



2010 Air Quality Report

New Jersey Department of Environmental Protection

SUMMARY

This report summarizes the New Jersey air quality monitoring data for 2010. 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 and toxic air contaminants are also provided.





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New Jersey Department of Environmental Protection

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2010 Introduction

New Jersey Department of Environmental Protection

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 to be 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.

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 PM_{2.5}. 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 PM_{2.5} 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:

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2010 Network Summary

New Jersey Department of Environmental Protection

NETWORK DESIGN

In 2010, the Bureau of Air Monitoring maintained 41 Ambient Air Monitoring Sites in New Jersey. These monitoring sites fulfill one or more of the following objectives: measure maximum pollutant concentration, assess population exposure, determine the impact of major pollution sources, measure background levels, determine the extent of regional pollutant transport, or measure secondary impacts in rural areas.

Data from the network is provided to various public and media outlets and is used to provide hourly updates on air quality to the Bureau's web page at

<http://www.njaqinow.net/Default.htm>. The Air Monitoring Sites can be divided into two primary networks: the Continuous Monitoring Network and the Manual Sampling Network.

SPATIAL SCALES

There are many factors which affect the design of a monitoring network. Among these are pollutant characteristics, topographical features, population distribution, location of pollution sources, meteorology, and logistics.

One of the most important factors to consider when selecting a site is the spatial area it actually represents. To assist with this, the United States Environmental Protection Agency (USEPA) developed specific scales of representativeness for air monitoring sites. The spatial scales specify the area surrounding a monitor where the pollutant concentrations should be relatively similar. For each monitoring objective, appropriate spatial scales can be used to identify the general physical location of a suitable monitoring site. The various spatial scales are defined below:

Micro-scale (10 – 100m): Monitors in locations that show significant concentration differences within 100 meters of the monitor are classified being Micro-scale monitors. This often occurs when monitors are located right next to low-level emission sources, such as busy roadways,



Figure 1: Photo of Brigantine Air Monitoring Station located on the grounds of the Edwin Forsythe National Wildlife Refuge in Atlantic County.

construction sites, and facilities with short stacks. These locations should be in areas where the general public is exposed to the concentrations measured.

Middle Scale (100 – 5000m): These monitors are in areas where pollutant levels are reasonably consistent over an area of up to 0.5 kilometer. Such sites may be near large industrial areas with many different operations or near large construction sites. Middle scale monitoring sites are often source oriented. Monitoring measurements of this type might be appropriate for the evaluation of short-term exposure to an emission source.

Neighborhood scale (0.5 – 4km): Neighborhood scale monitors are in locations that have fairly consistent pollutant concentrations over areas up to a few kilometers. A particular location can represent not only the immediate neighborhood but also neighborhoods of the same type in other parts of the city. Neighborhood scale monitors provide good data for trend analysis studies and compliance with National Ambient Air Quality Standards (NAAQS) because their zones of representation often encompass areas where people commonly reside.

Urban Scale (4 – 50km): Urban scale monitors show consistency among pollutant measurements with monitor separations up to 50 kilometers. Urban scale sites are usually located at higher elevations and away from highly traveled roads and industries. These locations are ideal for evaluating concentrations over an entire metropolitan and/or rural area.

Regional scale (100 – 1000km): Regional scale (background monitors) monitors can represent pollutant levels over an area of a few hundred kilometers. These monitors are best located in rural areas away from local sources, and at higher elevations. National parks, national wilderness areas, and many state and county parks and reserves are appropriate areas for regional scale sites. Data gathered at this scale location is most useful in assessing pollutant concentrations over a large area and evaluating transported emissions.

THE CONTINUOUS MONITORING NETWORK

The Continuous Monitoring Network consists of sites which measure carbon monoxide (CO), oxides of nitrogen (NO_x), ozone (O₃), sulfur dioxide (SO₂), particulate matter, smoke shade (SS), total reactive oxides of nitrogen (NO_y), mercury (Hg), and meteorological data which include wind speed (WS), wind direction (WD), barometric pressure, solar radiation, temperature, and relative humidity. The Bureau of Air Monitoring has a data acquisition system primarily for its continuous monitoring network. The system uses wireless communication technology to transmit data to a centralized computer station located in Trenton, NJ. The information is transmitted once every minute, thus providing real-time data retrieval capability. A map showing the location of the continuous monitoring sites is shown in Figure 2. Changes to the Continuous Network are summarized in Table 1 (page 3). The parameters recorded at each site are displayed in Table 2 (page 4). Many of the continuous site locations are also part of the Manual Monitoring Network, which is described in the next section.

Figure 2
2010 – Continuous Monitoring Network

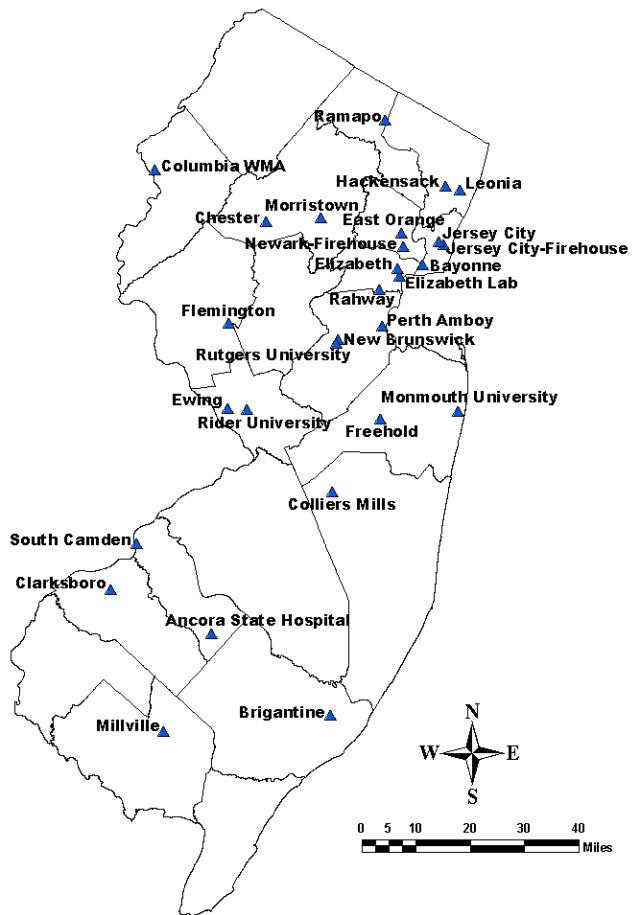


Table 1

| 2009-2010 Continuous Network Changes | | | |
|---|--|---------------|-------------|
| Monitoring Site | Parameter(s) | Action | Date |
| Burlington | CO, SO ₂ , SS | Shutdown | 12/29/09 |
| Columbia WMA | SO ₂ | Start-up | 09/23/10 |
| | TEOM | Start-up | 10/22/10 |
| Ewing | TEOM | Start-up | 01/01/09 |
| Fort Lee | CO | Shutdown | 11/04/09 |
| | TEOM | Shutdown | 10/16/09 |
| Hackensack | CO, SO ₂ , SS | Shutdown | 12/31/10 |
| Newark Firehouse | CO, O ₃ , SO ₂ | Start-up | 06/01/09 |
| | TEOM | Start-up | 09/01/09 |
| | NO _y , WS,WD, Barometric Pressure | Start-up | 11/09/10 |
| | Temperature, Solar Radiation | Start-up | 11/10/10 |
| | Relative Humidity | Start-up | 12/17/10 |

**Table 2
2010 – Continuous Air Monitoring Network**

Continuous Parameter Codes

- | | | | |
|-----------------------|-------------------------------------|-----------------------|---|
| CO | - Carbon Monoxide | SS | - Smoke Shade |
| NO_x | - Nitrogen Dioxide and Nitric Oxide | TEOM | - Continuous PM _{2.5} Analyzer |
| O₃ | - Ozone | MET | - Meteorological Parameters |
| SO₂ | - Sulfur Dioxide | NO_Y | - Total Reactive Oxides of Nitrogen |
| Hg | - Mercury Station | | |

| SITE | CO | NO _x | O ₃ | SO ₂ | NO _Y | SS | TEOM | MET | Hg |
|-----------------------|-----------|-----------------|----------------|-----------------|-----------------|----------|-----------|----------|----------|
| Ancora State Hospital | U | | U | U | | | | | |
| Bayonne | | U | N | N | | | | | |
| Brigantine | | | U | U | | | U | | U |
| Chester | | U | U | U | | | | N | U |
| Clarksboro | | | U | U | | | | | |
| Colliers Mills | | | U | | | | | | |
| Columbia WMA | | | | U | | | U | | |
| East Orange | N | N | | | | | | N | |
| Elizabeth | Mi | | | M | | N | | | |
| Elizabeth Lab | N | N | | N | | N | N | N | U |
| Ewing | | | | | | | N | | |
| Flemington | | | U | | | | N | N | |
| Freehold | Mi | | | | | N | | | |
| Hackensack | N | | | N | | N | | | |
| Jersey City-Firehouse | | | | | | | N | | |
| Jersey City | Mi | | | N | | N | | | |
| Leonia | | N | N | | | | | | |
| Millville | | N | N | N | | | N | | |
| Monmouth University | | | N | | | | | | |
| Morristown | Mi | | | | | N | | | |
| New Brunswick | | | | | | | N | | U |
| Newark - Firehouse | N | | N | N | N | | N | N | |
| Perth Amboy | N | | | N | | N | | | |
| Rahway | | | | | | | N | | |
| Ramapo | | | U | | | | | | |
| Rider University | | N | N | | | | | N | |
| Rutgers University | | N | N | | | | | U* | |
| South Camden | | | | | | | N | | |
| TOTAL | 10 | 8 | 14 | 13 | 1 | 7 | 11 | 7 | 4 |

Spatial Scale codes: Mi - **Micro**, M - **Middle**, N - **Neighborhood**, U - **Urban**, R - **Regional**

* Meteorological measurements at this site are collected by Rutgers University

MANUAL MONITORING NETWORK

The Manual Monitoring Network does not transmit data in near real-time as does the Continuous Monitoring Network. The manual network consists primarily of various instruments that collect samples for subsequent analysis in a laboratory. The network provides data on fine particulates (particles smaller than 2.5 micrometers in diameter or $PM_{2.5}$), inhalable particulates (particles smaller than 10 micrometers in diameter or PM_{10}), several parameters associated with atmospheric deposition, pollutants important in the formation of ground level ozone (ozone precursors), and a group of organic and inorganic compounds that are considered toxic pollutants. Sites that measure ozone precursors are part of the national Photochemical Assessment Monitoring Station (PAMS) program and operates from June to August. While these ozone precursors are automatically measured every hour, the data are retrieved daily and require extensive review before they are validated. Changes to the Manual Network are shown in Table 3. A map of the manual sampling sites is shown in Figure 3 and a list of the pollutants measured at each location is shown in Table 4 (page 6).

Figure 3
2010 – Manual Monitoring Network

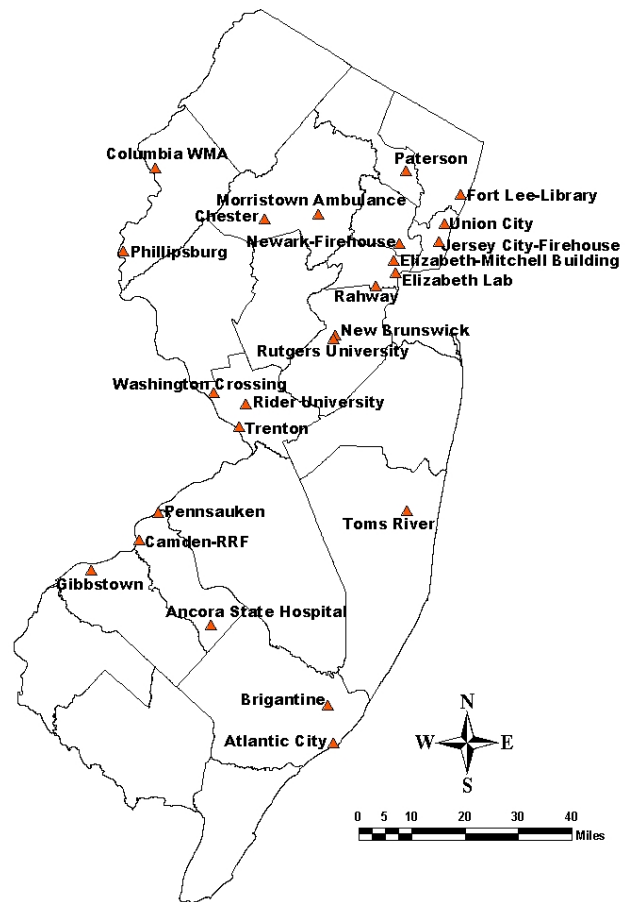


Table 3

| 2009-2010 Manual Network Changes | | | |
|----------------------------------|-----------------------------|----------|----------|
| Monitoring Site | Parameter(s) | Action | Date |
| Atlantic City | PM_{10} | Shutdown | 03/09/10 |
| Columbia WMA | $PM_{2.5}$ | Start-up | 09/23/10 |
| Fort Lee | PM_{10} | Shutdown | 12/03/09 |
| Newark - Firehouse | $PM_{2.5}$, $PM_{2.5}Spec$ | Start-up | 07/03/09 |
| Rider | PAMS | Shutdown | 08/31/10 |

**Table 4
2010 - Manual Air Monitoring Network**

Manual Parameter Codes

| | | | |
|------------------------------|---|------------------------|---------------------------------------|
| PM_{2.5} | - PM _{2.5} Sampler: FRM (Federal Reference Method) | CARB | - Carbonyls |
| PM₁₀ | - FRM Manual PM ₁₀ Sampler | VOCs | - Volatile Organic Compounds |
| PM_{2.5} Spec | - PM _{2.5} Speciation Trends Network Sampler | ACID Deposition | - Acidity (pH scale) in precipitation |
| PAMS | - Photochemical Assessment Monitoring (Ozone Precursors) | | |

| SITE | PM_{2.5} | PM₁₀ | PM_{2.5}Spec | PAMS | CARB | VOCs | ACID Deposition |
|-----------------------------|-------------------------|------------------------|-----------------------------|-------------|-------------|-------------|------------------------|
| Ancora State Hospital | | | | | | | U |
| Atlantic City | N | N | | | | | |
| Brigantine | U | | | | | | U* |
| Camden-RRF | | M | | | | | |
| Chester | U | | U | | U | U | |
| Columbia WMA | U | | | | | | |
| Elizabeth Lab | N | | N | | N | N | |
| Elizabeth-Mitchell Building | N | | | | | | |
| Fort Lee-Library | N | | | | | | |
| Gibbstown | N | | | | | | |
| Jersey City-Firehouse | N | N | | | | | |
| Morristown-Ambulance Squad | N | | | | | | |
| New Brunswick | N | | N | | N | N | |
| Newark - Firehouse | N | | N | | | | |
| Paterson | N | | | | | | |
| Pennsauken | N | | | | | | |
| Phillipsburg | N | | | | | | |
| Rahway | N | | | | | | |
| Rider University | | | | N | | | |
| Rutgers University | | | | N | | | |
| Toms River | N | | | | | | |
| Trenton | N | N | | | | | |
| Union City | N | | | | | | |
| Washington Crossing | N | | | | | | U |
| TOTAL | 20 | 4 | 4 | 2 | 3 | 3 | 3 |

Spatial Scale codes: Mi - **Micro**, M - **Middle**, N - **Neighborhood**, U - **Urban**, R - **Regional**

*The United States Fish and Wildlife Service - Air Quality Branch (USFWS-AQB) is responsible for the sample collection.

