic	X	X	X	X	X		
Rider University	X	X	X	X	X		
Washington Crossing							X

Figure 2

2013 Meteorological Monitoring Network

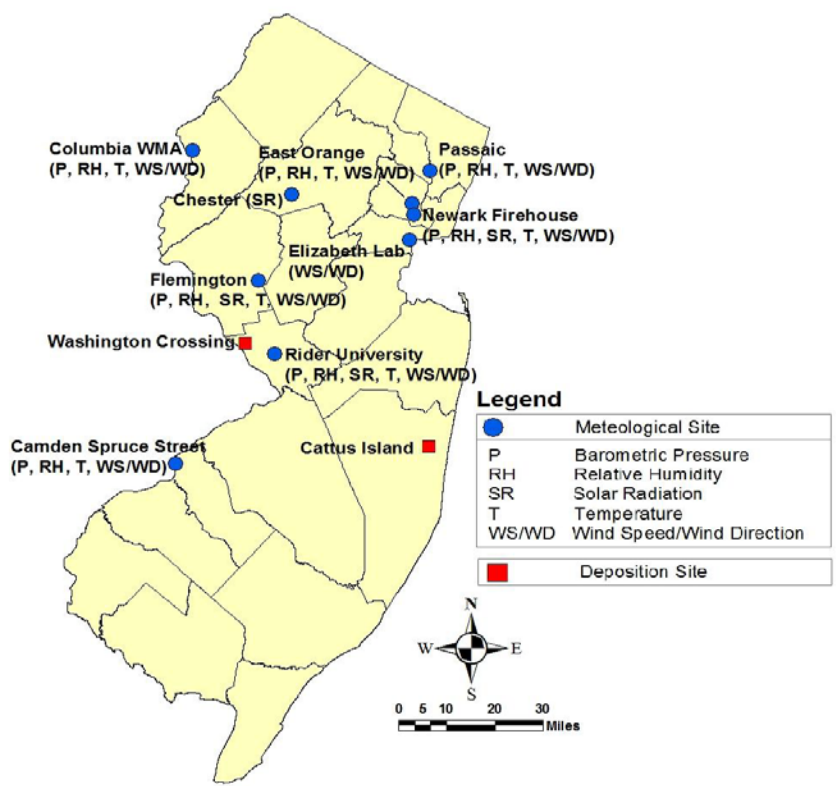


Table 2
Summary of Meteorological Monitoring Data - 2013

MONITORING SITES		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	YEAR
Camden Spruce Street														
Temperature: (°F)	Mean[5]	No Data[4]	No Data[4]	No Data[4]	No Data[4]	66/62	72/71	79/76	74/74	67/67	59/56	44/47	38/37	62/54
	Min	No Data[4]	No Data[4]	No Data[4]	No Data[4]	44	56	63	59	49	39	24	22	22
	Max	No Data[4]	No Data[4]	No Data[4]	No Data[4]	92	91	96	87	91	85	70	67	96
Relative Humidity: %	Mean	No Data[4]	No Data[4]	No Data[4]	No Data[4]	60.1	65.8	66.1	65.9	60.6	63.6	53.4	64.4	62.5
	Min	No Data[4]	No Data[4]	No Data[4]	No Data[4]	21.3	25.3	31.7	30.1	25.2	31.1	17.5	33.9	17.5
	Max	No Data[4]	No Data[4]	No Data[4]	No Data[4]	96.4	95.2	94.2	92.5	92.5	91.9	93.1	93.0	96.4
Barometric Pressure (in of Hg)	Mean	No Data[4]	No Data[4]	No Data[4]	No Data[4]	29.98	29.90	30.00	30.00	30.00	30.04	30.16	30.09	30.02
	Min	No Data[4]	No Data[4]	No Data[4]	No Data[4]	29.68	29.38	29.57	29.69	29.64	29.60	29.38	29.42	29.38
	Max	No Data[4]	No Data[4]	No Data[4]	No Data[4]	30.25	30.29	30.32	30.39	30.40	30.37	30.72	30.57	30.72
Chester														
Solar Radiation: (Langleys)	Mean	0.087	0.133	0.205	0.323	0.342	0.349	0.342	0.287	0.268	0.171	0.103	0.064	0.223
	Max	0.874	1.085	1.412	1.493	1.557	1.632	1.521	1.505	1.375	1.122	0.900	0.594	1.632
Columbia WMA														
Temperature: (°F)	Mean[1]	30/29	29/32	36/39	49/50	58/60	67/69	74/74	67/72	60/65	53/53	39/44	30/34	49/52
	Min	5	9	23	28	33	45	55	49	39	28	15	7	5
	Max	61	50	59	80	89	89	94	85	90	82	68	62	94
Relative Humidity: %	Mean	65.2	64.2	57.8	54.2	67.3	72.8	74.5	77.5	73.5	70.4	59.3	69.4	67.2
	Min	26.5	29.8	17.4	17.3	18.5	27.7	37.2	35.3	32.5	21.0	19.9	36.3	17.3
	Max	92.9	91.1	91.2	92.1	92.7	92.8	93.1	93.0	93.2	92.2	91.8	92.5	93.2
Barometric Pressure (in of Hg)	Mean	29.58	29.45	29.39	29.58	29.53	29.4	29.51	29.51	29.51	29.53	29.63	29.56	29.51
	Min	28.55	28.99	28.95	29.07	29.16	28.96	29.08	29.19	29.16	29.12	28.89	28.98	28.55
	Max	29.99	29.93	29.82	30.08	29.93	29.78	29.83	29.89	29.91	29.88	30.19	30.03	30.19

1) Office of the New Jersey State Climatologist 30-year mean Northern NJ temperature data shown to the right of the slash.
2) Office of the New Jersey State Climatologist 30-year Southern NJ mean precipitation data.
3) Observed monthly precipitation collected by NJDEP at Washington's Crossing state park.
4) Commenced data collection, May 2013
5) Office of the New Jersey State Climatologist 30-year mean Southern NJ temperature data shown to the right of the slash.
6) Office of the New Jersey State Climatologist 30-year Coastal NJ mean precipitation data.
7) Observed monthly precipitation collected by NJDEP at Cattus Island State Park.
8) Commenced data collection, April 2013.

Table 2 Continued
Summary of Meteorological Monitoring Data – 2013

MONITORING SITES		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	YEAR
East Orange														
Temperature : (°F)	Mean[1]	34/29	32/32	38/39	51/50	61/60	71/69	78/74	72/72	65/65	57/53	42/44	36/34	53/52
	Min	10	16	26	31	41	53	63	57	45	35	21	18	10
	Max	61	53	57	81	92	91	96	86	93	84	68	69	96
Relative Humidity: %	Mean	59.8	60.8	56.0	48.9	61.8	63.7	64.2	63.0	60.5	61.8	53.2	63.8	60.0
	Min	24.2	26.9	16.8	15.7	18.8	27.2	31.5	30.7	27.7	28.7	19.9	30.8	15.7
	Max	95.2	94.6	94.1	94.6	94.3	94.6	93.6	92.8	90.7	91.5	92.8	93.1	95.2
Barometric[4] Pressure (in of Hg)	Mean	29.93	29.79	29.73	29.97	29.87	29.72	29.83	29.83	29.83	29.87	29.97	29.91	29.85
	Min	28.88	29.32	29.29	29.44	29.49	29.28	29.38	29.52	29.46	29.44	29.18	29.25	28.88
	Max	30.34	30.31	30.20	30.45	30.29	30.12	30.15	30.21	30.25	30.23	30.56	30.39	30.56
Precipitation (inches)	Historical[2]	3.49	2.90	4.12	4.31	4.37	4.51	4.78	4.13	4.49	4.36	3.90	4.00	49.37
	Observed[3]	2.97	3.86	3.07	2.95	3.17	10.18	6.07	4.35	2.61	2.93	2.58	5.32	50.06
Flemington														
Temperature : (°F)	Mean[5]	32/33	31/35	38/42	52/52	61/62	72/71	78/76	69/74	61/67	54/56	40/47	33/37	52/54
	Min	4	13	19	25	32	44	55	49	38	29	16	12	4
	Max	67	56	63	87	97	96	103	88	90	82	67	66	103
Relative Humidity: %	Mean	78.6	77.6	74.1	72.0	82.6	86.6	89.1	77.5	72.0	70.8	59.0	70.8	75.7
	Min	38.1	41.8	29.2	30.9	36.2	47.3	60.0	33.1	32.8	18.1	18.9	30.9	18.1
	Max	99.2	99.2	99.6	99.6	99.6	99.5	99.5	99.5	95.8	94.8	95.3	95.1	99.6
Solar Radiation: (Langleys)	Mean	0.111	0.149	0.209	0.317	0.335	0.348	0.331	0.285	0.286	0.180	0.137	0.083	0.231
	Max	0.963	1.048	1.204	1.371	1.430	1.456	1.338	1.349	1.232	1.052	0.864	0.779	1.456
Barometric[4] Pressure (in of Hg)	Mean	30.22	30.09	30.02	30.21	30.15	30.01	30.13	29.90	29.83	29.87	29.98	29.91	30.03
	Min	29.17	29.63	29.57	29.71	29.78	29.53	29.68	29.52	29.48	29.44	29.20	29.27	29.17
	Max	30.64	30.59	30.48	30.71	30.57	30.41	30.45	30.23	30.25	30.22	30.55	30.39	30.71

1) Office of the New Jersey State Climatologist 30-year mean Northern NJ temperature data shown to the right of the slash.
2) Office of the New Jersey State Climatologist 30-year Southern NJ mean precipitation data.
3) Observed monthly precipitation collected by NJDEP at Washington's Crossing state park.
4) Commenced data collection, May 2013
5) Office of the New Jersey State Climatologist 30-year mean Southern NJ temperature data shown to the right of the slash.
6) Office of the New Jersey State Climatologist 30-year Coastal NJ mean precipitation data.
7) Observed monthly precipitation collected by NJDEP at Cattus Island State Park.
8) Commenced data collection, April 2013.

Table 2 Continued
Summary of Meteorological Monitoring Data – 2013

MONITORING SITES		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	YEAR
Newark Firehouse														
Temperature : (°F)	Mean[1]	35/29	33/32	39/39	52/50	62/60	72/69	80/74	73/72	66/65	59/53	44/44	37/34	55/52
	Min	11	17	27	32	42	55	64	59	47	36	21	18	11
	Max	62	55	58	83	93	93	97	88	95	85	70	70	97
Relative Humidity: %	Mean	57.5	58.5	53.3	49.5	59.8	62.0	61.3	60.5	58.0	59.8	50.9	62.7	57.8
	Min	18.3	22.8	13.6	12.7	14.5	22.9	27.2	28.0	24.5	24.2	14.6	26.6	12.7
	Max	94.3	93.9	91.7	94.0	94.0	92.6	90.8	90.9	88.9	91.1	92.1	93.8	94.3
Solar Radiation: (Langleys)	Mean	0.099	0.140	0.199	0.300	0.316	0.339	0.327	0.275	0.270	0.166	0.109	0.070	0.218
	Max	0.754	0.922	1.238	1.331	1.407	1.409	1.373	1.348	1.208	1.005	0.777	0.590	1.409
Barometric Pressure (in of Hg)	Mean	30.00	29.86	29.80	30.00	29.93	29.79	29.89	29.89	29.90	29.94	30.04	29.97	29.92
	Min	28.95	29.39	29.35	29.51	29.55	29.34	29.44	29.58	29.53	29.50	29.25	29.31	28.95
	Max	30.41	30.37	30.26	30.53	30.36	30.18	30.21	30.28	30.32	30.29	30.62	30.46	30.62
Passaic														
Temperature : (°F)	Mean[1]	No Data[8]	No Data[8]	No Data[8]	53/50	62/60	72/69	79/74	73/72	68/65	55/53	43/44	36/34	60/52
	Min	No Data[8]	No Data[8]	No Data[8]	37	41	53	63	57	47	36	21	18	18
	Max	No Data[8]	No Data[8]	No Data[8]	70	93	94	98	89	95	74	69	69	98
Relative Humidity: %	Mean	No Data[8]	No Data[8]	No Data[8]	48.0	60.9	62.7	63.7	62.1	59.6	60.3	53.3	64.4	60.3
	Min	No Data[8]	No Data[8]	No Data[8]	15.8	18.2	24.0	30.4	28.9	26.3	23.1	20.5	31.0	15.8
	Max	No Data[8]	No Data[8]	No Data[8]	89.4	96.1	94.6	93.5	92.7	91.6	91.4	93.9	94.2	96.1
Barometric Pressure (in of Hg)	Mean	No Data[8]	No Data[8]	No Data[8]	30.15	29.97	29.82	29.93	29.93	29.92	29.97	30.07	30.01	29.97
	Min	No Data[8]	No Data[8]	No Data[8]	29.55	29.59	29.4	29.50	29.59	29.56	29.54	29.29	29.37	29.29
	Max	No Data[8]	No Data[8]	No Data[8]	30.59	30.40	30.19	30.30	30.3	30.35	30.34	30.68	30.51	30.68

1) Office of the New Jersey State Climatologist 30-year mean Northern NJ temperature data shown to the right of the slash.
2) Office of the New Jersey State Climatologist 30-year Southern NJ mean precipitation data.
3) Observed monthly precipitation collected by NJDEP at Washington's Crossing state park.
4) Commenced data collection, May 2013
5) Office of the New Jersey State Climatologist 30-year mean Southern NJ temperature data shown to the right of the slash.
6) Office of the New Jersey State Climatologist 30-year Coastal NJ mean precipitation data.
7) Observed monthly precipitation collected by NJDEP at Cattus Island State Park.
8) Commenced data collection, April 2013.