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2010 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). The Nitrogen Dioxide and Sulfur Dioxide NAAQS were revised in 2010 because the U.S. Environmental Protection Agency (EPA) had determined that the old standard was not sufficiently protective of public health. On January 22, 2010, they set a revised standard of 100 ppb maximum daily 1-hour average for NO₂ and on June 2, 2010, they set a revised standard of 75 ppb maximum daily 1-hour standard for SO₂. 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>.

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 |

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 (<http://www.enviroflash.info>) to those who subscribe to receive air quality forecast and alert emails. 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.

Figure 1
Air Quality Index Regions

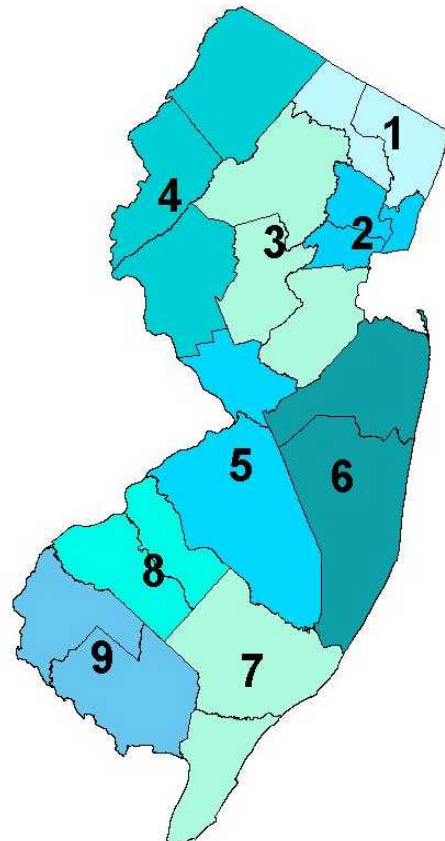


Table 2
Pollutants Monitored According to Air Quality Index Reporting Region - 2010

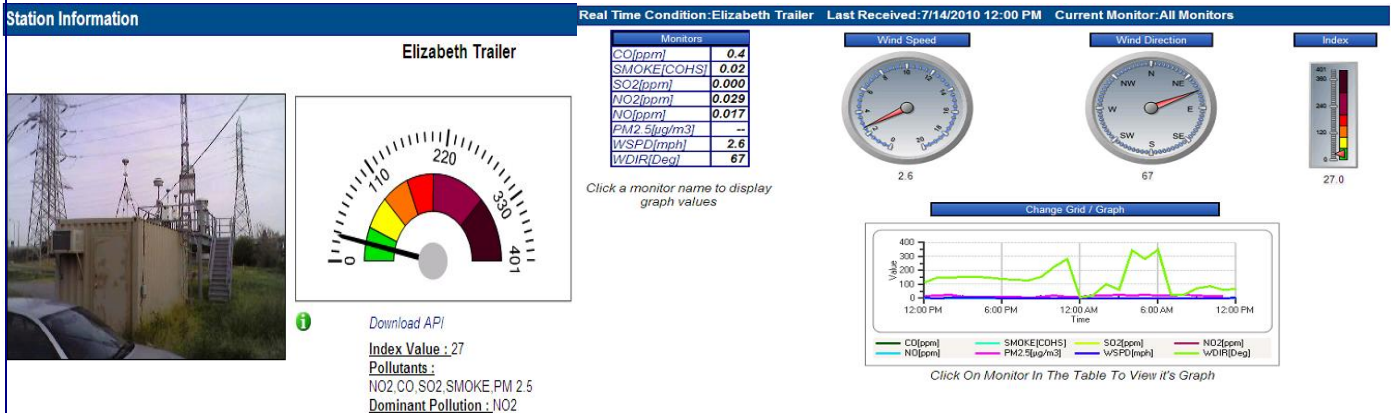
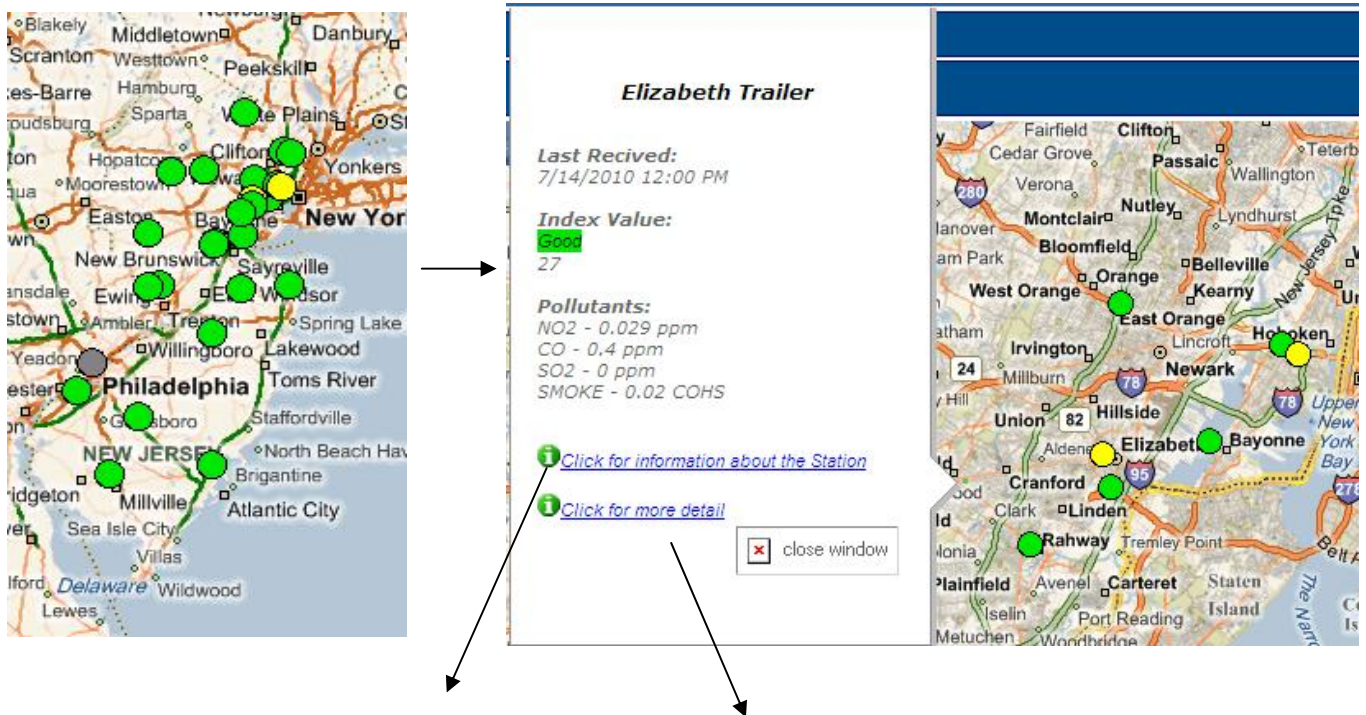
CO - Carbon Monoxide O₃ - Ozone
SO₂ - Sulfur Dioxide NO₂ - Nitrogen Dioxide
PM - Particulate Matter

| Reporting Region | Monitoring Site | CO | SO ₂ | PM | O ₃ | NO ₂ |
|------------------------------------|---------------------------|-----|-----------------|-----|----------------|-----------------|
| 1. Northern Metropolitan | Hackensack | X | X | X | --- | --- |
| | Leonia | --- | --- | --- | X | 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 | --- |
| | Rahway | --- | --- | X | --- | --- |
| 3. Suburban | Chester | --- | X | --- | X | X |
| | Morristown | X | --- | X | --- | --- |
| | New Brunswick | --- | --- | X | --- | --- |
| | Perth Amboy | X | X | X | --- | --- |
| | Rutgers University | --- | --- | --- | X | X |
| 4. Northern Delaware Valley | Columbia WMA ^a | --- | X | X | --- | --- |
| | Flemington | --- | --- | X | X | --- |
| 5. Central Delaware Valley | Ewing | --- | --- | X | --- | --- |
| | Rider University | --- | --- | --- | X | X |
| 6. Northern Coastal | Colliers Mills | --- | --- | --- | X | --- |
| | Freehold | X | --- | X | --- | --- |
| | Monmouth University | --- | --- | --- | X | --- |
| 7. Southern Coastal | Brigantine | --- | X | X | X | --- |
| 8. Southern Delaware Valley | Ancora State Hospital | X | X | --- | X | --- |
| | Clarksboro | --- | X | --- | X | --- |
| | South Camden | --- | --- | X | --- | --- |
| 9. Delaware Bay | Millville | --- | X | X | X | X |

^a Monitoring at Columbia WMA began 9/23/2010

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



2010 AQI SUMMARY

A summary of the AQI ratings for New Jersey in 2010 is presented in the pie chart in Figure 3 below. In 2010, there were 188 "Good" days, 135 were "Moderate", 40 were rated "Unhealthy for Sensitive Groups", 2 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 nine. This may appear to be a substantial increase from 2009, however 2009 was an unusually cool and wet summer accounting for much lower concentrations of pollutants. In addition to the change in weather pattern, this is the first year with the revised NO₂ and SO₂ standards previously mentioned. 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 (AQI data was not available for every day therefore some of the regions total day count does not add up to 365).

Figure 3
2010 Air Quality Summary by Days

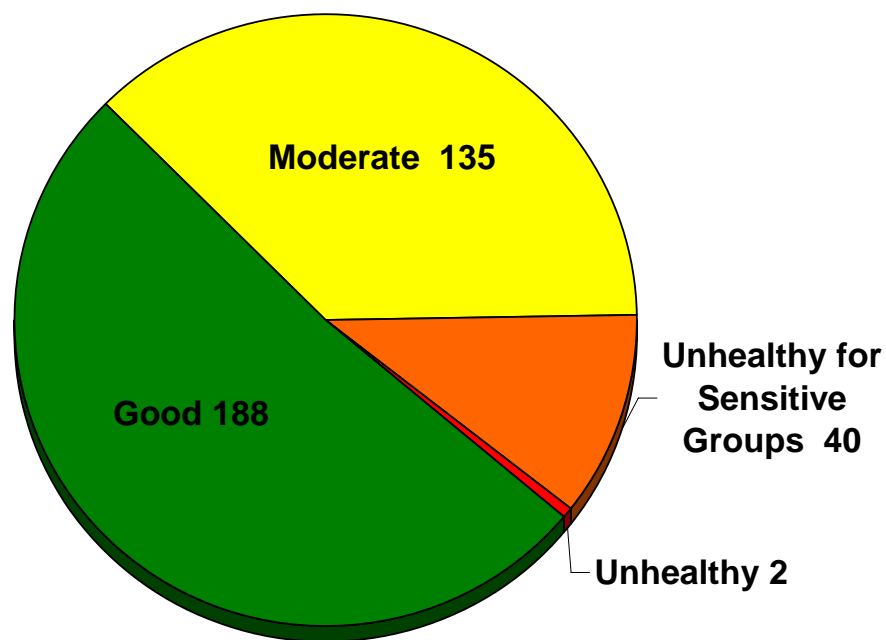


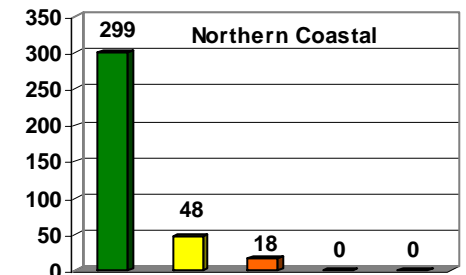
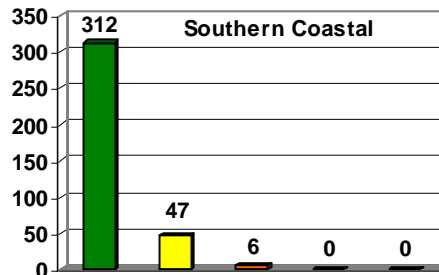
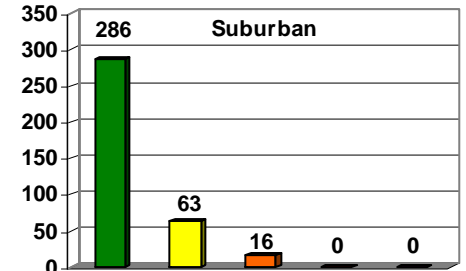
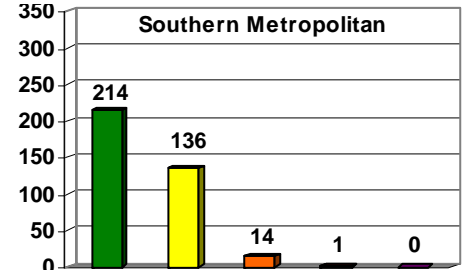
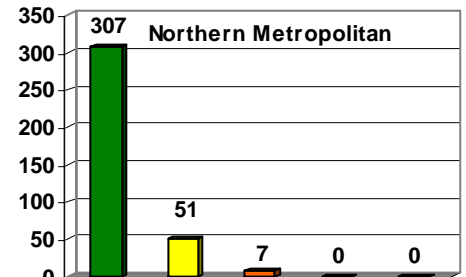
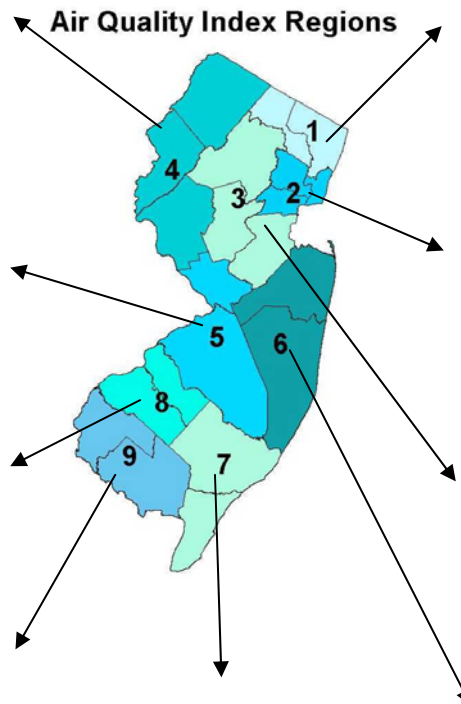
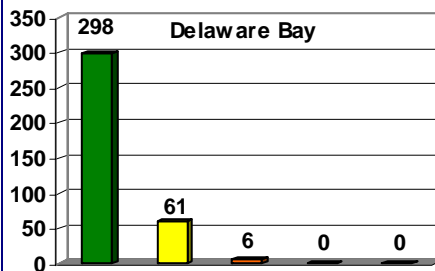
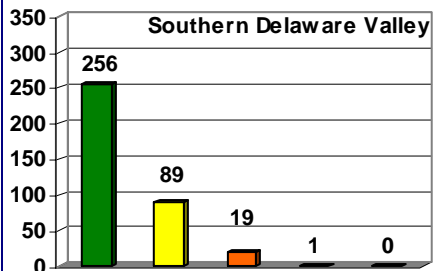
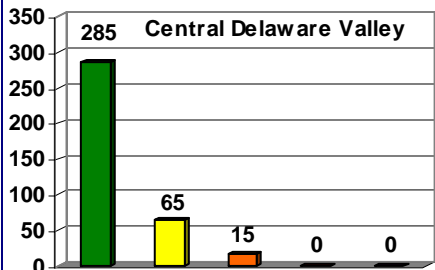
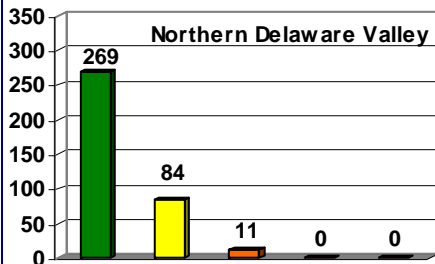
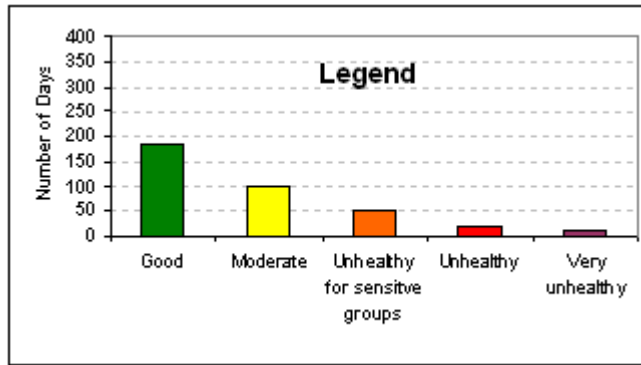
Table 3
Air Quality Index (AQI) Exceedances of 100 During 2010
Ratings Pollutants

| | | | | | |
|-----|---|--------------------------------|-----|---|---------------------------------|
| USG | - | Unhealthy for Sensitive Groups | PM | - | Fine Particle Matter (11 Sites) |
| UH | - | Unhealthy | O3 | - | Ozone (14 Sites) |
| VUH | - | Very Unhealthy | SO2 | - | Sulfur Dioxide (13 Sites) |
| | | | NO2 | - | Nitrogen Dioxide (8 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 * |
|--------------|---|-------------------|-------------------|----------------|-----------------------------------|
| March 25 | Bayonne | 102 | NO2 | USG | NO2 (1) |
| April 06 | Elizabeth Lab | 101 | PM | USG | PM (1) |
| May 01 | Rider University | 106 | O3 | USG | O3 (2) |
| May 26 | Millville | 101 | O3 | USG | O3 (1) |
| May 31 | Newark Firehouse | 132 | O3 | USG | O3 (3) |
| June 02 | Leonia | 104 | O3 | USG | O3 (3) |
| June 03 | Colliers Mills | 111 | O3 | USG | O3 (1) |
| June 04 | Rutgers University | 106 | O3 | USG | O3 (1) |
| June 19 | Rider University | 124 | O3 | USG | O3 (3) |
| June 22 | Clarksboro | 106 | O3 | USG | O3 (3) |
| June 23 | Ancora State Hospital | 111 | O3 | USG | O3 (3) |
| June 25 | Ancora State Hospital | 101 | O3 | USG | O3 (1) |
| June 26 | Colliers Mills | 129 | O3 | USG | O3 (4) |
| June 27 | Newark Firehouse | 114 | O3 | USG | O3 (3) |
| June 28 | Colliers Mills | 104 | O3 | USG | O3 (1) |
| July 04 | Colliers Mills | 111 | O3 | USG | O3 (5) |
| July 05 | Monmouth University | 147 | O3 | USG | O3 (8) |
| July 06 | Bayonne | 190 | O3 | UH | O3 (7) |
| July 07 | Rutgers University | 147 | O3 | USG | O3 (14) |
| July 12 | Newark Firehouse | 104 | O3 | USG | O3 (1) |
| July 16 | Rider / Rutgers University | 109 | O3 | USG | O3 (3) |
| July 17 | Colliers Mills | 111 | O3 | USG | O3 (2) |
| July 21 | Colliers Mills | 106 | O3 | USG | O3 (1) |
| July 23 | Flemington | 114 | O3 | USG | O3 (3) |
| July 28 | Rutgers University | 119 | O3 | USG | O3 (2) |
| August 09 | Rider University | 129 | O3 | USG | O3 (2) |
| August 10 | Clarksboro | 154 | O3 | UH | O3 (6), PM(1) |
| August 11 | Rutgers University | 116 | O3 | USG | O3 (4) |
| August 17 | Ancora State Hospital | 127 | O3 | USG | O3 (2) |
| August 19 | Rider University | 150 | O3 | USG | O3 (11) |
| August 20 | Ancora State Hospital / Monmouth University | 106 | O3 | USG | O3 (2) |
| August 29 | Ancora State Hospital | 116 | O3 | USG | O3 (1) |
| August 30 | Ancora State Hospital | 132 | O3 | USG | O3 (5) |
| August 31 | Monmouth University | 150 | O3 | USG | O3 (2) |
| September 01 | Colliers Mills | 147 | O3 | USG | O3 (13) |
| September 02 | Chester / Ramapo | 147 | O3 | USG | O3 (7) |
| September 22 | Rutgers University | 116 | O3 | USG | O3 (2) |
| September 24 | Columbia WMA | 128 | SO2 | USG | SO2 (1) |
| September 29 | Columbia WMA | 108 | SO2 | USG | SO2 (1) |
| October 30 | Columbia WMA | 149 | SO2 | USG | SO2 (1) |
| December 15 | Elizabeth Lab | 102 | NO2 | USG | NO2(1) |
| December 30 | South Camden | 105 | PM | USG | PM (1), SO2 (1) |

Figure 4
2010 Air Quality Index Summary
Number of Days by Reporting Region



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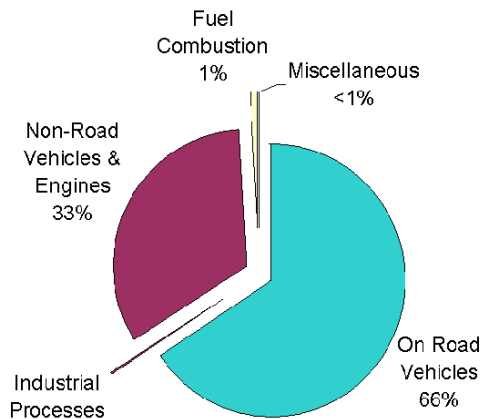
2010 Carbon Monoxide Summary

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 66 percent of all CO emissions nationwide. In cities, automobile exhaust can cause as much as 95 percent of all CO emissions. Non-road engines and vehicles, such as construction equipment and boats, are also significant sources of CO. Overall, the transportation sector (Non-Road and On Road Vehicles combined) is responsible for about 99% of all CO emissions nationally. 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**



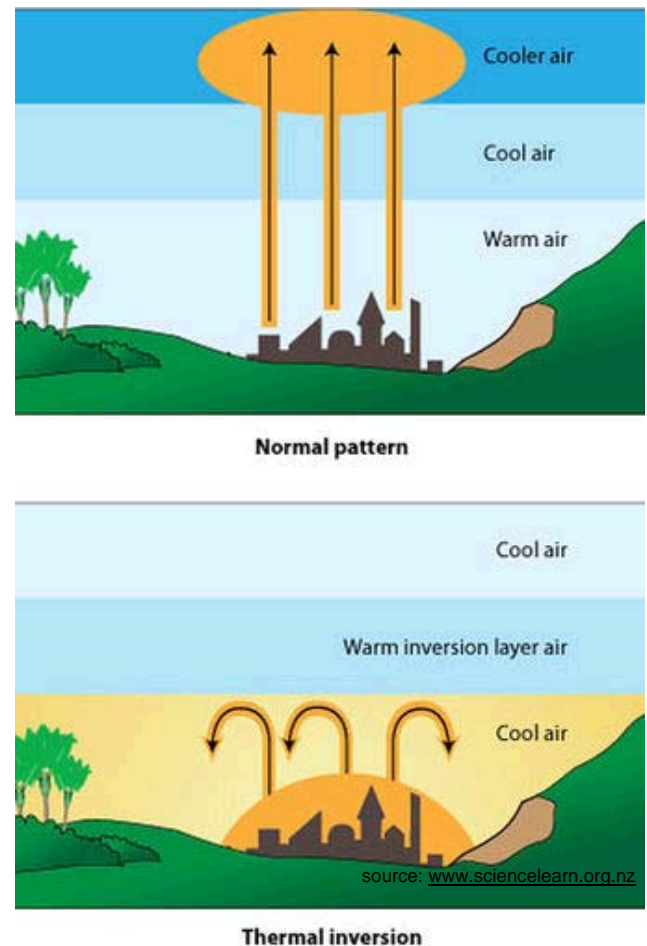
Source: United States Environmental Protection Agency
www.epa.gov/air/emissions/co.htm

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 2: Effect of Atmospheric Inversion on Air Pollution



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.

New Jersey state standards for CO are based on different units (milligrams per cubic meter as opposed to parts per million), and our standards are not to be exceeded more than once in any 12-month period. The state has set secondary (welfare based) 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/m³ = 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) | ---- |

STANDARDS

There are currently two national primary, or health based, standards for carbon monoxide. They are set at a one-hour 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 (welfare based) standards for CO at this time.

**Figure 3
2010 Carbon Monoxide Concentrations – New Jersey
Monthly Variation
Parts Per Million (PPM)**

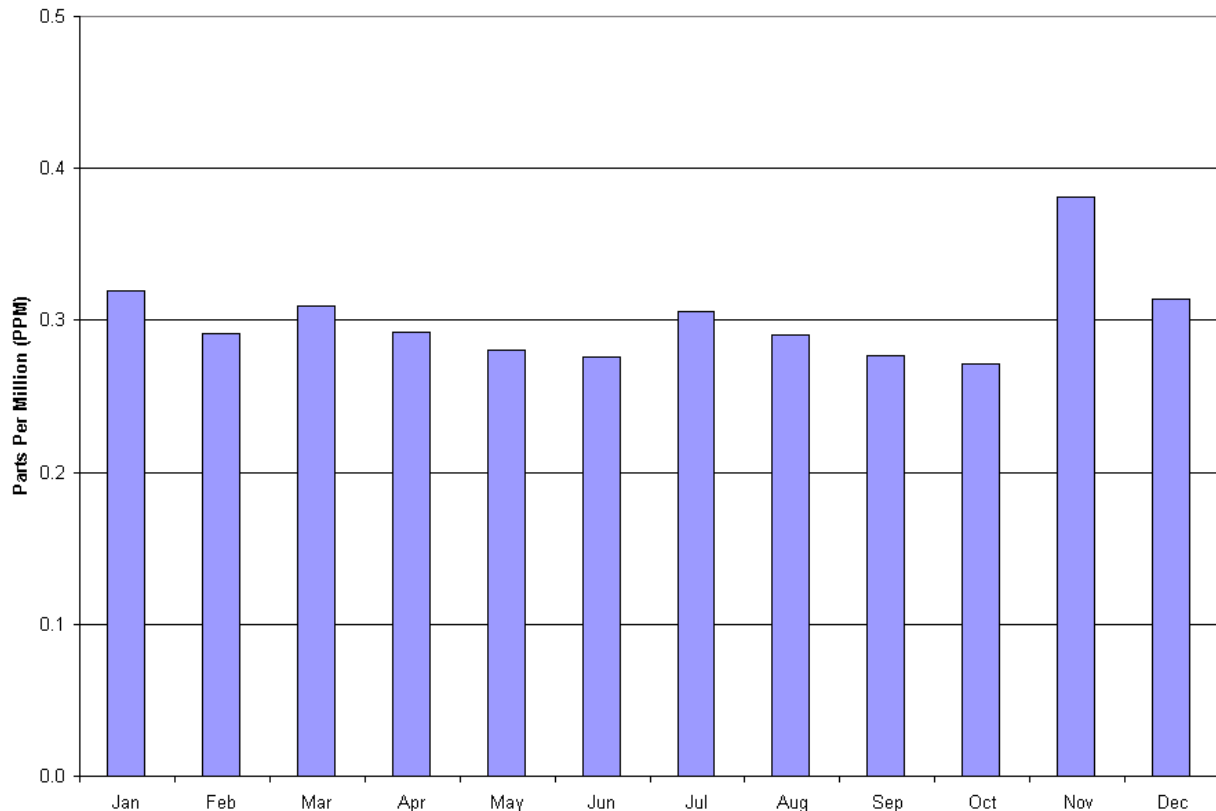
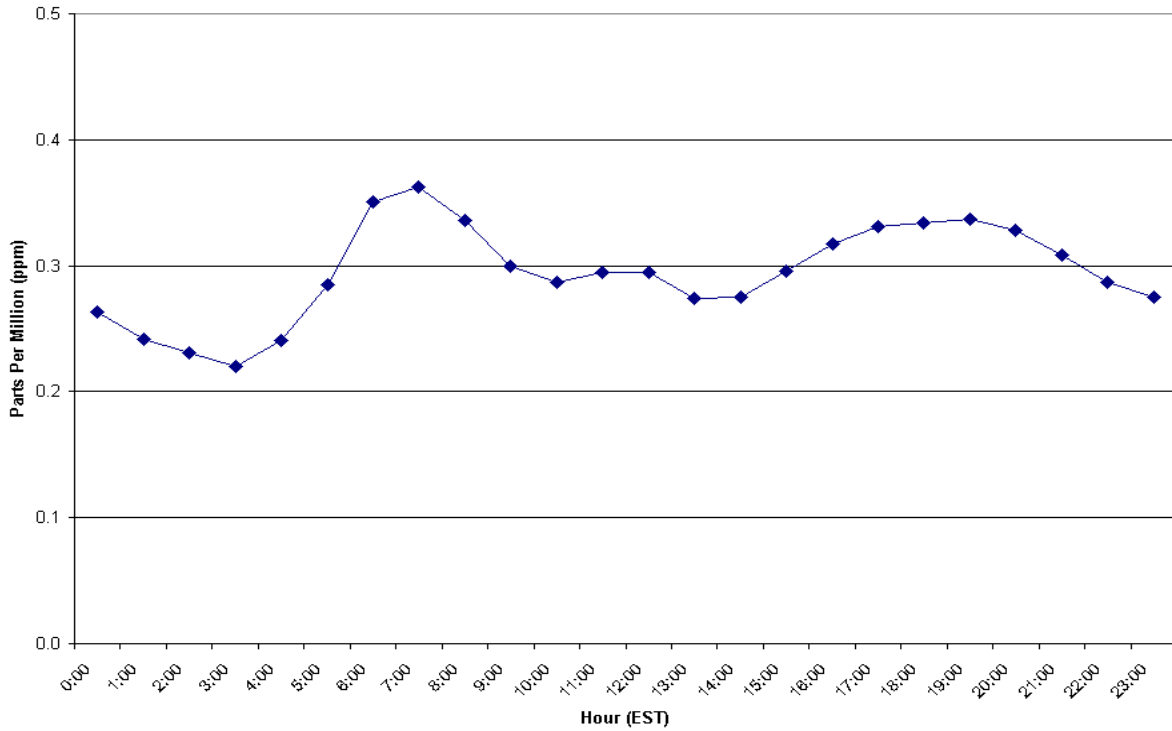