Table 2 Continued
Summary of Meteorological Monitoring Data – 2013

MONITORING SITES		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	YEAR
Rider Universtiy														
Temperature: (F°)	Mean[5]	33/33	32/35	38/42	51/52	60/62	70/71	76/76	70/74	63/67	56/56	42/47	35/37	52/54
	Min	7	12	25	25	36	48	58	53	41	30	19	15	7
	Max	67	55	59	85	90	90	94	86	91	85	70	68	94
Relative Humidity: %	Mean	67.2	66.3	60.7	57.3	70.1	74.2	76.0	77.5	74.6	74.9	61.4	74.8	69.6
	Min	22.1	28.3	16.0	16.9	22.3	29.4	33.4	32.6	31.7	26	15.6	29.4	15.6
	Max	99.7	100.0	99.7	57.3	99.0	98.3	98.2	98.6	98.8	98.8	99.2	99.5	100.0
Solar Radiation: (Langleys)	Mean	0.092	0.130	0.189	0.292	0.316	0.327	0.316	0.267	0.259	0.162	0.114	0.069	0.211
	Max	0.721	0.831	1.106	1.285	1.332	1.337	1.360	1.386	1.147	0.939	0.707	0.572	1.386
Barometric Pressure (in of Hg)	Mean	30.36	30.21	30.14	30.35	30.29	30.13	30.25	30.24	30.24	30.28	30.40	30.33	30.27
	Min	29.27	29.70	29.66	29.85	29.90	29.61	29.79	29.92	29.86	29.82	29.58	29.63	29.27
	Max	30.80	30.73	30.61	30.35	30.72	30.56	30.60	30.65	30.67	30.64	31.00	30.84	31.00
Precipitation (Inches)	Historical[6]	3.35	2.91	4.10	3.75	3.49	3.14	3.87	4.06	3.37	3.57	3.33	3.66	42.59
	Observed[7]	2.48	4.42	4.27	3.06	2.87	9.50	4.27	4.31	1.07	2.86	2.63	4.64	46.38

1) Office of the New Jersey State Climatologist 30-year mean Northern NJ temperature data shown to the right of the slash.
2) Office of the New Jersey State Climatologist 30-year Southern NJ mean precipitation data.
3) Observed monthly precipitation collected by NJDEP at Washington's Crossing state park.
4) Commenced data collection, May 2013
5) Office of the New Jersey State Climatologist 30-year mean Southern NJ temperature data shown to the right of the slash.
6) Office of the New Jersey State Climatologist 30-year Coastal NJ mean precipitation data.
7) Observed monthly precipitation collected by NJDEP at Cattus Island State Park.
8) Commenced data collection, April 2013.

Figure 3
2013 Maximum, Minimum and Mean Temperatures, Camden Spruce Street

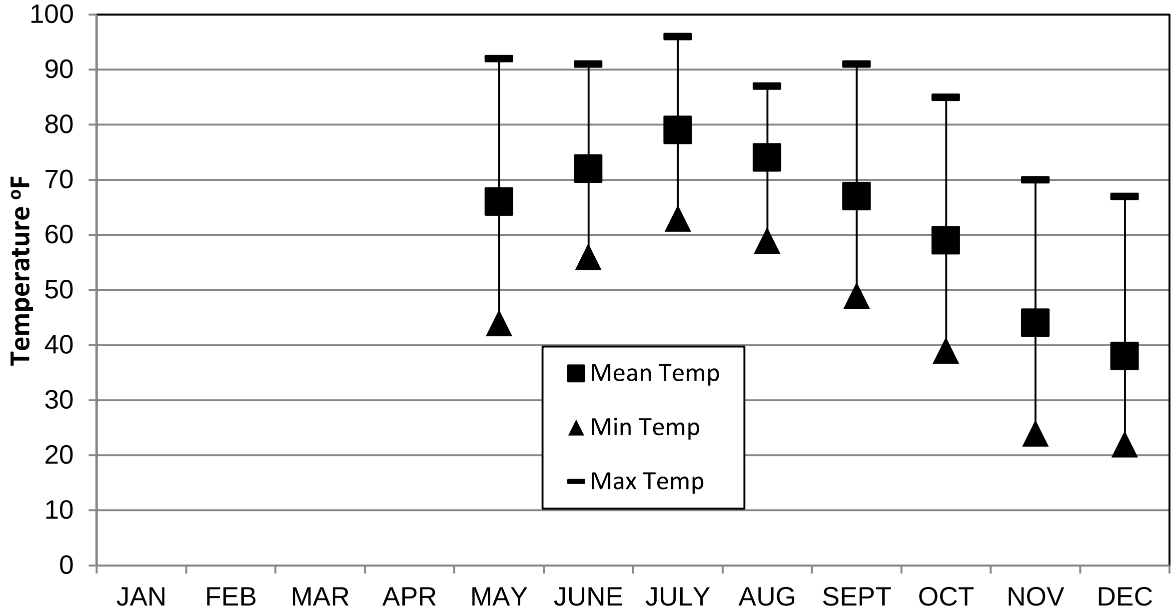


Figure 4
Camden Spruce Street 2013 Monthly Temperature
Difference from New Jersey State Climatologist
Southern New Jersey 30-Year Temperature Average

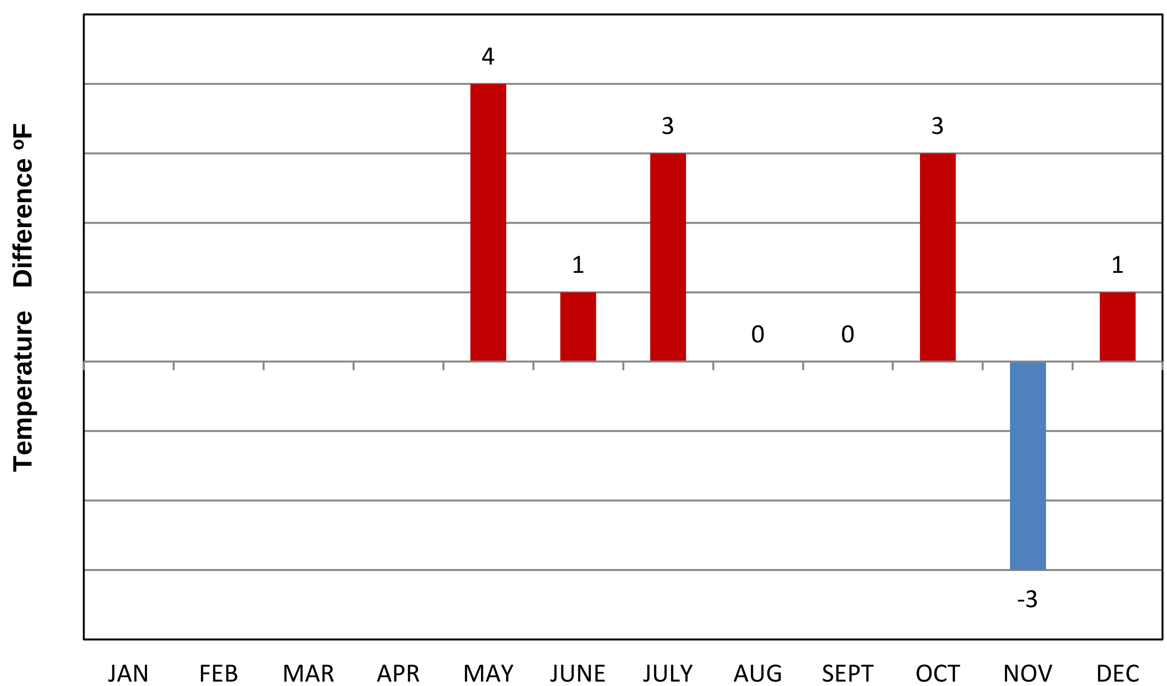


Figure 5
2013 Maximum, Minimum and Mean Temperatures, Columbia WMA

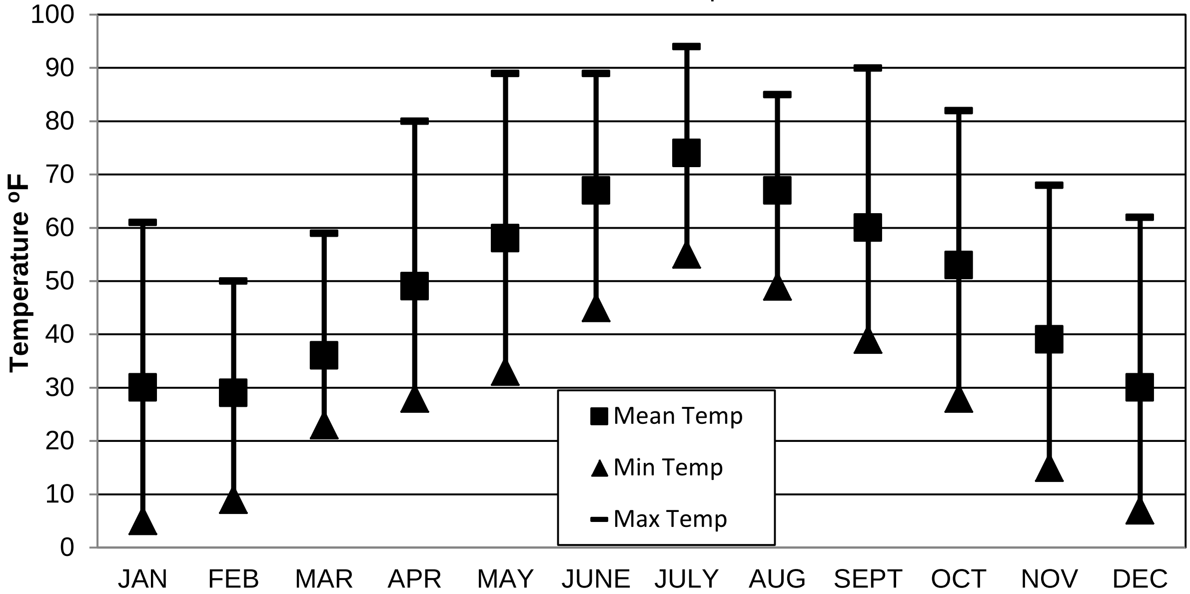
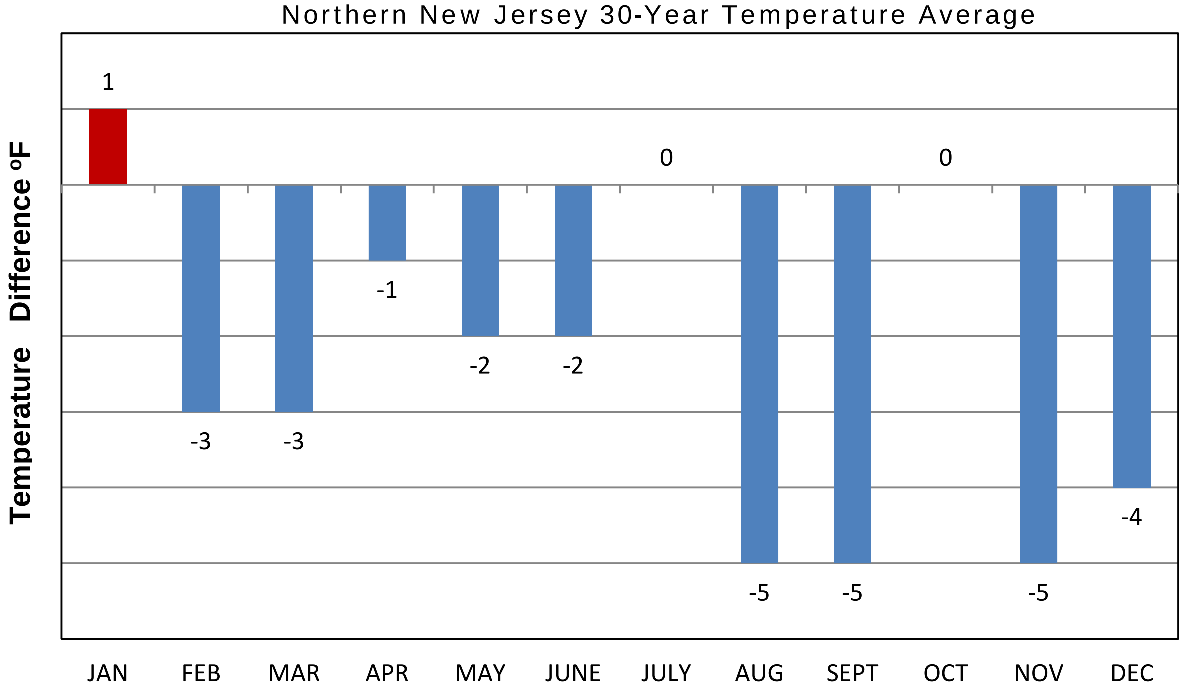


Figure 6
Columbia WMA 2013 Monthly Temperature
Difference from New Jersey State Climatologist
Northern New Jersey 30-Year Temperature Average



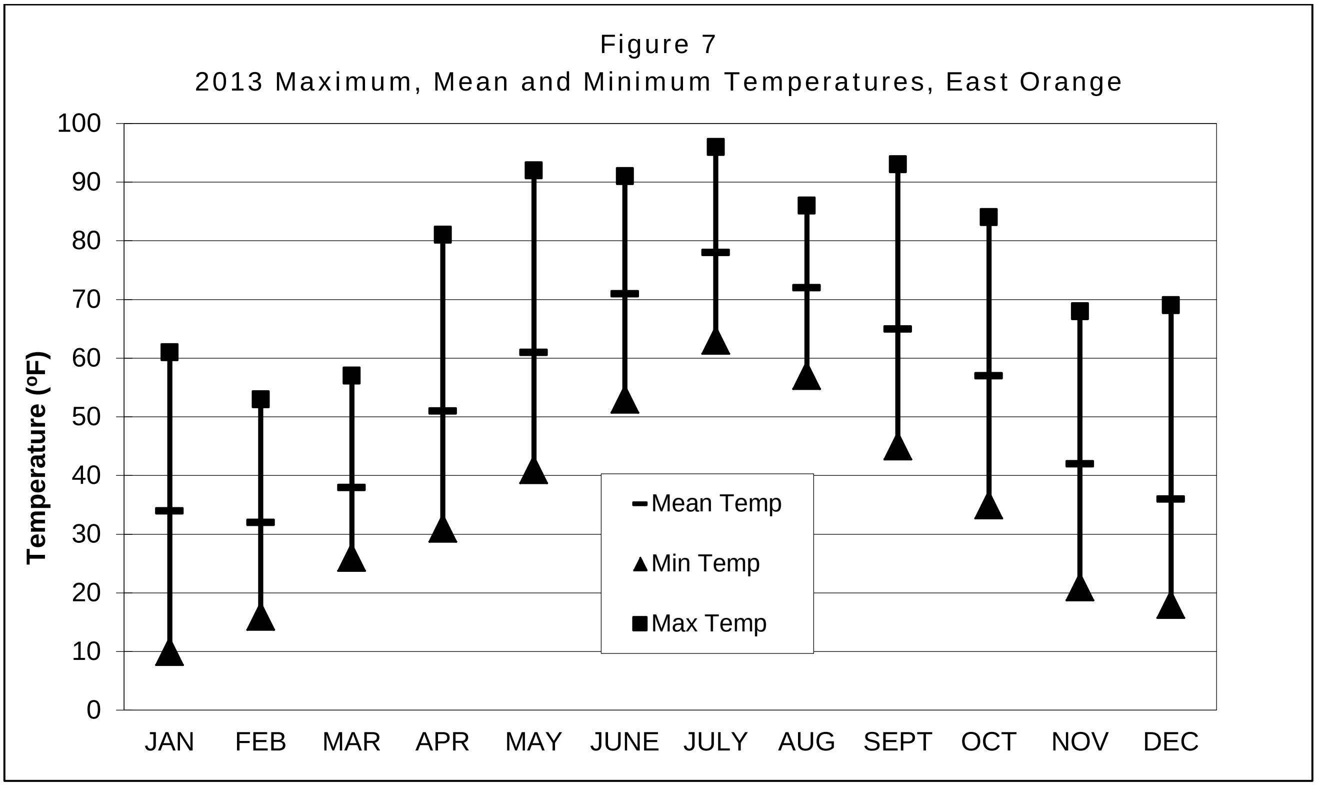


Figure 7
2013 Maximum, Mean and Minimum Temperatures, East Orange
Temperature (ºF)
100
90
80
70
60
50
40
30
20
10
0
Mean Temp
Min Temp
Max Temp
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC

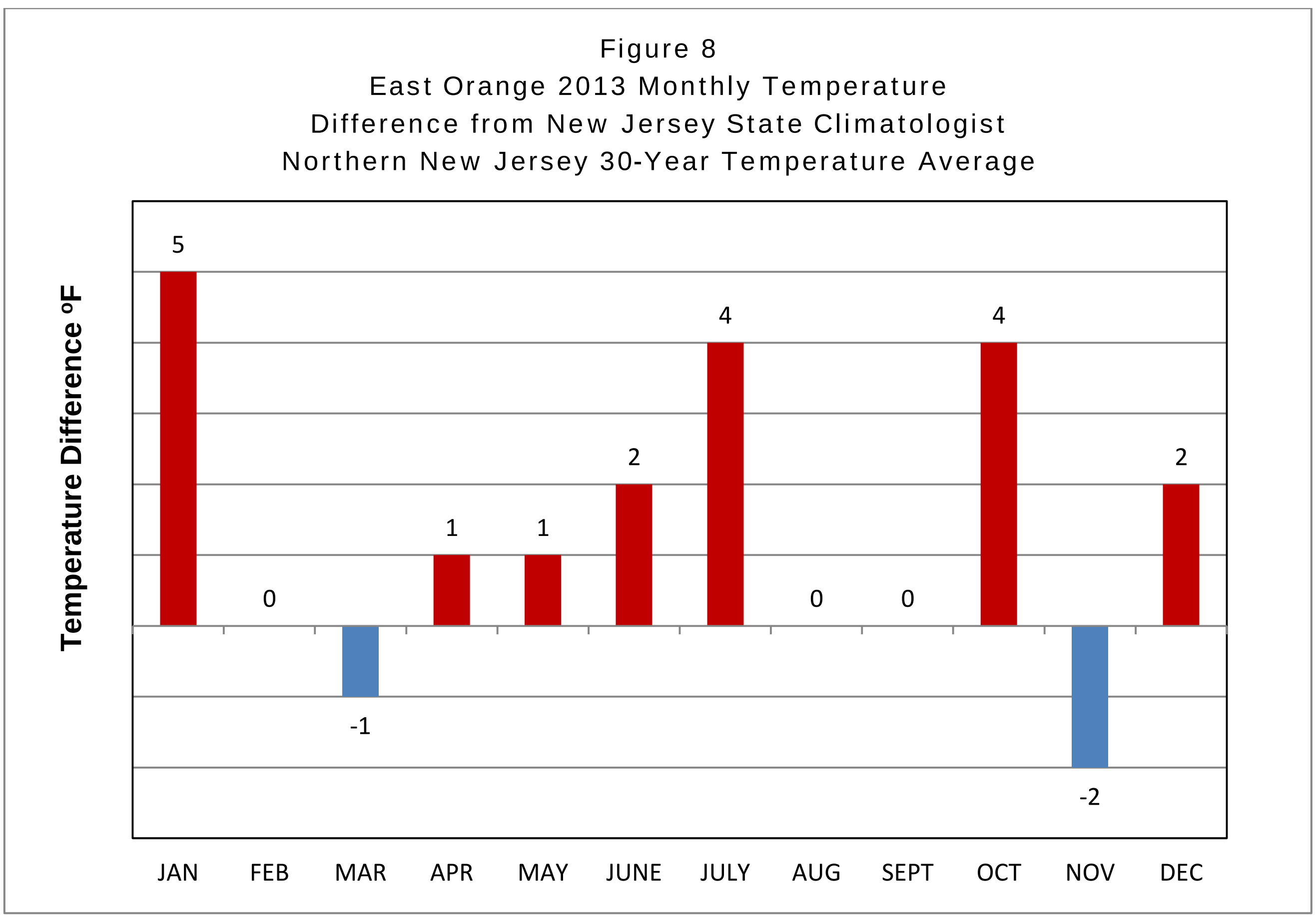


Figure 8
East Orange 2013 Monthly Temperature
Difference from New Jersey State Climatologist
Northern New Jersey 30-Year Temperature Average
Temperature Difference ºF
5
0
-1
1
1
2
4
0
0
4
-2
2
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC

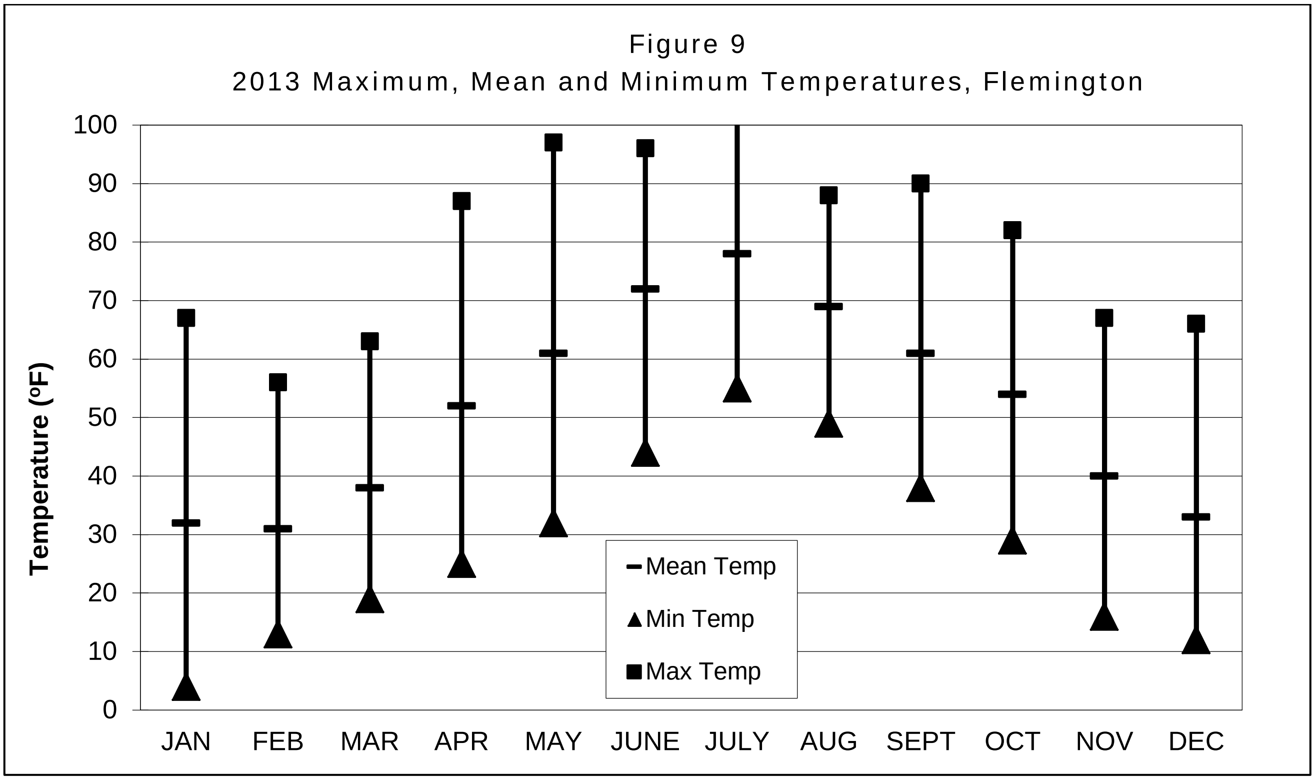


Figure 9
2013 Maximum, Mean and Minimum Temperatures, Flemington
Temperature (ºF)
100
90
80
70
60
50
40
30
20
10
0
Mean Temp
Min Temp
Max Temp
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC

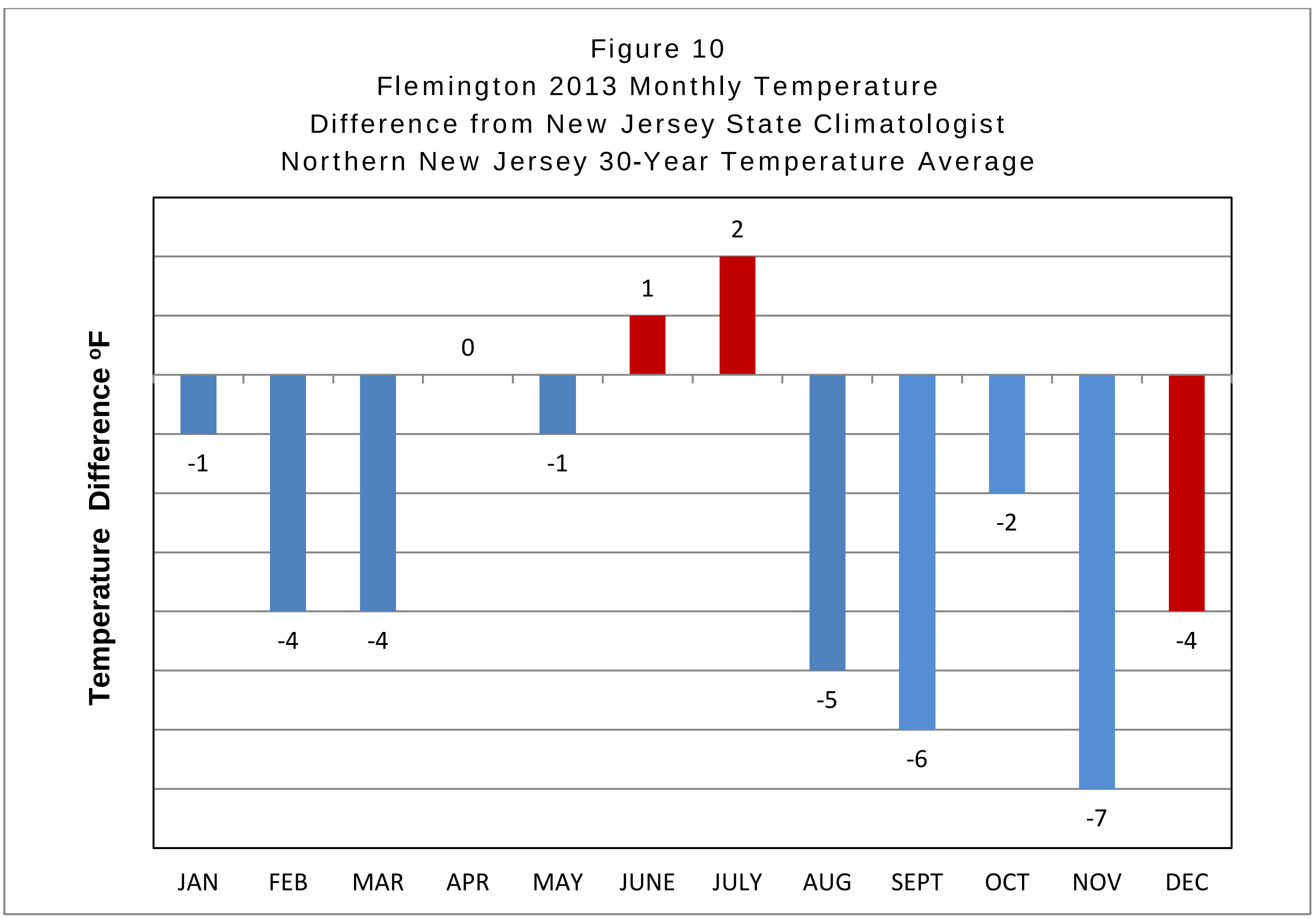


Figure 10
Flemington 2013 Monthly Temperature
Difference from New Jersey State Climatologist
Northern New Jersey 30-Year Temperature Average
Temperature Difference ºF
-1
-4
-4
0
-1
1
2
-5
-6
-2
-7
-4
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC

Figure 11
2013 Maximum, Minimum and Mean Temperatures, Newark Firehouse

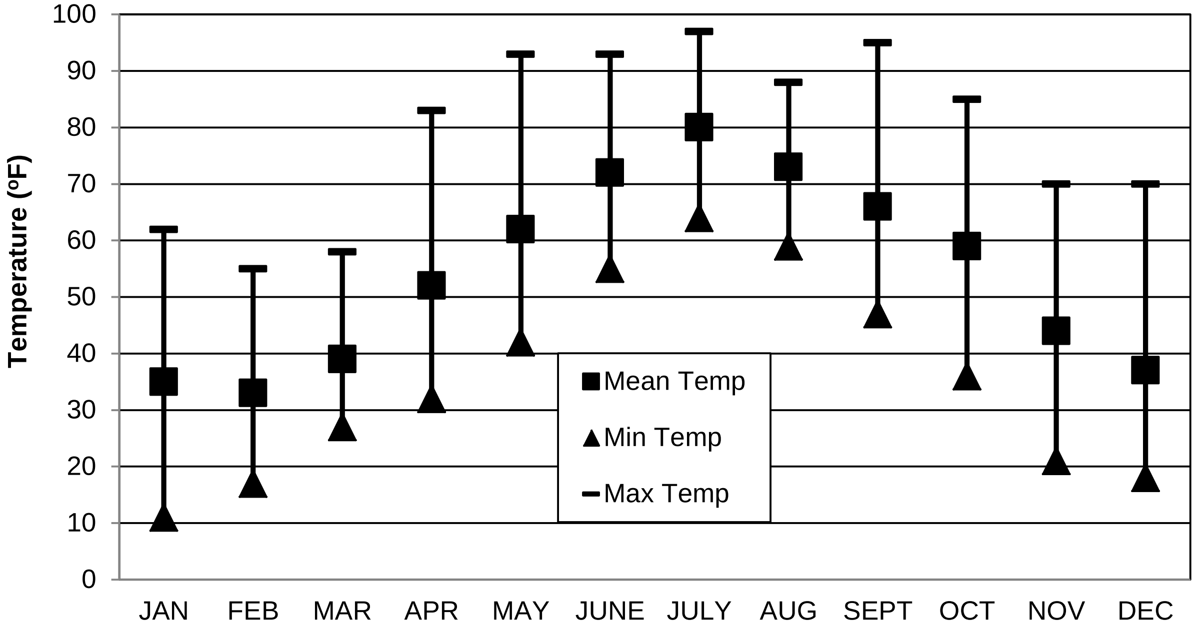


Figure 12
Newark Firehouse 2013 Monthly Temperature
Difference from New Jersey State Climatologist
Northern New Jersey 30-Year Temperature Average

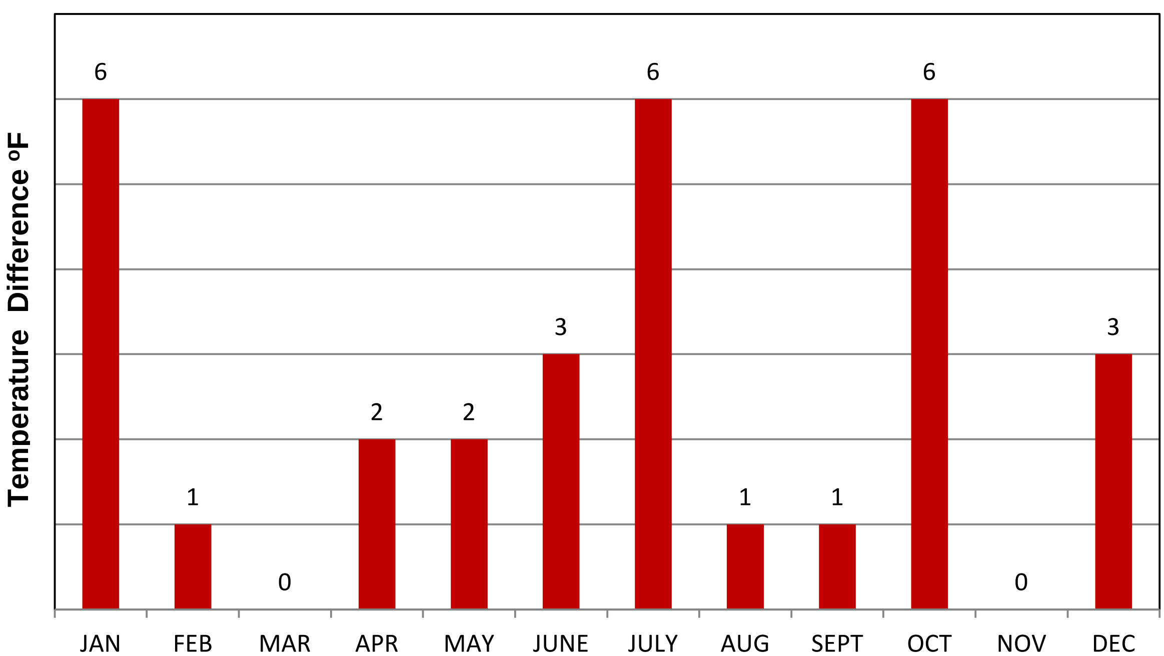


Figure 13
2013 Maximum, Mean and Minimum Temperatures, Passaic

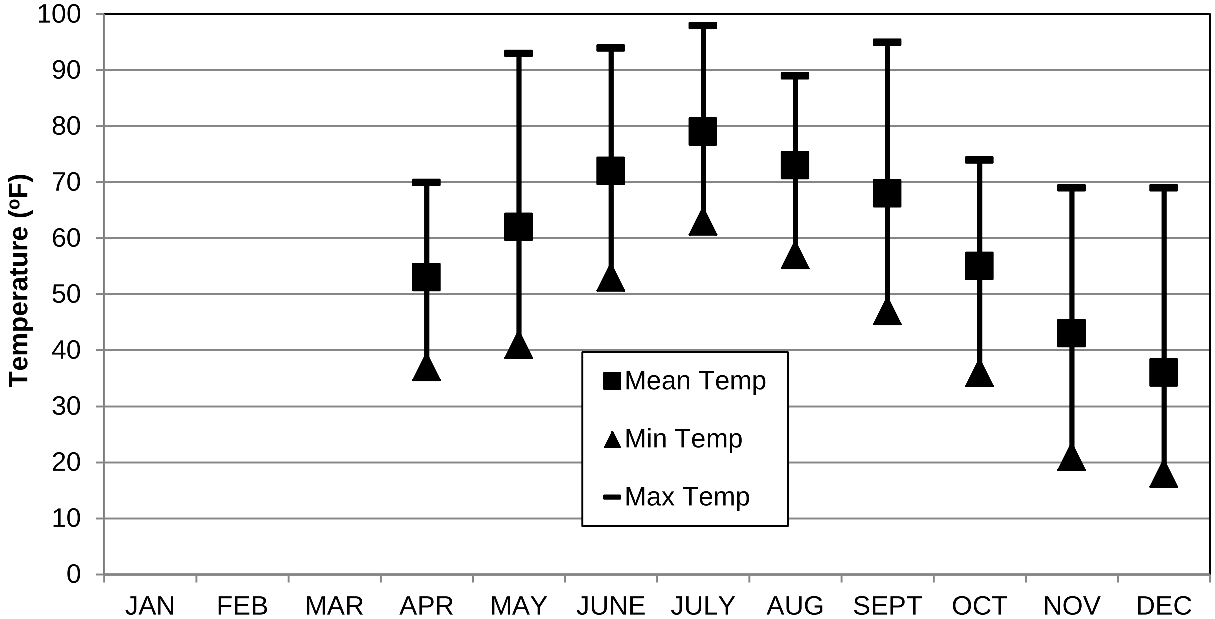


Figure 14
Passaic 2013 Monthly Temperature
Difference from New Jersey State Climatologist
Northern New Jersey 30-Year Temperature Average