Figure 4
2010 Carbon Monoxide Concentrations – New Jersey
Diurnal Variation
Parts Per Million (PPM)



MONITORING LOCATIONS

The state monitored CO levels at 10 locations in 2010. These sites are shown in the map in Figure 5. The NJDEP is actively pursuing the establishment of new monitoring locations in Camden and Fort Lee.

CO LEVELS IN 2010

None of the monitoring sites recorded exceedances of any CO standard during 2010. The maximum one-hour average concentration recorded was 6.0 ppm at the Freehold station. The highest 8-hour average concentration recorded was 3.1 ppm at the East Orange station. Summaries of the 2010 data are provided in Figure 6 and Table 2 (page 4).

Figure 5
2010 Carbon Monoxide
Monitoring Network



Figure 6
Highest and 2nd Highest 8-Hour Averages
Of Carbon Monoxide in New Jersey – 2010
Parts Per Million (PPM)

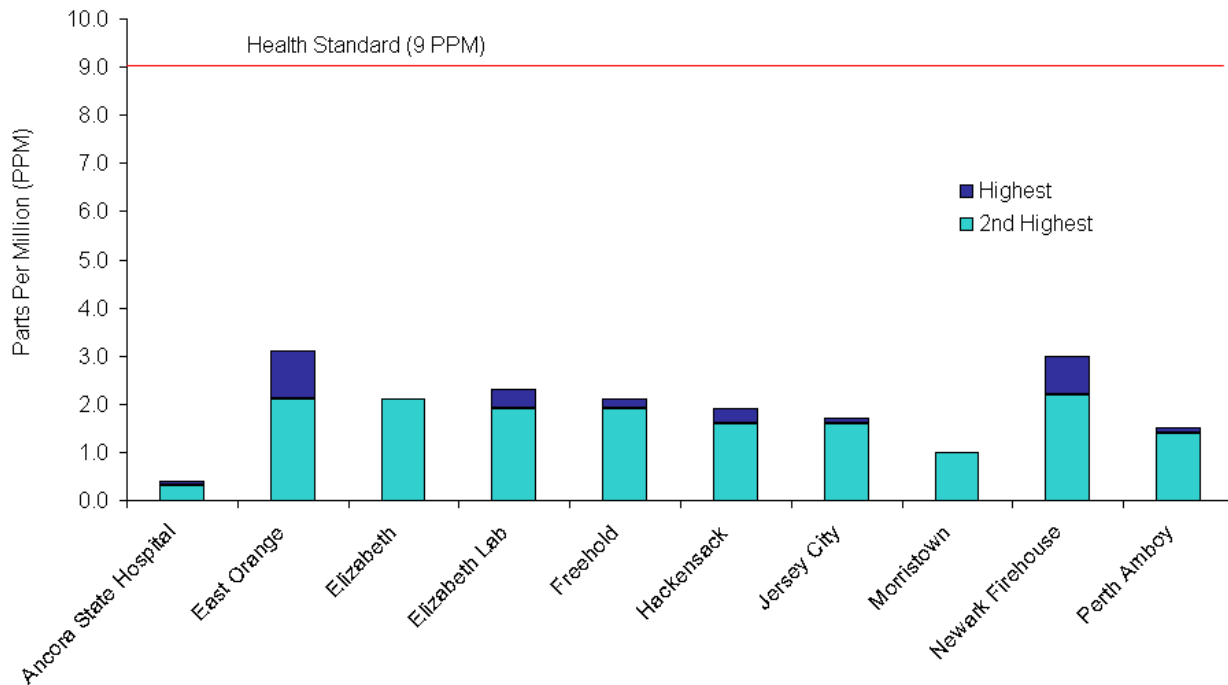


Table 2
Carbon Monoxide Data – 2010
1-Hour and 8-Hour Averages

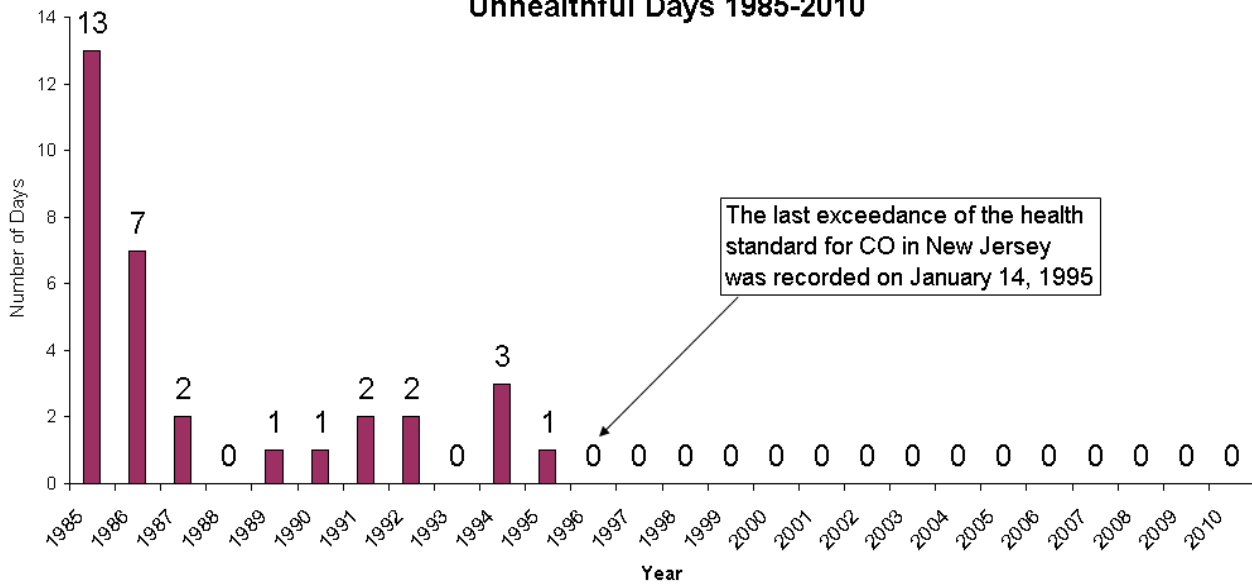
Parts Per Million (ppm)
 1-hour standard = 35 ppm
 8-hour standard = 9 ppm

| Monitoring Sites | Maximum 1-Hour Average | 2 nd Highest 1-Hour Average | Maximum 8-Hour Average | 2 nd Highest 8-Hour Average |
|-----------------------|------------------------|--|------------------------|--|
| Ancora State Hospital | 1.1 | 0.7 | 0.4 | 0.3 |
| East Orange | 3.7 | 3.4 | 3.1 | 2.1 |
| Elizabeth | 3.5 | 2.8 | 2.1 | 2.1 |
| Elizabeth Lab | 2.8 | 2.7 | 2.3 | 1.9 |
| Freehold | 6.0 | 5.7 | 2.1 | 1.9 |
| Hackensack | 2.7 | 2.3 | 1.9 | 1.6 |
| Jersey City | 3.0 | 2.8 | 1.7 | 1.6 |
| Morristown | 1.7 | 1.4 | 1.0 | 1.0 |
| Newark Firehouse | 3.64 | 3.33 | 2.99 | 2.16 |
| Perth Amboy | 3.3 | 3.2 | 1.5 | 1.4 |

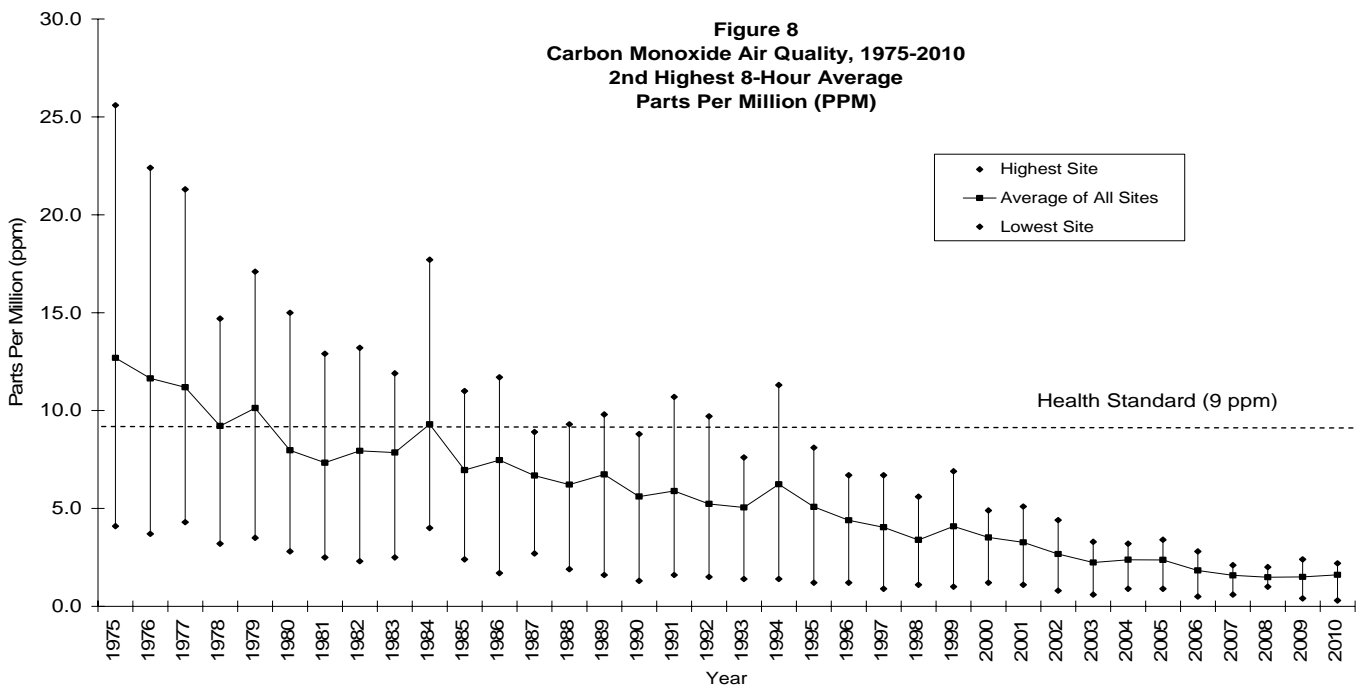
Trends

Carbon monoxide levels have improved dramatically over the past 20 years. The last time the CO standard was exceeded in New Jersey was in January of 1995 (Figure 7), 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. A trend graph of CO levels showing the highest, average and lowest site concentrations recorded since 1975 is provided in Figure 8. The graph depicts the second highest 8-hour value recorded; as this is the value that determines if the health standard is being met (one exceedance per site is allowed each year).

**Figure 7
Carbon Monoxide
Unhealthy Days 1985-2010**



**Figure 8
Carbon Monoxide Air Quality, 1975-2010
2nd Highest 8-Hour Average
Parts Per Million (PPM)**



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



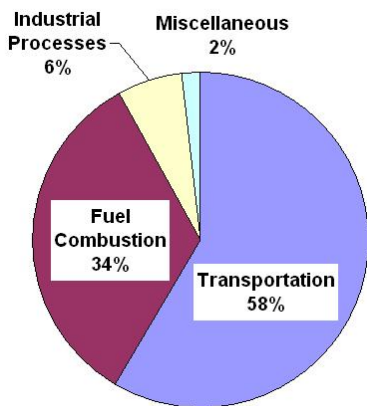
2010 Nitrogen Dioxide Summary

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 (NO_x) is a mixture of gases which is mostly comprised of NO and NO_2 . These gases are emitted from the exhaust of motor vehicles, the burning of coal, oil or natural gas, and during industrial processes such as welding, electroplating, and dynamite blasting. Although most NO_x is emitted as NO, it is readily converted to NO_2 in the atmosphere. In the home, gas stoves and heaters produce substantial amounts of nitrogen dioxide. A pie chart summarizing the major sources of NO_x is shown below (Figure 1). As much of the NO_x in the air is emitted by motor vehicles, concentrations tend to peak during the morning and afternoon rush hours. This is shown in the graph in Figures 2-4 (pages 2-3). Figures 6-8 (pages 6-7) 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.