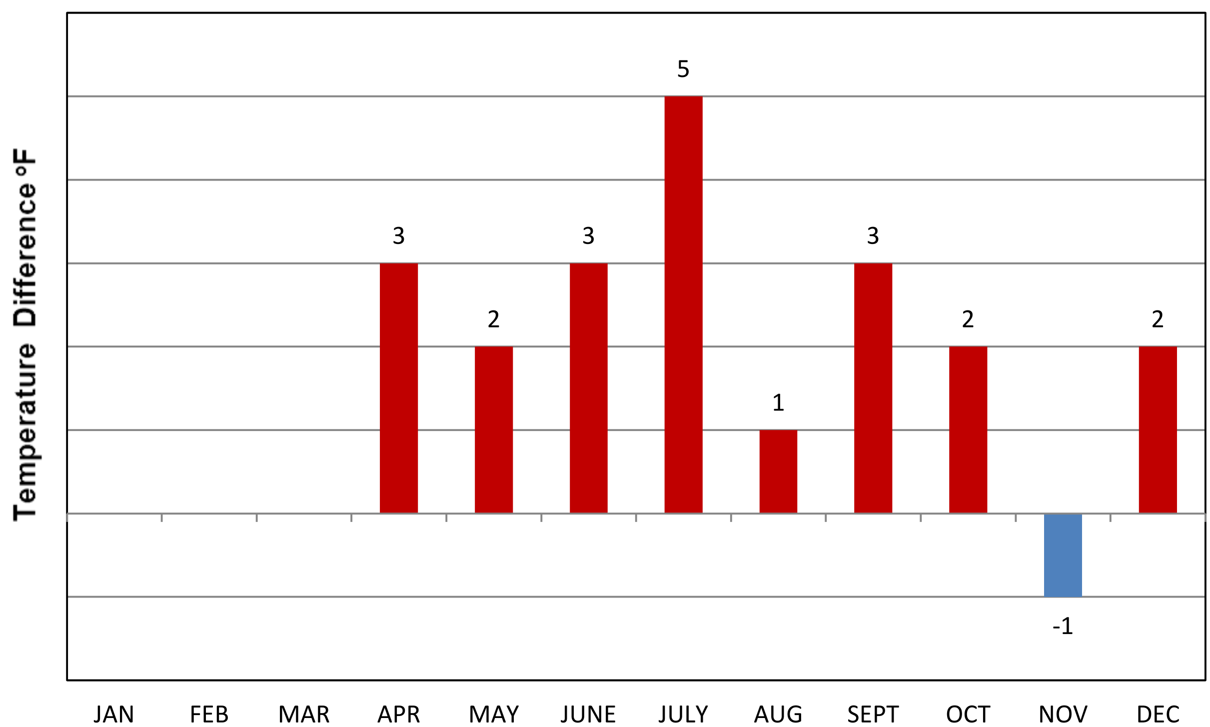


Figure 15
2013 Maximum, Mean and Minimum Temperatures, Rider University

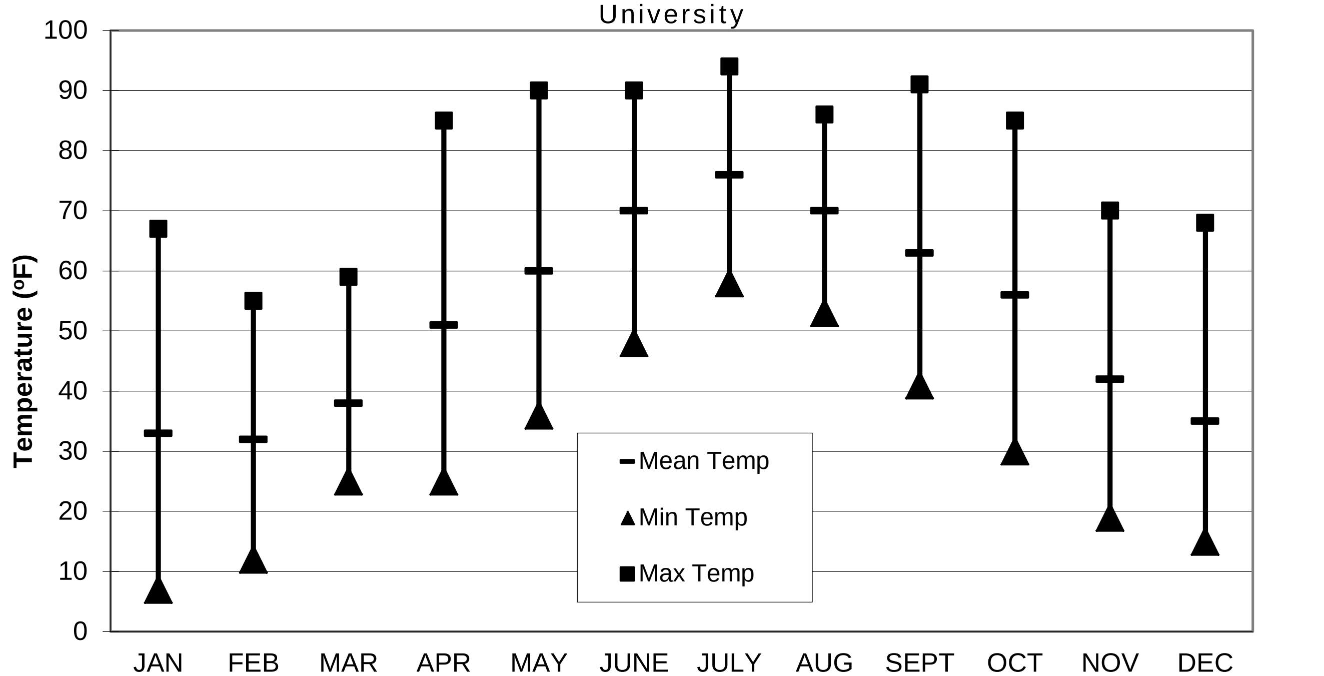


Figure 16
Rider University 2013 Monthly Temperature Difference from New Jersey State Climatologist Southern New Jersey 30-Year Temperature Average

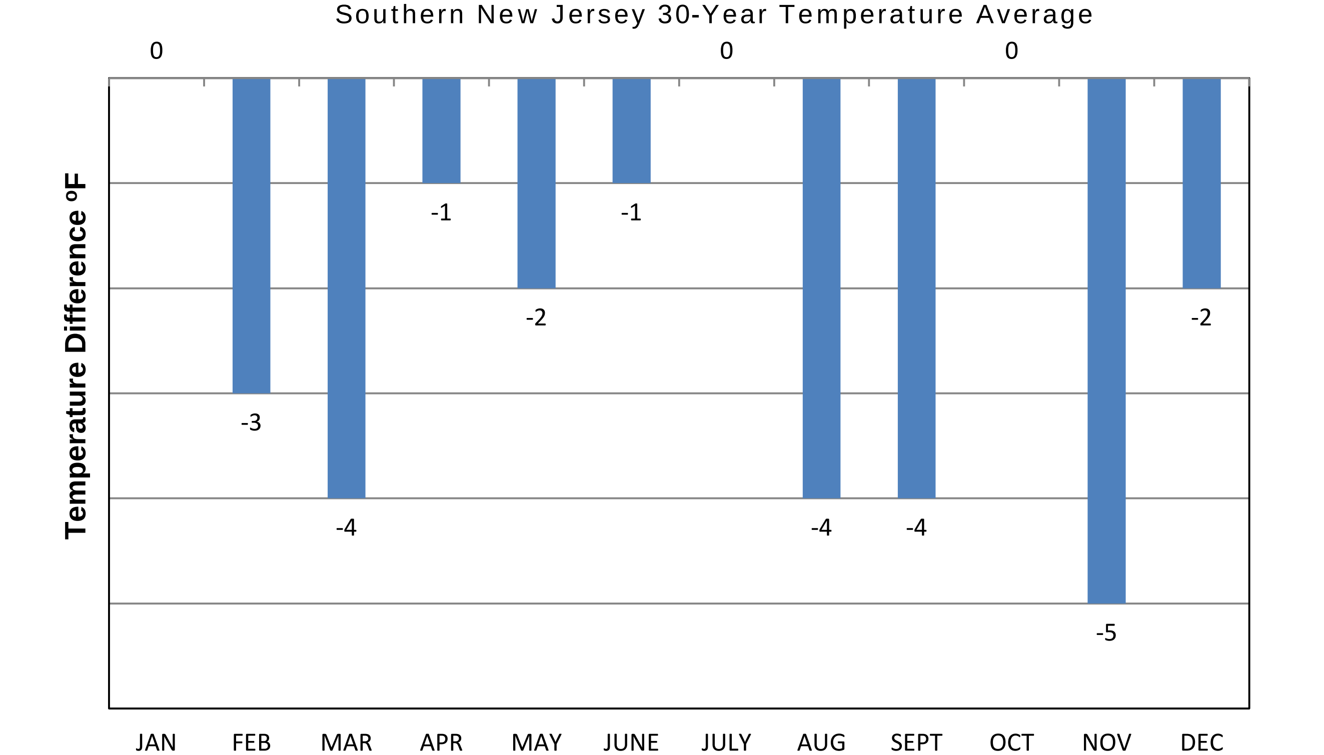


Figure 17

Annual Wind Rose for Camden Spruce Street

Displaying Distribution of Wind Speed & Wind Direction

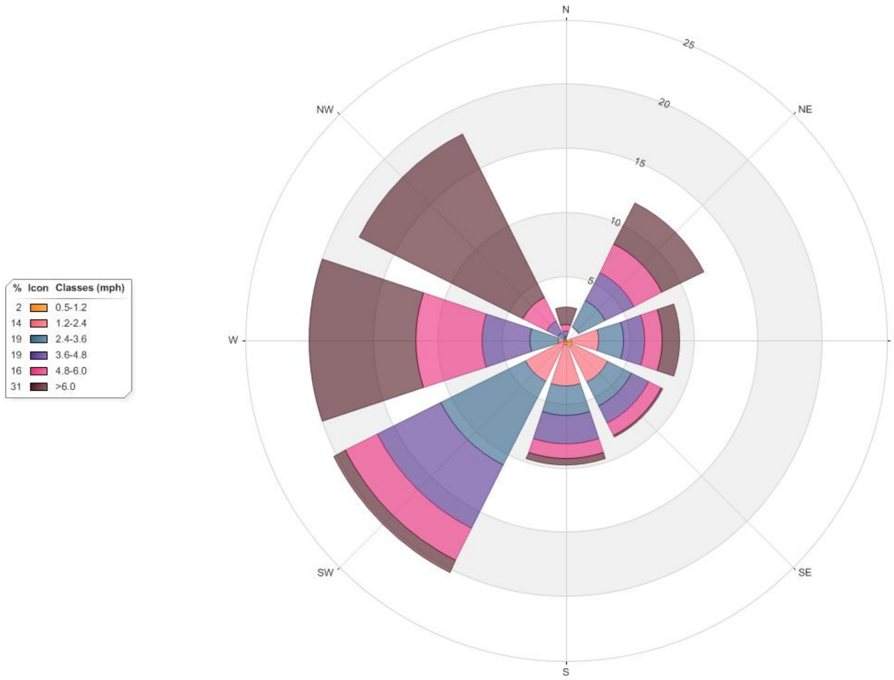


Figure 18

Annual Wind Rose for Columbia WMA

Displaying Distribution of Wind Speed & Wind Direction

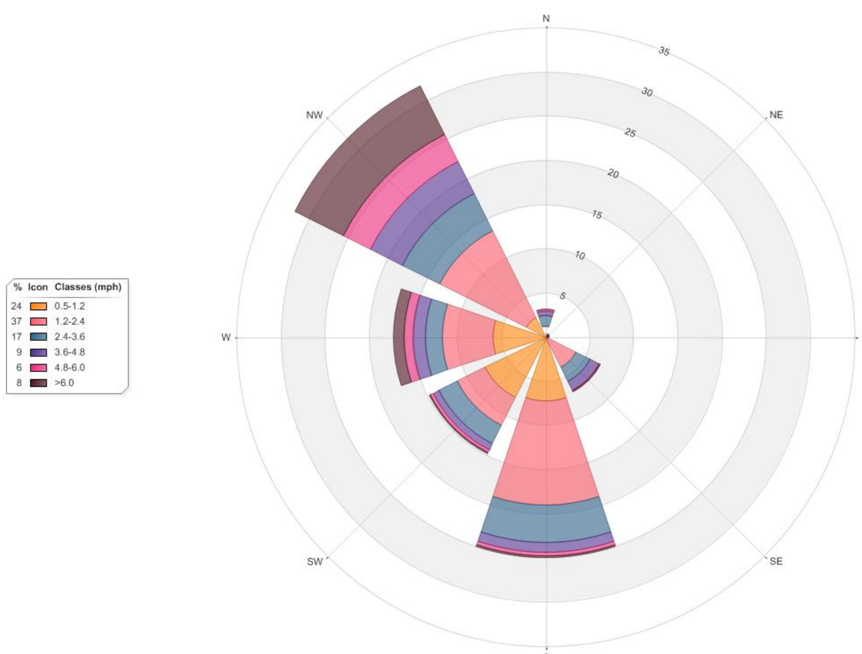


Figure 19

Annual Wind Rose for East Orange

Displaying Distribution of Wind Speed & Wind Direction

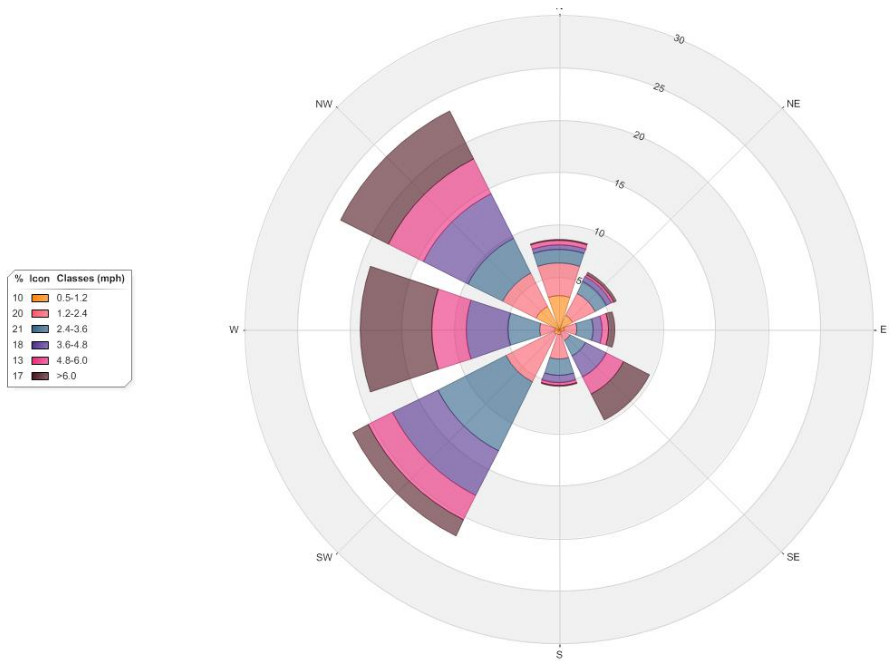


Figure 20

Annual Wind Rose for Elizabeth Lab

Displaying Distribution of Wind Speed & Wind Direction

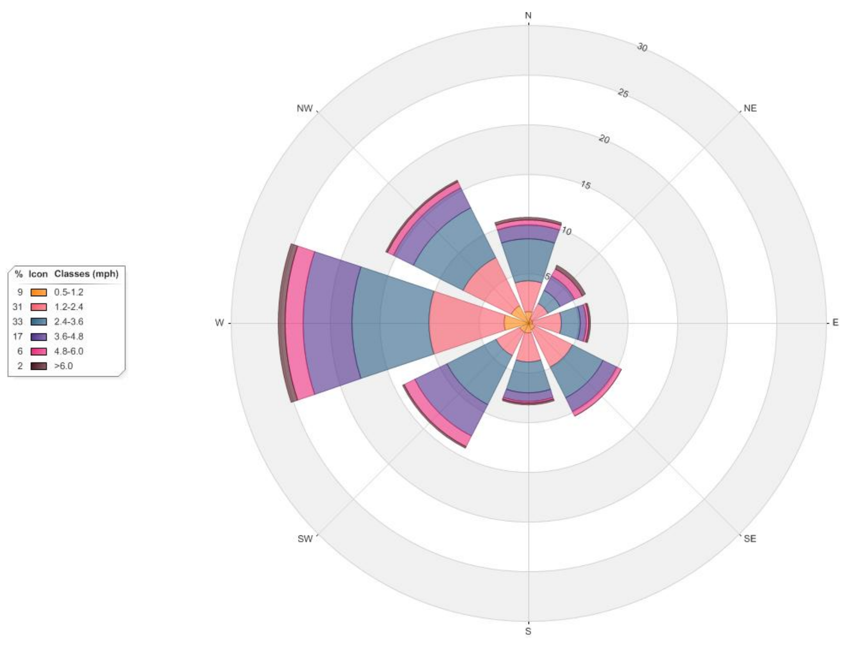


Figure 21
Annual Wind Rose for Flemington
Displaying Distribution of Wind Speed & Wind Direction

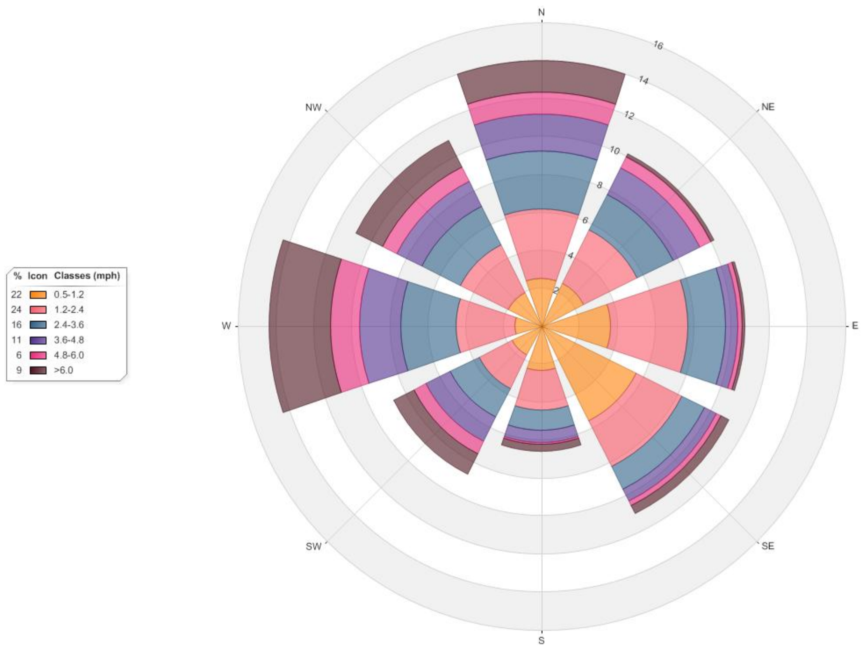


Figure 22
Annual Wind Rose for Newark Firehouse
Displaying Distribution of Wind Speed & Wind Direction

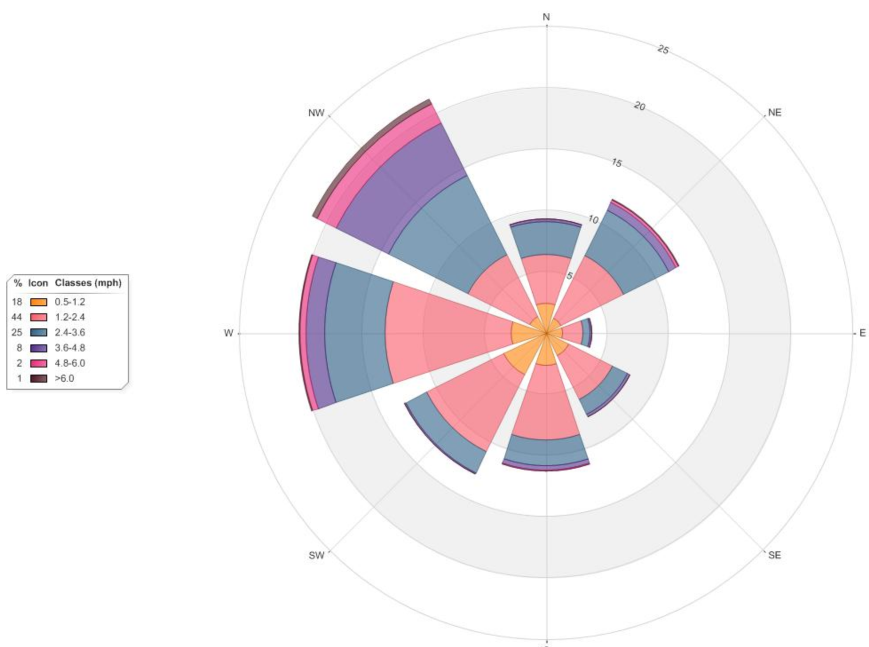


Figure 23

Annual Wind Rose for Passaic

Displaying Distribution of Wind Speed & Wind Direction

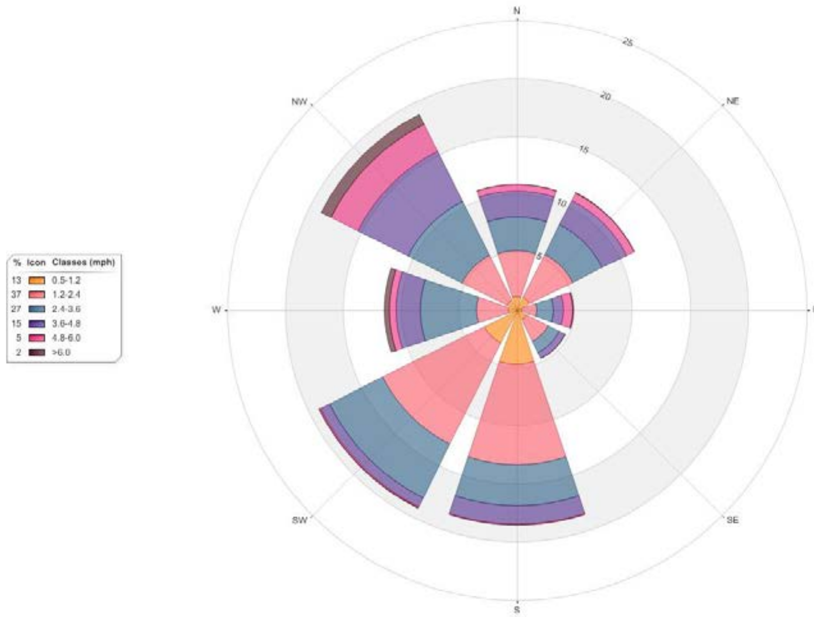
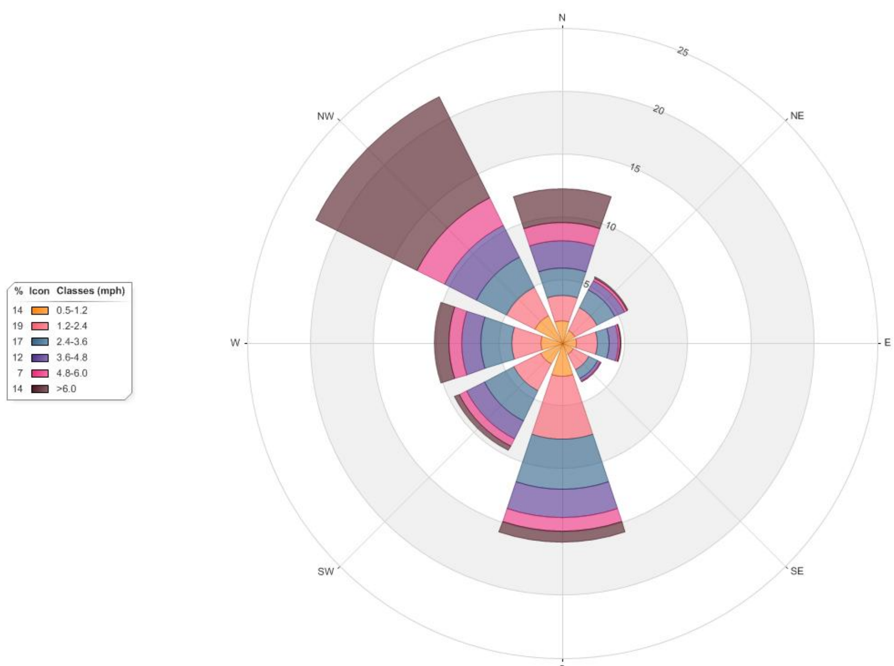


Figure 24

Annual Wind Rose for Rider University

Displaying Distribution of Wind Speed & Wind Direction



REFERENCES

The Climate of New Jersey, Office of the New Jersey State Climatologist, URL: http://climate.rutgers.edu/stateclim/?section=njcp&target=NJCoverview

Basic Air Pollution Meteorology, United States Environmental Protection Agency (USEPA), URL: http://yosemite.epa.gov/oaqps/eogtrain.nsf/DisplayView/SI_409_0-5?OpenDocument