Figure 1
National Summary of 2005 Oxides of Nitrogen (NO_x) Emissions by Source Category



Source: USEPA National Summary of Nitrogen Oxides Emissions, 2005

HEALTH AND ENVIRONMENTAL EFFECTS

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

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

STANDARDS

The primary (health based) and secondary (welfare based) National Ambient Air Quality Standards (NAAQS) annual average for NO_2 are the same. They are set at a calendar year average concentration of 0.053 parts per million (ppm). The New Jersey Ambient Air Quality Standards (NJAAQS) are identical to the NAAQS except micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) 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 (NO₂)
Parts Per Million (ppm) and Micrograms Per Cubic Meter (µg/m³)

| 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) |

Figure 2
Nitric Oxide – New Jersey
2010 Hourly Variation
Parts Per Million (ppm)

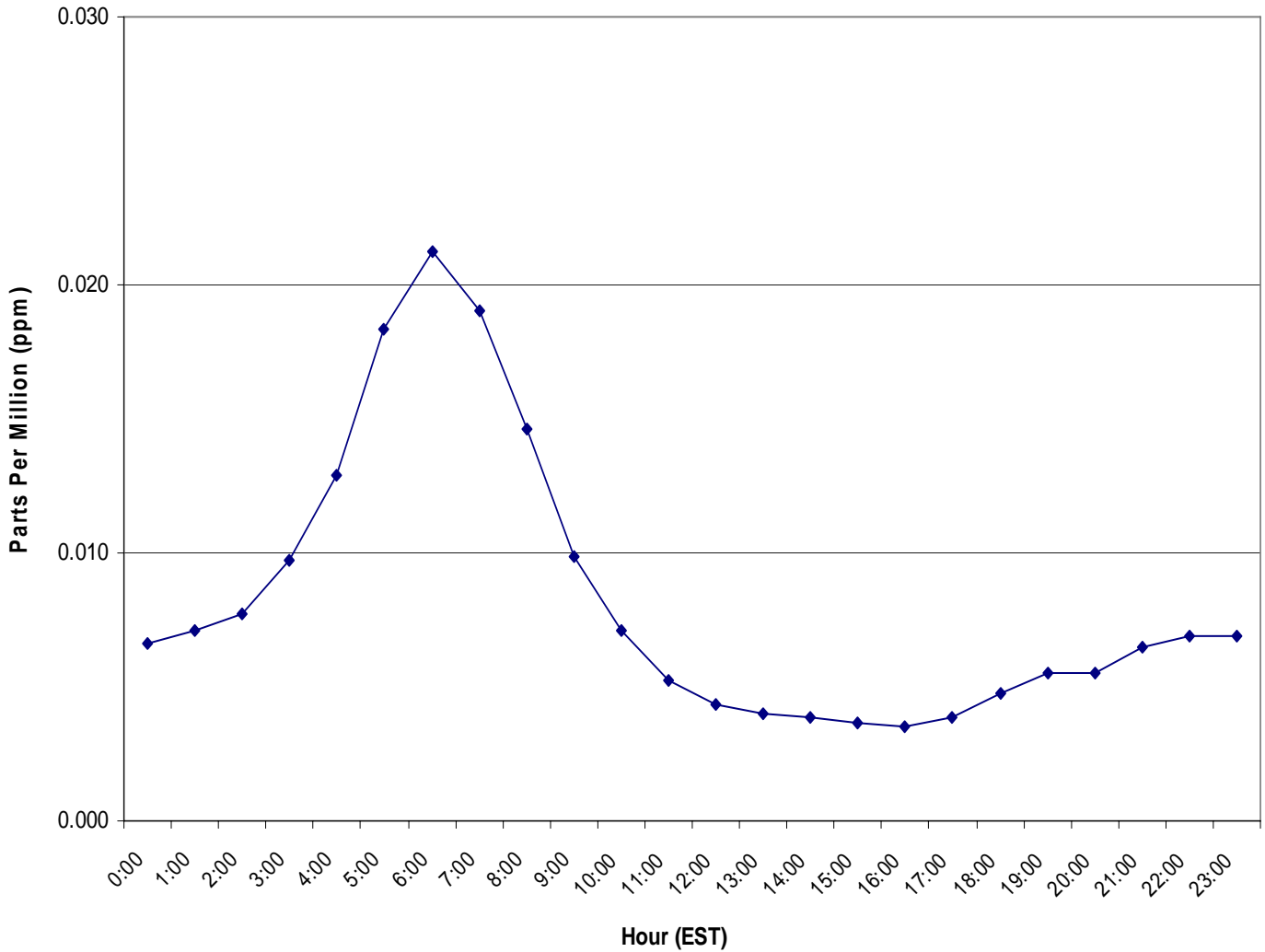


Figure 3
Nitrogen Dioxide – New Jersey
2010 Hourly Variation
Parts Per Million (ppm)

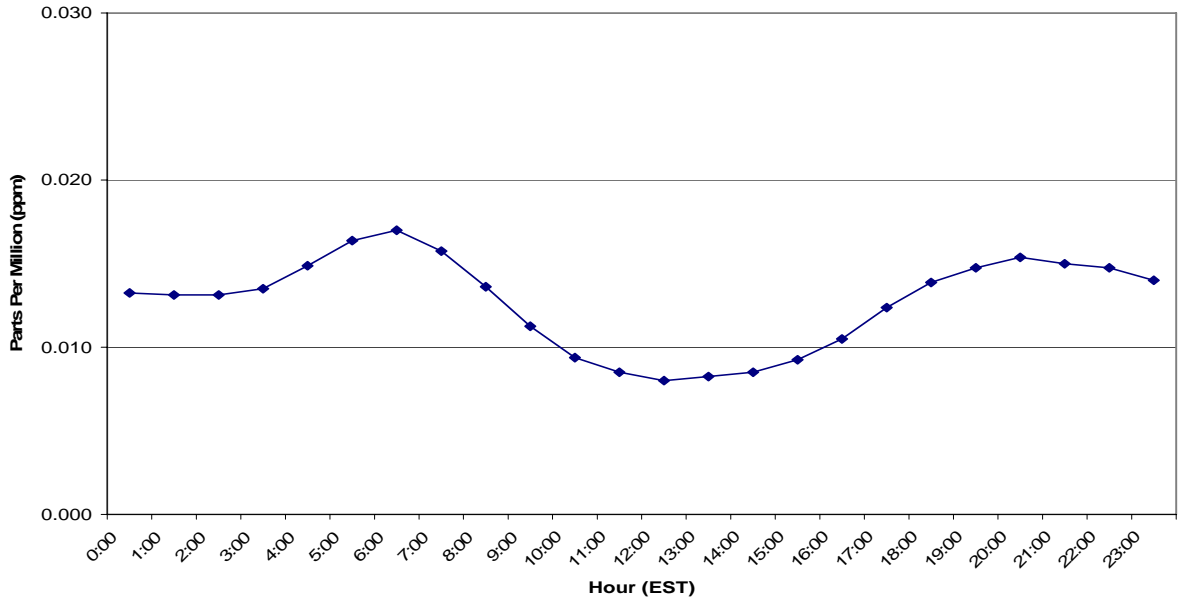
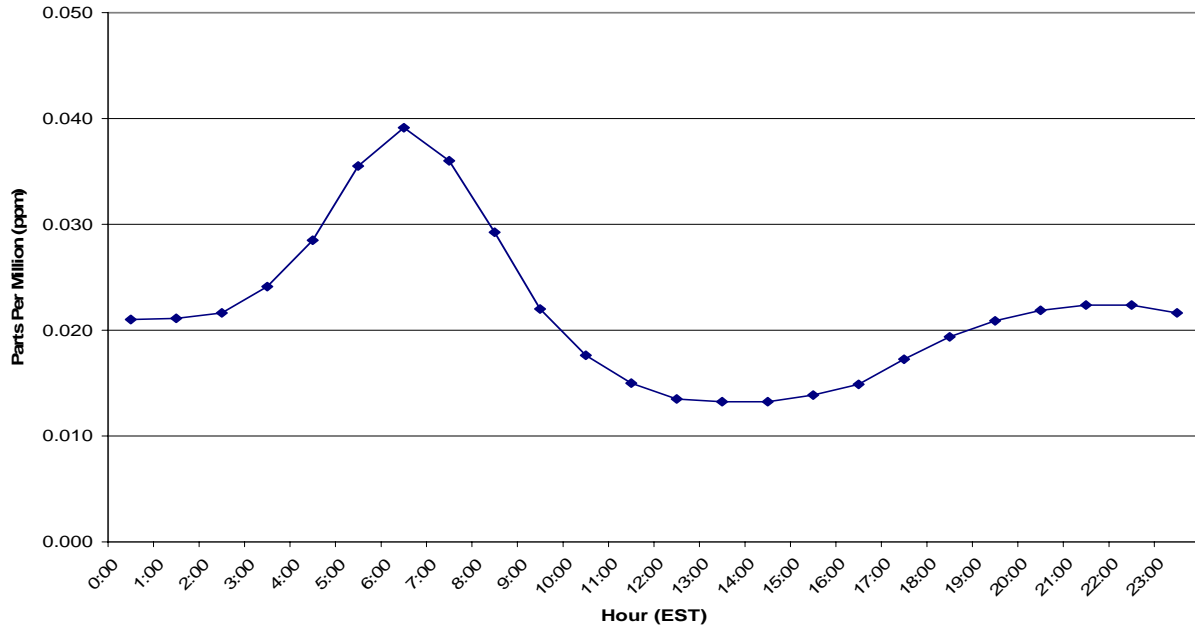


Figure 4
Total Oxides of Nitrogen – New Jersey
2010 Hourly Variation
Parts Per Million (ppm)



STANDARDS (CONTINUED)

An area meets the new 1-hour NO₂ standard when the 3-year average of the 98th percentile of the daily maximum NO₂ 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 NO₂ concentrations for each day. Then, determine the 98th percentile of the daily maximum NO₂ 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.

MONITORING LOCATIONS

The state monitored NO₂ levels at 8 locations in 2010. These sites are shown in the map on page 5. The NO₂ analyzers at the Leonia and Rider University sites were shut down on December 31, 2010.

NO₂ LEVELS IN 2010

None of the monitoring sites recorded exceedances of either the National or New Jersey Air Quality Standards for NO₂ during 2010. The highest 12-month (calendar year) average concentration of NO₂ recorded was 0.022 ppm at the Elizabeth Lab site located at Exit 13 of the New Jersey Turnpike (Table 2, page 6 and Figure 9, page 8). At Bayonne, there was one measurement of the 1-hour average NO₂ concentration above 0.100 ppm. This occurred at Elizabeth Lab on a different day. The site that measured the highest 98th percentile of the daily maximum NO₂ concentrations in 2010 was Elizabeth Lab with 0.071 ppm (Table 2, page 6 and Figure 13, page 10). The site that measured the highest 3-year average of the 98th percentiles from 2008 to 2010 was also Elizabeth Lab with 0.073 ppm (Table 2, page 6 and Figure 12, page 9). All sites in New Jersey met the new 1-hour NO₂ 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 2010 was 0.021 ppm, also at the Elizabeth Lab site (Table 2, page 6 and Figure 10, page 8).

TRENDS

Routine monitoring for NO₂ began in 1966 and 1974 was the last year that concentrations exceeded the NAAQS in New Jersey. A graph of NO₂ levels provided in Figure 11 (page 9) shows the statewide average annual mean concentrations recorded from 1975 to 2010 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 NO₂ 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 5
2010 Nitrogen Dioxide
Monitoring Network

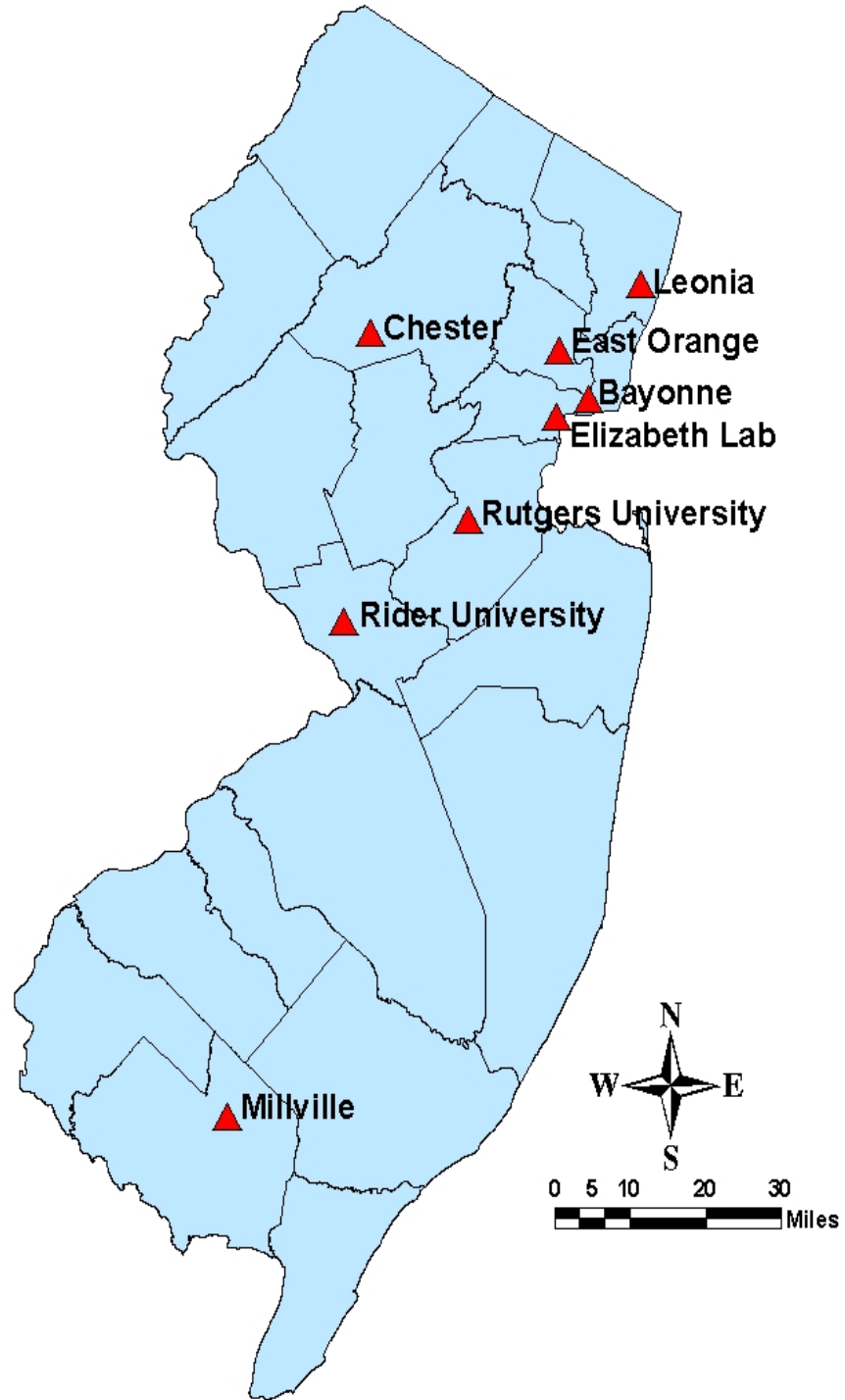


Table 2
Nitrogen Dioxide (NO₂) and Nitric Oxide (NO) Data - 2010
1-Hour and 12-Month Averages