Appendix A
2013 Air Monitoring Sites

New Jersey Department of Environmental Protection

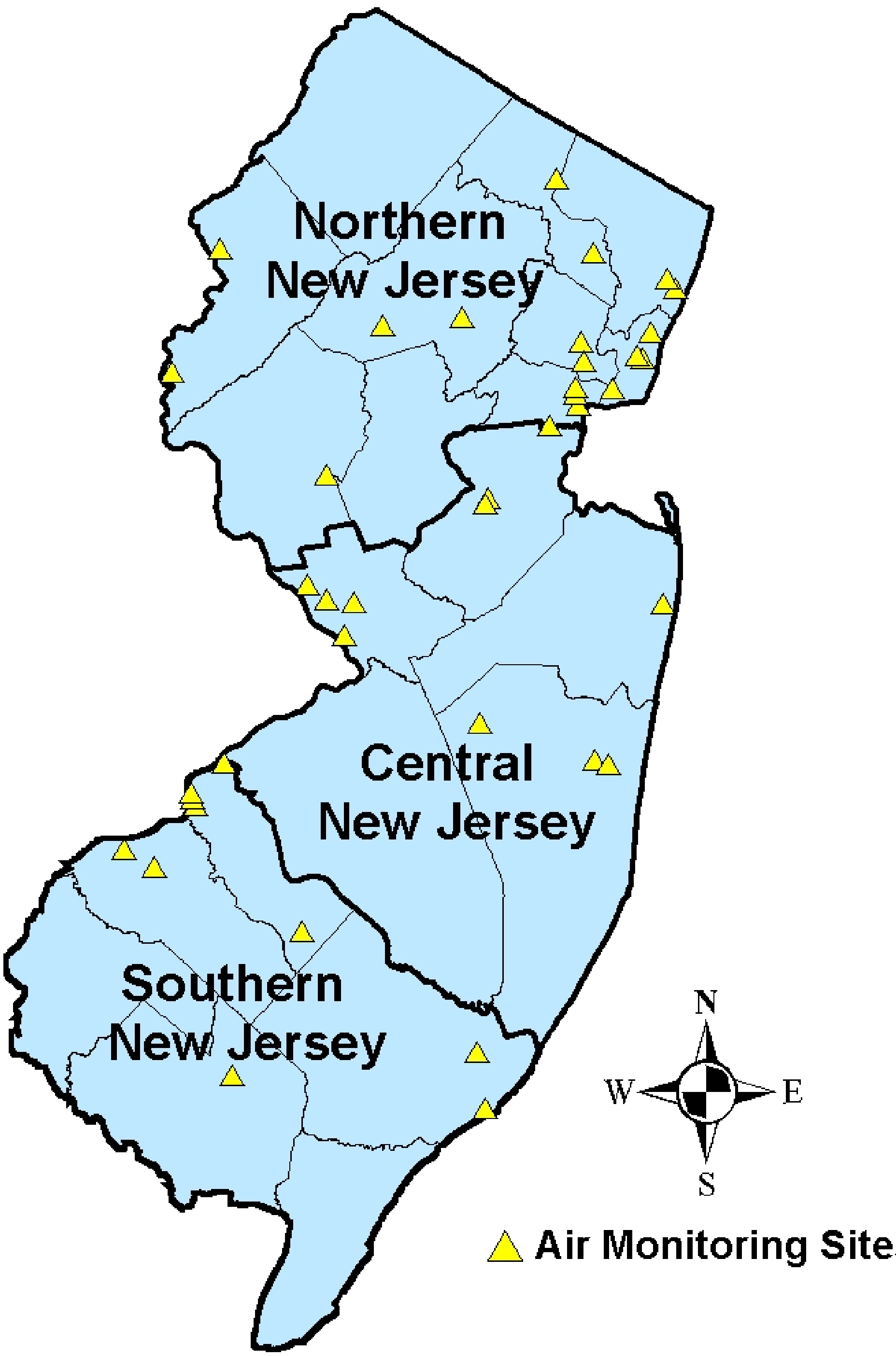


FIGURE 1

NORTHERN NEW JERSEY

AIR MONITORING SITES

Table 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	Fort Lee Public Library, 320 Main Street
	Leonia	34 003 0006	O_3	40.870436	-73.991994	Over peck 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, $PM_{2.5}$, $PM_{2.5}$Spec, MET, NOy, NO_X, BTEX, Pb, TEOM	40.720989	-74.192892	360 Clinton Avenue
HUDSON	Bayonne	34 017 0006	NO_X, O_3, SO_2, MET	40.670250	- 74.126081	Veterans Park on Newark Bay, 25th St. near Park Road
	Jersey City	34 017 1002	CO, SO_2, SS	40.731645	- 74.066308	2828 Kennedy Boulevard
	Jersey City Firehouse	34 017 1003	$PM_{2.5}$, PM_{10}, TEOM	40.725454	- 74.052290	Consolidated Firehouse, 355 Newark Avenue
	Union City	34 017 2002	$PM_{2.5}$	40.772793	-74.031718	Health Department, 714 , 31st Street
HUNTERDON	Flemington	34 019 0001	O_3, MET, TEOM	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, $PM_{2.5}$Spec, MET	40.787628	- 74.676301	Bldg. #1, Department of Public Works, (DPW), Route 513
	Morristown Amb Squad	34 027 0004	$PM_{2.5}$	40.801211	- 74.483433	16 Early Street
PASSAIC	Paterson	34 031 0005	$PM_{2.5}$	40.918381	-74.168092	Health Department, 176 Broadway Avenue
	Ramapo	34 031 5001	O_3	41.058617	- 74.255544	Ramapo Mountain State Forest, Access Road, off Skyline Drive
UNION	Elizabeth	34 039 0003	CO, SO_2, SS	40.662389	- 74.214817	7 Broad Street
	Elizabeth Lab	34 039 0004	CO, NO_X, SO_2, SS, MET, $PM_{2.5}$, TOXICS, Hg, $PM_{2.5}$Spec ,BTEX, Black Carbon, TEOM	40.641440	- 74.208365	Interchange 13, New Jersey Turnpike
	Elizabeth Mitchell Bldg	34 039 0006	$PM_{2.5}$	40.673406	-74.213889	Mitchell Bldg., 500 North Broad Street
	Rahway	34 039 2003	$PM_{2.5}$, TEOM	40.603943	- 74.276174	Fire Dept. Bldg., 1300 Main Street
WARREN	Columbia WMA	34 041 0007	NO_X, O_3, SO_2, $PM_{2.5}$, MET, TEOM	40.924580	-75.067815	Columbia Wildlife Management Area, Delaware Road
	Phillipsburg	34 041 0006	$PM_{2.5}$	40.699207	- 75.180525	Municipal Bldg., 675 Corliss Avenue

[1] See Parameter Codes, Table 4 (Appendix A-8)

FIGURE 2
CENTRAL NEW JERSEY
AIR MONITORING SITES

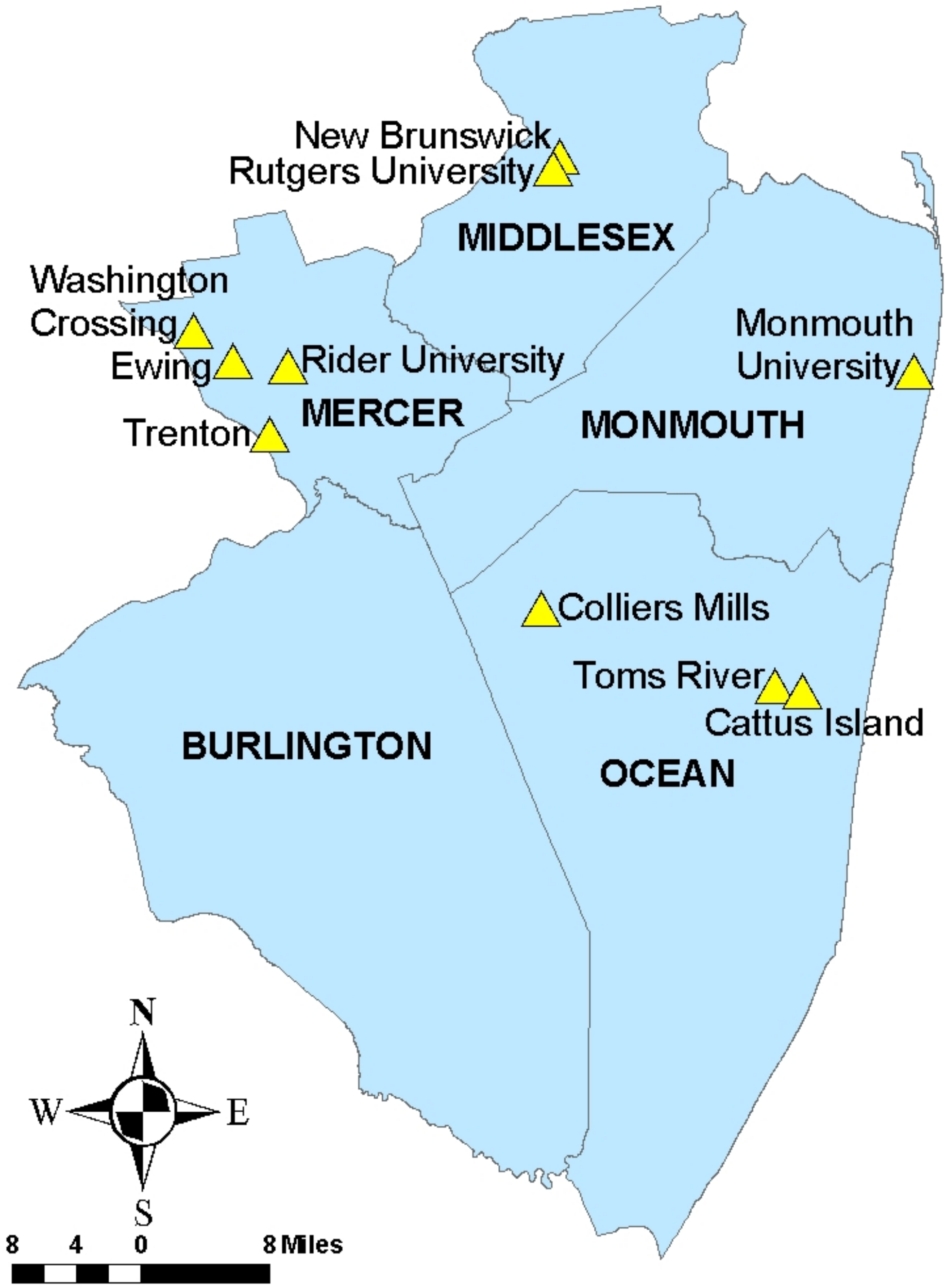


Table 2
Central New Jersey Air Monitoring Sites

County	Monitoring Site	AIRS Code	Parameter(s) Measured[1]	Coordinates (Decimal degrees)		Address
				Latitude	Longitude	
MERCER	Ewing	34 021 0010	TEOM	40.287530	-74.807770	Bureau of Air Monitoring Technical Center, 380 Scotch Road
	Rider University	34 021 0005	O_3, MET	40.283092	-74.742644	Athletic Fields, Route 206 South
	Trenton	34 021 0008	$PM_{2.5}$	40.222411	-74.763167	Trenton Library, 120 Academy Street
	Washington Crossing	34 021 8001	$PM_{2.5}$, ACID	40.312390	-74.872660	Washington Crossing State Park, near 66 Church Road
MIDDLESEX	New Brunswick	34 023 0006	$PM_{2.5}$, Hg, TEOM, $PM_{2.5}$Spec, TOXICS	40.472825	- 74.422403	Cook College, Log Cabin Road near Horticulture Lab
	Rutgers University	34 023 0011	NO_X, O_3, MET[2], PAMS	40.462182	- 74.429439	Horticultural Farm #3, off Ryder's Lane
MONMOUTH	Monmouth University	34 025 0005	O_3	40.277647	- 74.005100	Edison Science Bldg., 400 Cedar Avenue
OCEAN	Cattus Island	N/A	ACID	39.989400	-74.134400	1170 Cattus Island Blvd, Toms River
	Colliers Mills	34 029 0006	O_3	40.064830	-74.444050	Colliers Mills Wildlife Management Area
	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 Appendix A-8)
[2] Meteorological Measurements at the site are collected by Rutgers University

FIGURE 3
SOUTHERN NEW JERSEY
AIR MONITORING SITES

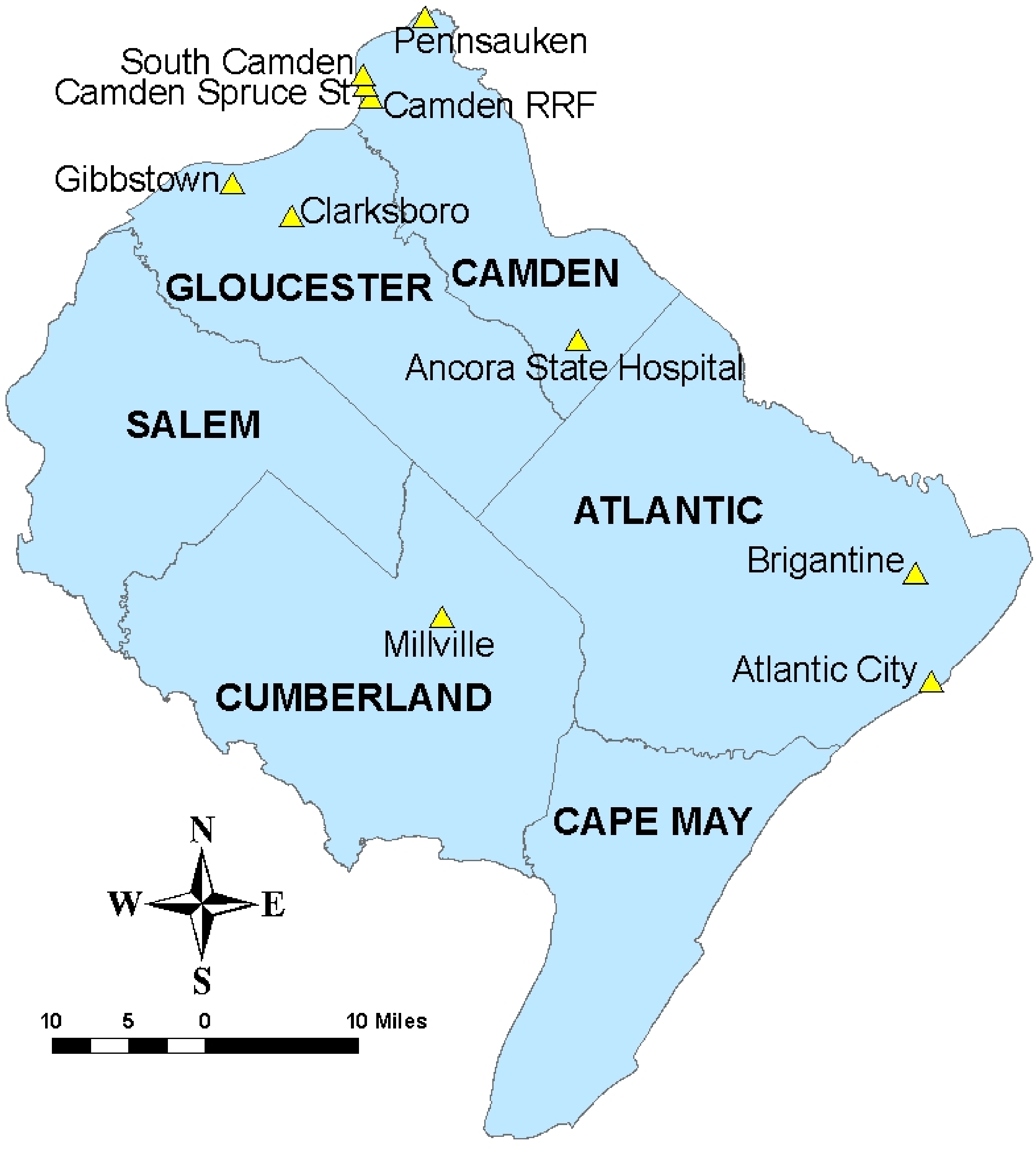


Table 3
Southern New Jersey Air Monitoring Sites

County	Monitoring Site	AIRS Code	Parameter(s) Measured[1]	Coordinates (Decimal degrees)		Address
				Latitude	Longitude	
ATLANTIC	Atlantic City	34 001 1006	$PM_{2.5}$	39.363528	-74.431219	1535 Bacharach Boulevard
	Brigantine	34 001 0006	Visibility, O_3, SO_2,, TEOM, $PM_{2.5,}$ Hg, ACID[3]	39.464872	-74.448736	Edwin B. Forsythe National Wildlife Refuge Visitor Center, Great Creek Road
CAMDEN	Ancora State Hospital	34 007 1001	O_3	39.684250	- 74.861491	Ancora State Hospital, 202 Spring Garden Road
	South Camden	34 007 0010	TEOM	39.923969	-75.122317	Camden County Municipal Utilities Authority, 1645 Ferry Avenue
	Camden RRF	34 007 0009	PM_{10}	39.912431	- 75.116864	Camden RRF, Morgan Blvd. & I-676 entrance ramp
	Camden Spruce Street	34 007 0002	CO, NO_X, O_3, SO_2, $PM_{2.5}$ $PM_{2.5}$Spec, BTEX, Black Carbon, TOXICS	39.934446	-75.125291	Spruce St. near Locust St.
	Pennsauken	34 007 1007	$PM_{2.5}$	39.989036	-75.050008	Morris-Delair Water Treatment Plant Off Griffith Morgan Lane
CUMBERLAND	Millville	34 011 0007	NO_X, O_3	39.422273	- 75.025204	Lincoln Avenue & Route 55. Northeast of Millville
GLOUCESTER	Clarksboro	34 015 0002	O_3	39.800339	-75.212119	Clarksboro Shady Rest Home, Shady Lane and County House Road
	Gibbstown	34 015 0004	$PM_{2.5}$	39.830806	-75.284723	Municipal Maintenance Yard, North School Street, North of Morse Avenue

[1] See Parameter Codes, Table 4 (page Appendix A-8)
[3] The United States Fish and Wildlife Service-Air Quality Branch (USFWS-AQB) is responsible for sample collection

Table 4
Parameter Codes

ACID	Acid Deposition	**PAMS**	Photochemical Assessment Monitoring Station measures ozone precursors
Black Carbon	Measured by Aethalometer	**PM_{10}**	Coarse Particles (10 Microns or less) collected by a Federal Reference Method PM_{10} Sampler
BTEX	Measured Benzene, Toluene, Ethyl benzene, and Xylenes	**$PM_{2.5}$Spec**	Speciated (2.5 Microns or less) Fine Particles
CO	Carbon Monoxide	**$PM_{2.5}$**	Fine Particles (2.5 Microns or less) collected by a Federal Reference Method $PM_{2.5}$ Sampler
Hg	Mercury	**TEOM**	Real-Time $PM_{2.5}$ Analyzer
Pb	Lead	**SO_2**	Sulfur Dioxide
MET	Metrological Parameters	**SS**	Smoke Shade
NO_X	Nitrogen Dioxide and Nitric Oxide	**TOXICS**	Air Toxics
NOy	Total Reactive Oxides of Nitrogen	**Visibility**	Measured by Nephelometer
O_3	Ozone		

2013 Appendix B

Fine Particulate Speciation Summary- 2013

New Jersey Department of Environmental Protection

Table 1
Fine Particulate Speciation Data – 2013
Camden Spruce Street, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu g/m^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Aluminum	0.030	0.213	0.173
Ammonium	0.775	4.140	3.290
Antimony	0.018	0.026	0.026
Arsenic	0.001	0.010	0.005
Barium	0.008	0.030	0.030
Bromine	0.004	0.030	0.012
Cadmium	0.002	0.024	0.016
Calcium	0.031	0.153	0.111
Cerium	0.008	0.043	0.043
Cesium	0.010	0.023	0.023
Chlorine	0.184	2.010	1.740
Chromium	0.004	0.051	0.039
Cobalt	0.001	0.004	0.004
Copper	0.006	0.062	0.033
Elemental carbon	0.482	1.870	1.680
Indium	0.010	0.028	0.022
Iron	0.197	2.280	1.150
Lead	0.009	0.375	0.055
Magnesium	0.011	0.060	0.054
Manganese	0.004	0.025	0.013
Nickel	0.003	0.014	0.013
Nitrate	1.159	8.160	6.930
Organic carbon	2.325	9.340	5.040
Phosphorus	0.005	0.008	0.008
Potassium	0.104	0.594	0.485
Rubidium	0.001	0.001	0.001
Selenium	0.001	0.003	0.003
Silicon	0.063	0.393	0.354
Silver	0.008	0.019	0.019
Sodium	0.174	0.700	0.692
Strontium	0.001	0.004	0.003
Sulfate	1.790	5.980	5.430

Table 1 (Continued)
Fine Particulate Speciation Data – 2013
Camden Spruce Street, New Jersey

Concentrations in Micrograms Per Cubic Meter (μg/m³)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Sulfur	0.700	2.450	2.150
Tin	0.014	0.037	0.033
Titanium	0.003	0.014	0.011
Total mass	10.500	33.700	28.500
Vanadium	0.002	0.007	0.007
Zinc	0.024	0.261	0.210
Zirconium	0.003	0.012	0.012

Table 2
Fine Particulate Speciation Data – 2013
Chester, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu g/m^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Aluminum	0.020	0.183	0.155
Ammonium	0.564	2.890	2.230
Antimony	0.022	0.072	0.072
Arsenic	0.000	0.004	0.003
Barium	0.007	0.030	0.030
Bromine	0.003	0.008	0.007
Cadmium	0.002	0.019	0.019
Calcium	0.009	0.063	0.040
Cerium	0.007	0.044	0.044
Cesium	0.010	0.023	0.023
Chlorine	0.007	0.065	0.059
Chromium	0.007	0.092	0.068
Cobalt	0.001	0.002	0.001
Copper	0.002	0.010	0.007
Elemental carbon	0.158	0.861	0.506
Indium	0.010	0.022	0.017
Iron	0.034	0.117	0.113
Lead	0.001	0.016	0.006
Magnesium	0.011	0.047	0.046
Manganese	0.001	0.004	0.003
Nickel	0.001	0.008	0.007
Nitrate	1.034	18.500	6.680
Organic carbon	1.605	6.140	4.230
Phosphorus	0.006	0.008	0.008
Potassium	0.035	0.156	0.111
Rubidium	0.001	0.001	0.001
Selenium	0.001	0.002	0.001
Silicon	0.037	0.345	0.344
Silver	0.008	0.019	0.019
Sodium	0.088	2.730	0.346
Strontium	0.001	0.008	0.005
Sulfate	1.634	5.250	4.700

Table 2 (Continued)
Fine Particulate Speciation Data – 2013
Chester, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu g/m^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Sulfur	0.608	2.100	1.810
Tin	0.013	0.021	0.018
Titanium	0.003	0.015	0.008
Total mass	7.600	26.700	19.800
Vanadium	0.002	0.002	0.002
Zinc	0.005	0.038	0.030
Zirconium	0.004	0.015	0.013

Table 3
Fine Particulate Speciation Data – 2013
Elizabeth Lab, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu g/m^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Aluminum	0.035	0.223	0.208
Ammonium	0.802	3.650	3.070
Antimony	0.020	0.062	0.058
Arsenic	0.001	0.003	0.003
Barium	0.008	0.030	0.030
Bromine	0.003	0.009	0.009
Cadmium	0.001	0.020	0.019
Calcium	0.027	0.101	0.086
Cerium	0.008	0.043	0.043
Cesium	0.010	0.023	0.023
Chlorine	0.024	0.478	0.315
Chromium	0.008	0.105	0.068
Cobalt	0.001	0.003	0.003
Copper	0.005	0.021	0.018
Elemental carbon	0.989	3.090	2.980
Indium	0.010	0.029	0.019
Iron	0.125	0.345	0.293
Lead	0.001	0.008	0.006
Magnesium	0.010	0.104	0.063
Manganese	0.002	0.006	0.006
Nickel	0.002	0.017	0.011
Nitrate	1.364	7.490	7.180
Organic carbon	2.503	7.400	6.560
Phosphorus	0.006	0.013	0.008
Potassium	0.043	0.186	0.152
Rubidium	0.001	0.002	0.001
Selenium	0.001	0.003	0.001
Silicon	0.067	0.395	0.394
Silver	0.008	0.019	0.019
Sodium	0.117	0.809	0.681
Strontium	0.001	0.013	0.004
Sulfate	1.813	5.110	4.780

Table 3 (Continued)
Fine Particulate Speciation Data – 2013
Elizabeth Lab, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu g/m^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Sulfur	0.681	1.870	1.780
Tin	0.013	0.026	0.025
Titanium	0.004	0.016	0.013
Total mass	11.200	32.700	29.700
Vanadium	0.002	0.008	0.007
Zinc	0.012	0.216	0.049
Zirconium	0.003	0.014	0.012

Table 4
Fine Particulate Speciation Data – 2013
New Brunswick, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu g/m^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Aluminum	0.032	0.448	0.237
Ammonium	0.557	2.940	2.580
Antimony	0.019	0.032	0.030
Arsenic	0.000	0.004	0.002
Barium	0.007	0.030	0.030
Bromine	0.003	0.011	0.009
Cadmium	0.002	0.021	0.019
Calcium	0.013	0.059	0.052
Cerium	0.007	0.044	0.043
Cesium	0.009	0.023	0.023
Chlorine	0.015	0.257	0.220
Chromium	0.012	0.165	0.127
Cobalt	0.001	0.002	0.002
Copper	0.004	0.036	0.028
Elemental carbon	0.285	1.120	0.756
Indium	0.010	0.029	0.023
Iron	0.071	0.509	0.418
Lead	0.001	0.013	0.007
Magnesium	0.010	0.074	0.064
Manganese	0.002	0.012	0.008
Nickel	0.003	0.043	0.033
Nitrate	1.017	6.560	6.250
Organic carbon	1.965	6.160	5.020
Phosphorus	0.006	0.010	0.008
Potassium	0.040	0.150	0.142
Rubidium	0.001	0.001	0.001
Selenium	0.001	0.004	0.002
Silicon	0.040	0.363	0.146
Silver	0.007	0.019	0.019
Sodium	0.078	0.585	0.488
Strontium	0.001	0.003	0.003
Sulfate	1.503	4.790	4.320

Table 4 (Continued)
Fine Particulate Speciation Data – 2013
New Brunswick, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu g/m^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Sulfur	0.603	1.920	1.630
Tin	0.013	0.030	0.029
Titanium	0.003	0.018	0.008
Total mass	9.200	27.000	26.300
Vanadium	0.002	0.004	0.002
Zinc	0.007	0.044	0.042
Zirconium	0.003	0.016	0.012

Table 5
Fine Particulate Speciation Data – 2013
Newark Firehouse, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu g/m^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Aluminum	0.032	0.264	0.261
Ammonium	0.742	3.230	3.060
Antimony	0.019	0.041	0.033
Arsenic	0.000	0.003	0.003
Barium	0.007	0.030	0.030
Bromine	0.003	0.011	0.008
Cadmium	0.002	0.020	0.018
Calcium	0.020	0.085	0.074
Cerium	0.006	0.044	0.044
Cesium	0.009	0.023	0.023
Chlorine	0.017	0.389	0.191
Chromium	0.006	0.085	0.065
Cobalt	0.001	0.002	0.002
Copper	0.005	0.025	0.022
Elemental carbon	0.447	1.670	1.460
Indium	0.009	0.019	0.018
Iron	0.081	0.271	0.238
Lead	0.001	0.009	0.007
Magnesium	0.010	0.087	0.060
Manganese	0.001	0.006	0.006
Nickel	0.002	0.015	0.013
Nitrate	1.343	7.050	6.850
Organic carbon	2.283	5.830	5.420
Phosphorus	0.006	0.008	0.008
Potassium	0.043	0.193	0.161
Rubidium	0.001	0.001	0.001
Selenium	0.001	0.001	0.001
Silicon	0.060	0.572	0.561
Silver	0.007	0.019	0.019
Sodium	0.105	0.731	0.719
Strontium	0.002	0.026	0.015
Sulfate	1.670	4.990	4.660

Table 5 (Continued)
Fine Particulate Speciation Data – 2013
Newark Firehouse, New Jersey

Concentrations in Micrograms Per Cubic Meter ($\mu g/m^3$)

Pollutant	Annual Average Concentration	Daily Average Maximum Concentration	Daily Average 2nd Highest Concentration
Sulfur	0.649	1.890	1.740
Tin	0.013	0.036	0.036
Titanium	0.003	0.019	0.017
Total mass	9.800	29.200	25.800
Vanadium	0.002	0.013	0.008
Zinc	0.010	0.041	0.036
Zirconium	0.003	0.012	0.012