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

| Monitoring Sites | Nitrogen Dioxide | | | | Nitrogen Dioxide | | Nitric Oxide |
|--------------------|----------------------|-------------|-------------------|---|-----------------------------------|---------------|---------------|
| | 1-Hour Average (ppm) | | | | 12-Month Average (ppm) | | 12-Month |
| | Maximum | 2nd Highest | 2010 98th%-ile | 2008-2010 98 th %-ile (3-year) | Maximum (Running 12- month) | Calendar year | Average (ppm) |
| | | | | | | | Calendar Year |
| Bayonne | 0.106 | 0.096 | 0.068 | 0.067 | 0.018 | 0.018 | 0.009 |
| Chester | 0.063 | 0.049 | 0.035 | 0.038 | 0.004 | 0.004 | 0.000 |
| East Orange | 0.072 | 0.072 | 0.064 | 0.062 | 0.019 | 0.018 | 0.012 |
| Elizabeth Lab | 0.108 | 0.094 | 0.071 | 0.073 | 0.026 | 0.022 | 0.021 |
| Leonia | 0.080 | 0.071 | 0.064 | 0.066 | 0.017 | 0.015 | 0.013 |
| Millville | 0.054 | 0.050 | 0.040 | 0.040 | 0.009 | 0.008 | 0.005 |
| Rider University | 0.046 | 0.045 | 0.040 | 0.041 | 0.008 | 0.008 | 0.004 |
| Rutgers University | 0.052 | 0.049 | 0.045 | 0.049 | 0.011 | 0.010 | 0.003 |

Figure 6
Nitric Oxide – New Jersey
2010 Monthly Variation
Parts Per Million (ppm)

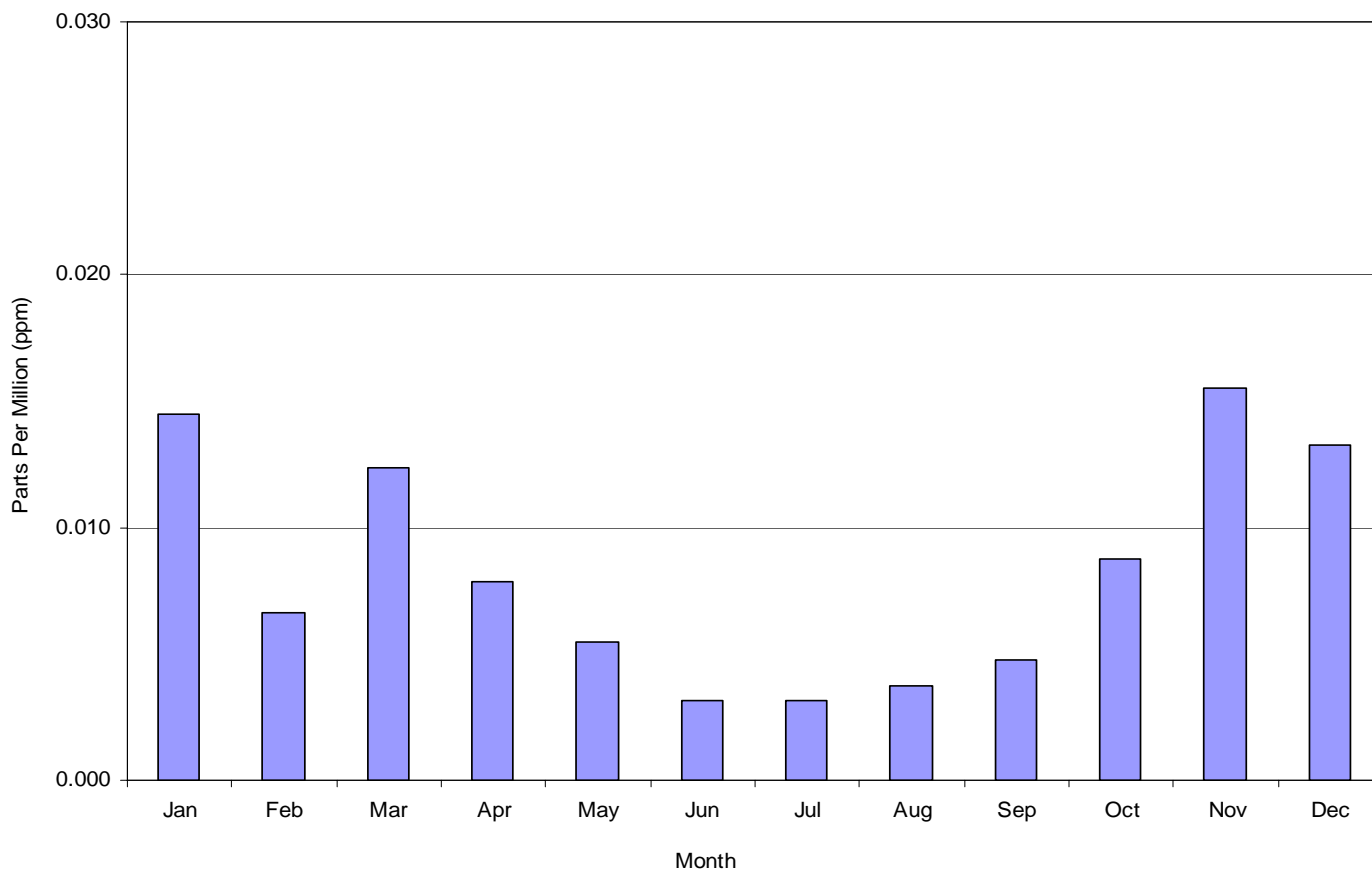


Figure 7
Nitrogen Dioxide – New Jersey
2010 Monthly Variation
Parts Per Million (ppm)

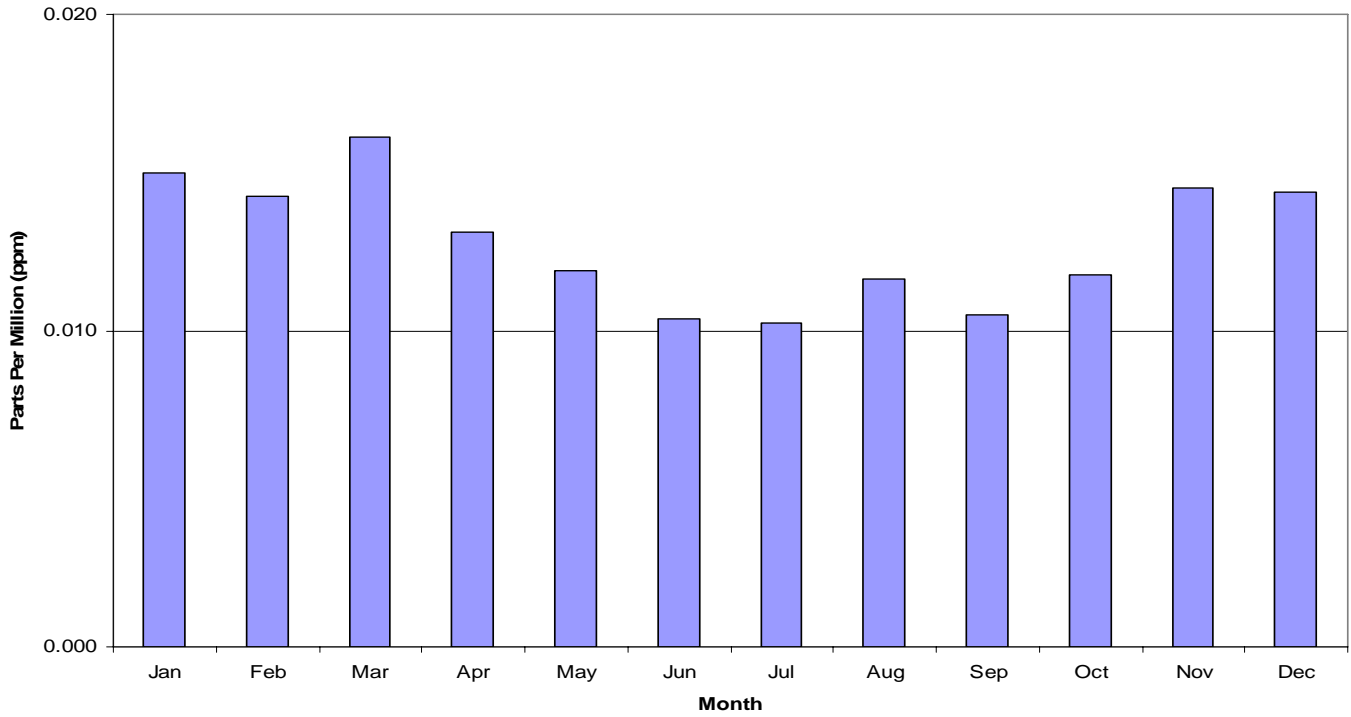


Figure 8
Total Oxides of Nitrogen – New Jersey
2010 Monthly Variation
Parts Per Million (ppm)

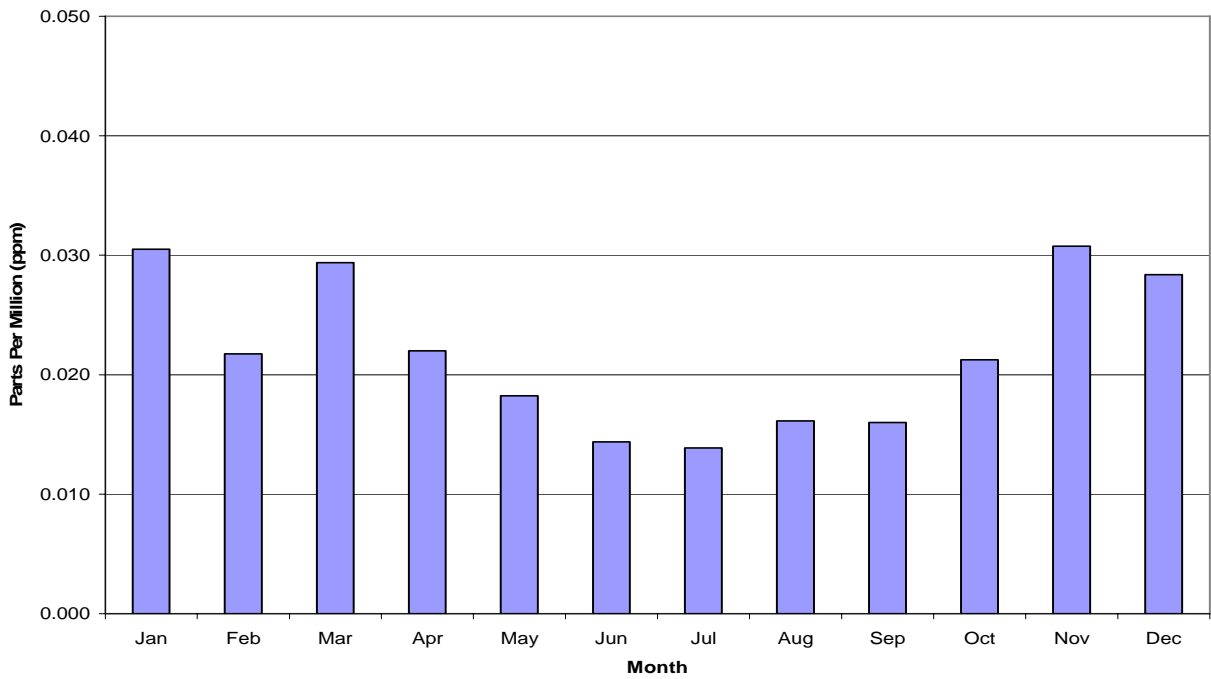


Figure 9
Annual Average Nitrogen Dioxide Concentrations
In New Jersey – 2010
Parts Per Million (ppm)

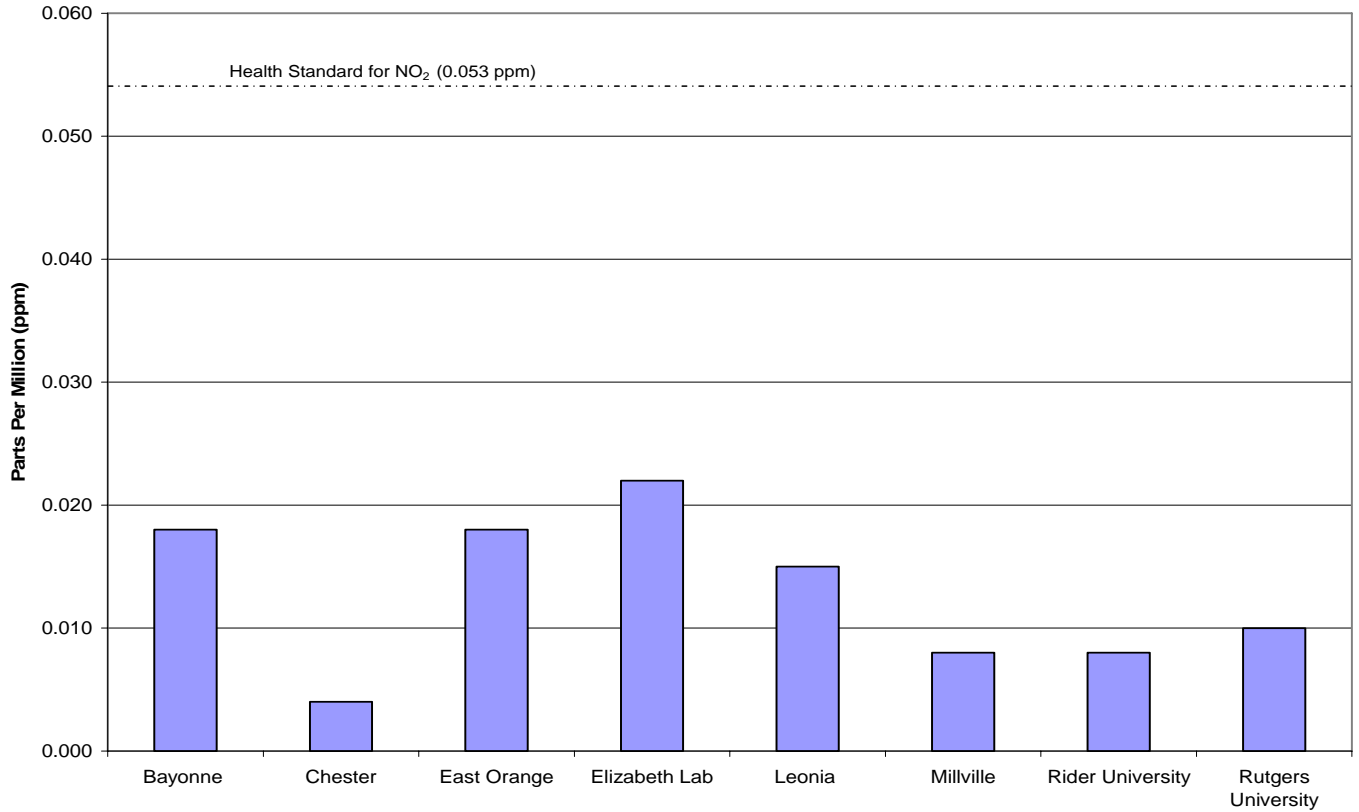


Figure 10
Annual Average Nitric Oxide Concentrations
In New Jersey – 2010
Parts Per Million (ppm)

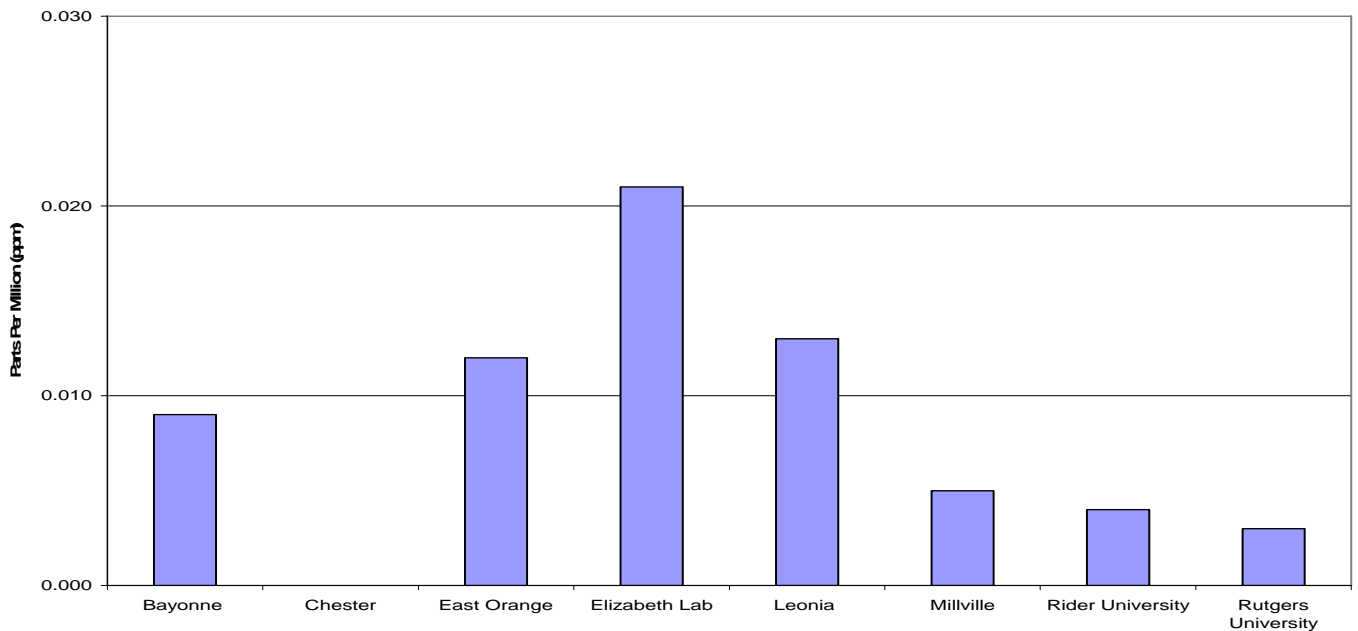


Figure 11
Nitrogen Dioxide Concentrations in New Jersey 1975-2010
12-Month (Calendar Year) Average
Parts Per Million (ppm)

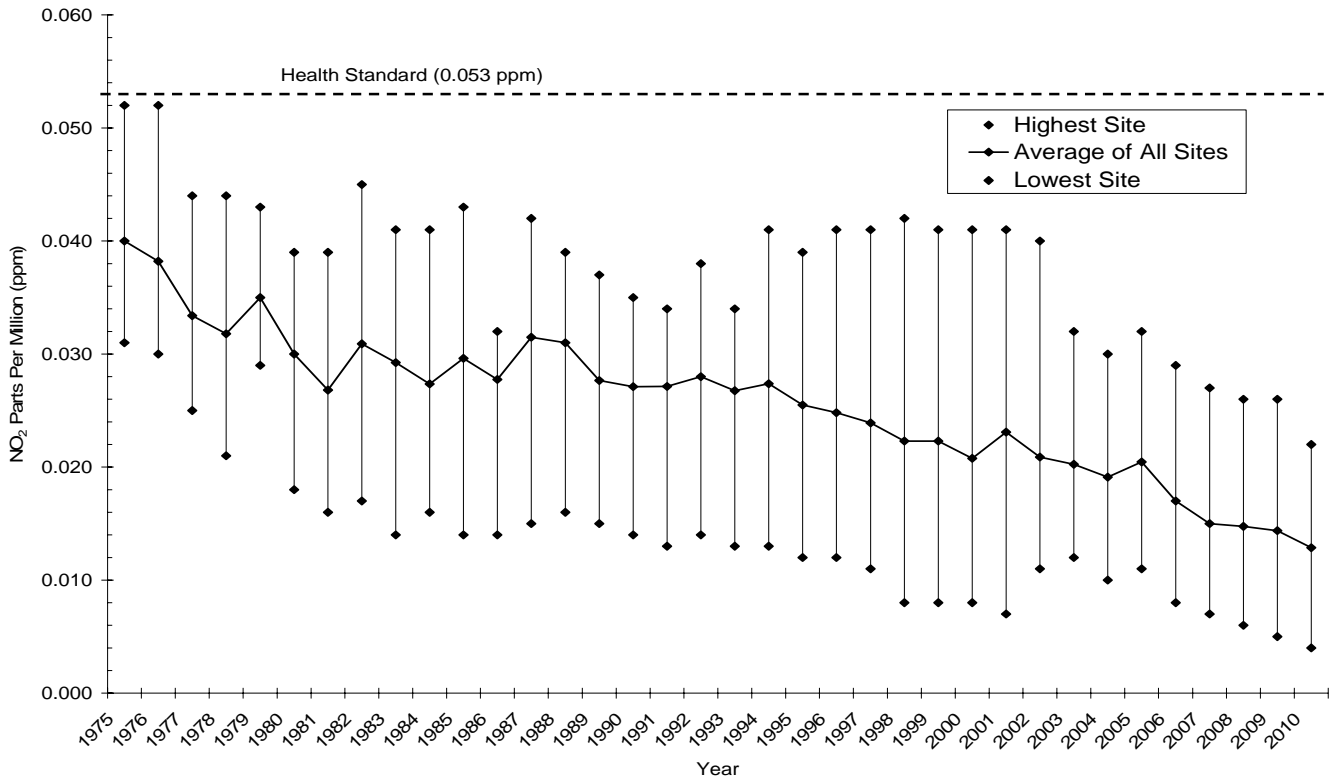


Figure 12
3-Year Average 98th Percentile Nitrogen Dioxide Concentration
In New Jersey (2008-2010)
Parts Per Million (ppm)

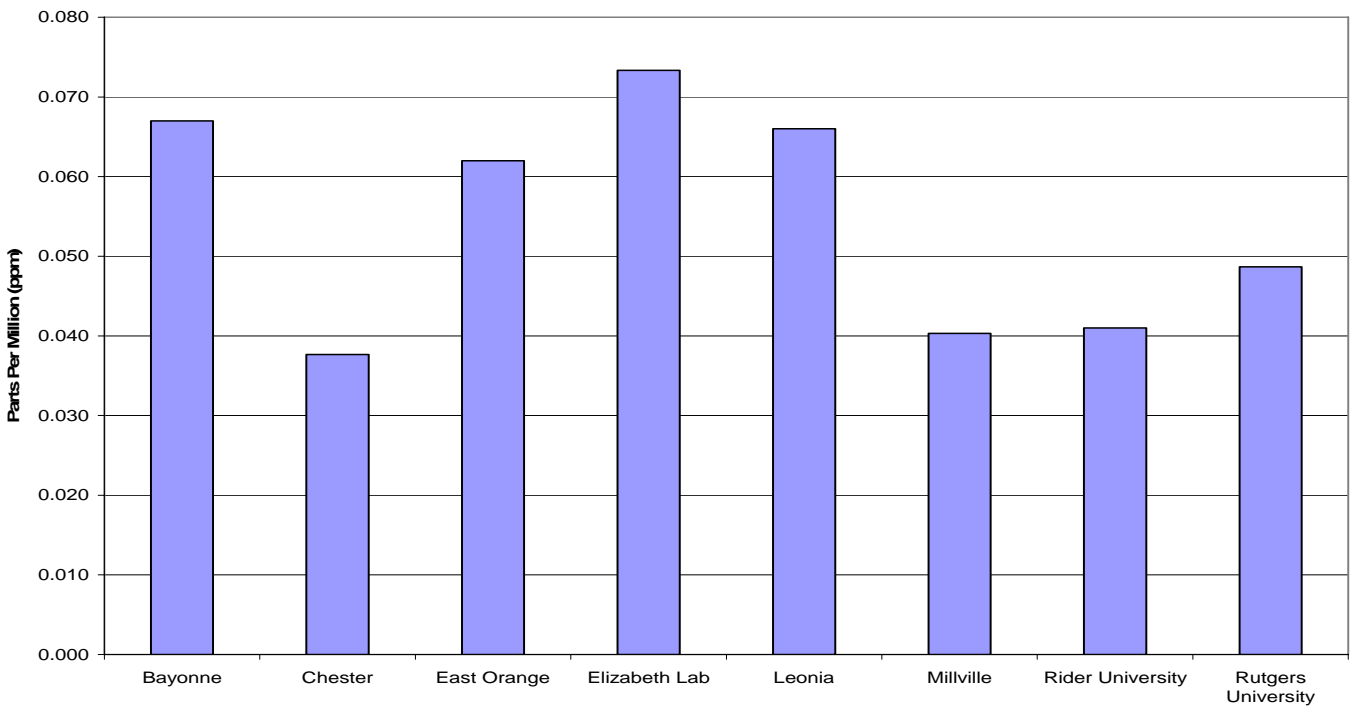
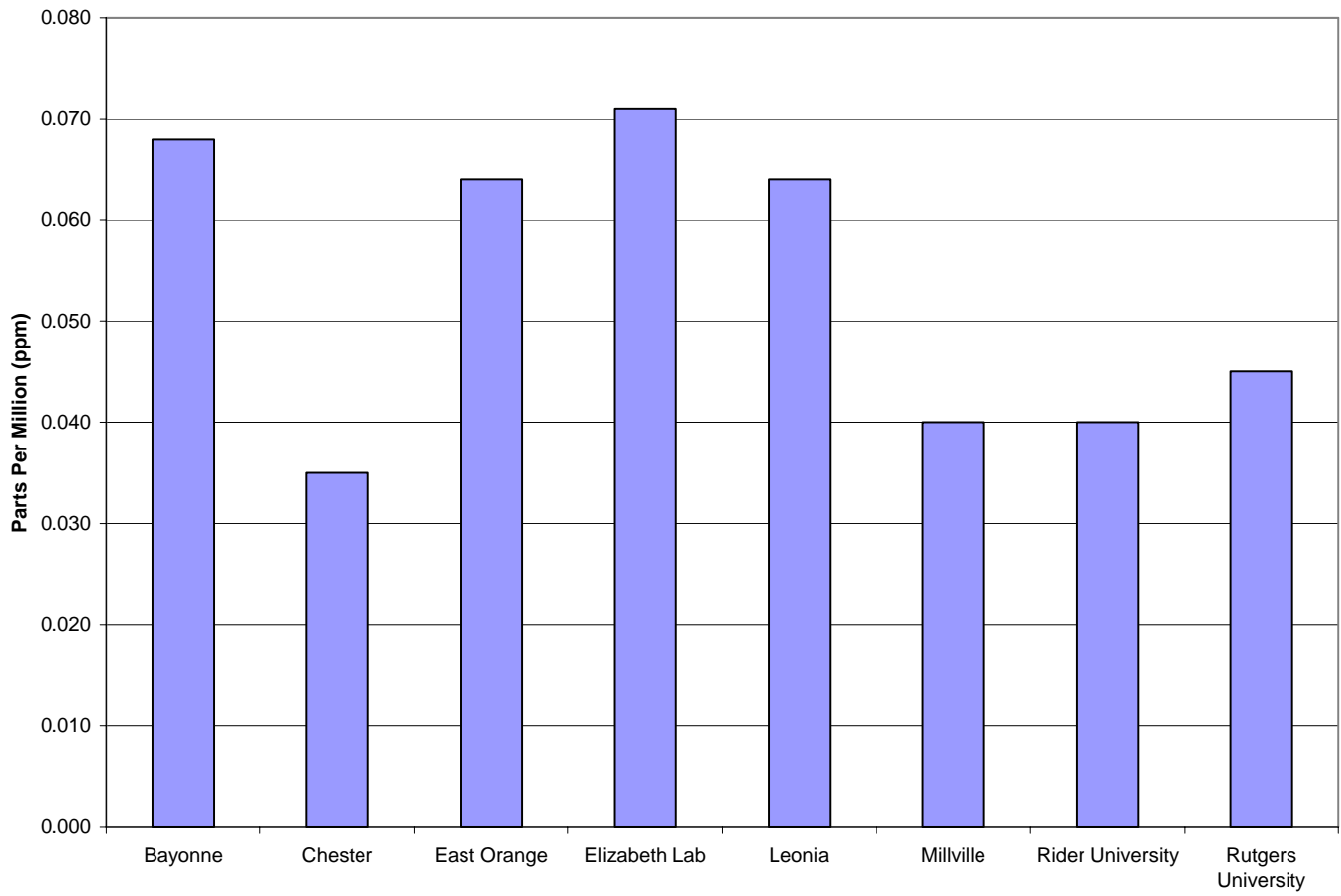


Figure 13
2010 Average 98th Percentile Nitrogen Dioxide Concentration
In New Jersey
Parts Per Million (ppm)



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2010 Ozone Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

Ozone (O₃) 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 and heat. 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.

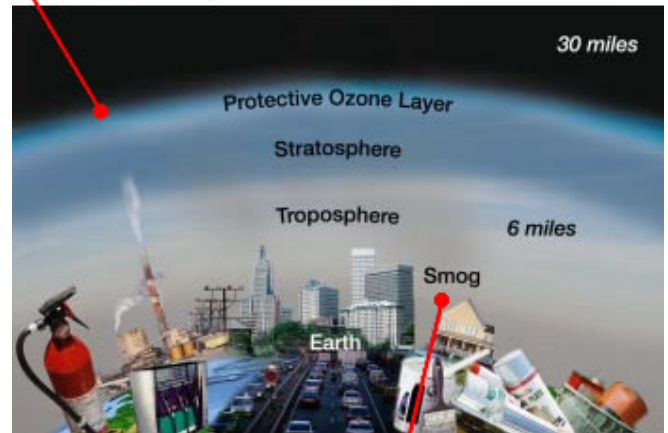
Since ground-level ozone needs sunlight to form, it is mainly a daytime problem during the summer months. Weather patterns have a significant effect on ozone formation and hot, dry summers will result in more ozone than cool, wet ones. In New Jersey, the ozone monitoring season runs from April 1st to 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 Photos by: Gerald Holmes, NCSU Dept. of Horticulture)

Figure 1: Good and Bad Ozone

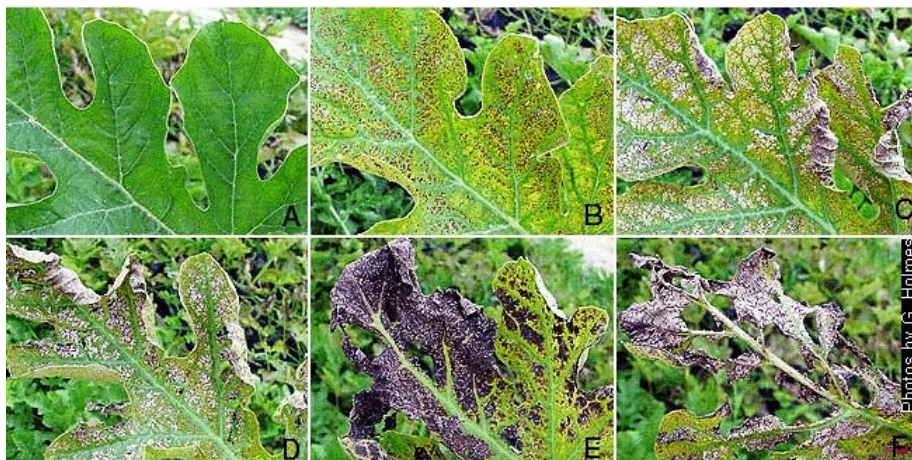
Ozone is good up here... Many popular consumer products like air conditioners and refrigerators involve CFCs or halons during either manufacturing or use. Over time, these chemicals damage the earth's protective ozone layer.



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.

Source: EPA

Figure 2

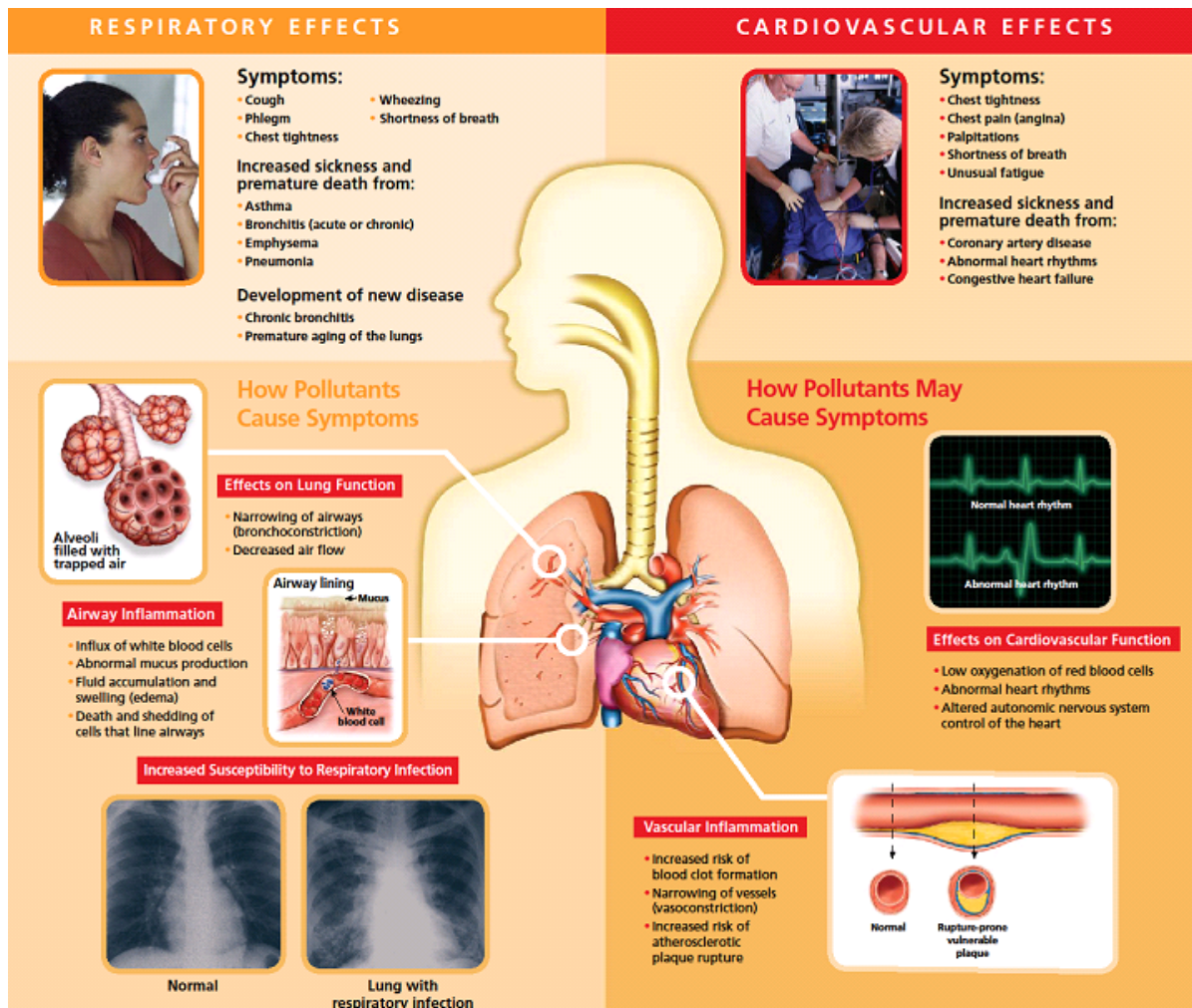


HEALTH EFFECTS

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

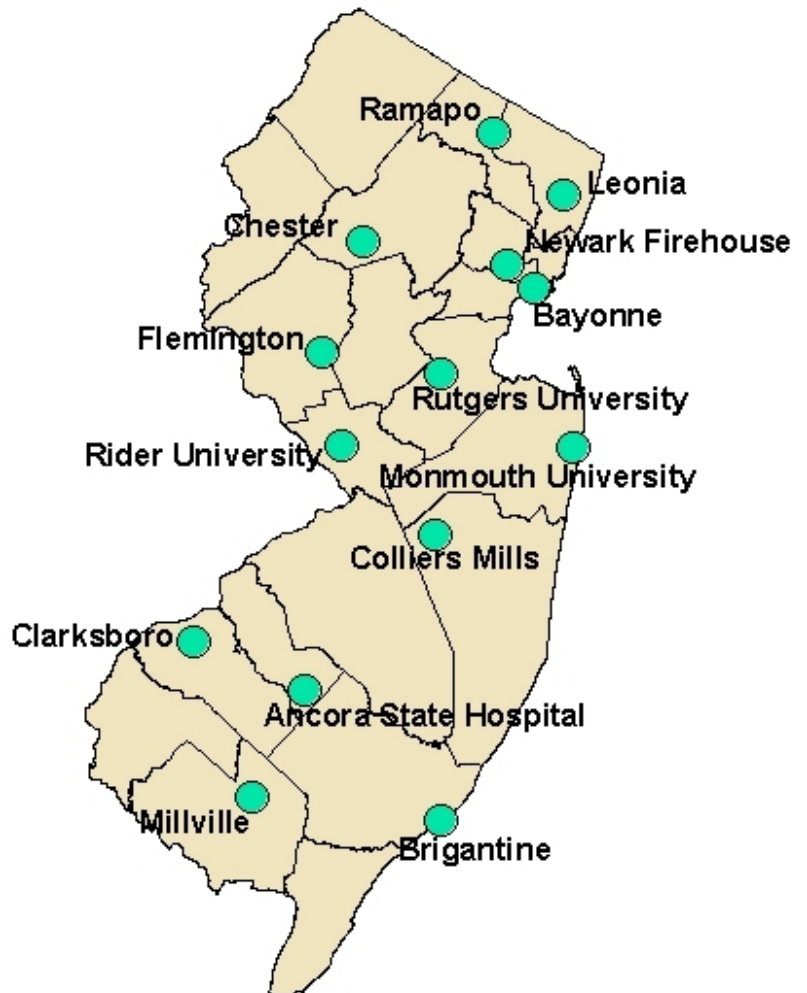
National and state air quality standards have been established for ground-level ozone. There are both primary standards, which are based on health effects, and secondary standards, which are based on welfare effects (e.g. damage to trees, crops and materials). For ground-level ozone, the primary and 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 |

Figure 4
2010 Ozone Monitoring Network



OZONE NETWORK

Ozone was monitored at 14 locations in New Jersey during 2010. Of those 14 sites, 11 operated year round and 3 operated only during the ozone season (April 1st through October 31st). Colliers Mills, Monmouth University, and Ramapo were only operated during the ozone season.

Site locations are shown in Figure 4.

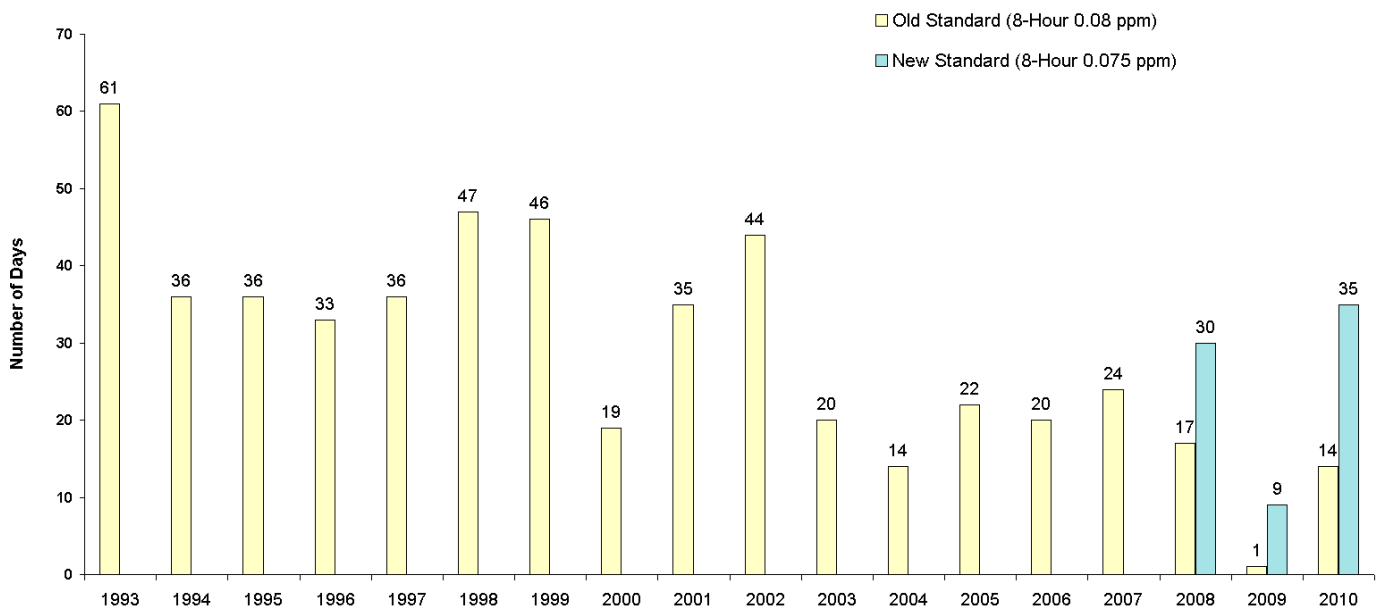
HOW THE CHANGES TO THE OZONE STANDARDS AFFECT AIR QUALITY RATINGS

Unlike 2009, the cleanest air quality year on record, 2010 was a much more typical summer in New Jersey for air pollution. 35 days exceeded the 0.075 ppm 8-hour standard and 14 days exceeded the old 0.08 ppm 8-hour standard and for the first time since 2007, the old 1-hour standard of 0.12 ppm was exceeded in New Jersey. There are, however, fewer days on which those old standards are exceeded, and when they are, fewer sites tend to be involved. Also, the maximum levels reached are not as high as they were in the past. The maximum 1-hour average concentration recorded in 1993 was 0.162 ppm, compared to a maximum of 0.126 ppm in 2010.

It is apparent, however, that the current standard is significantly more stringent than the old (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.

Figure 5

**Days on Which the Old and New
Ozone Standards Have Been Exceeded in New Jersey
1993 - 2010**



DESIGN VALUES

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.

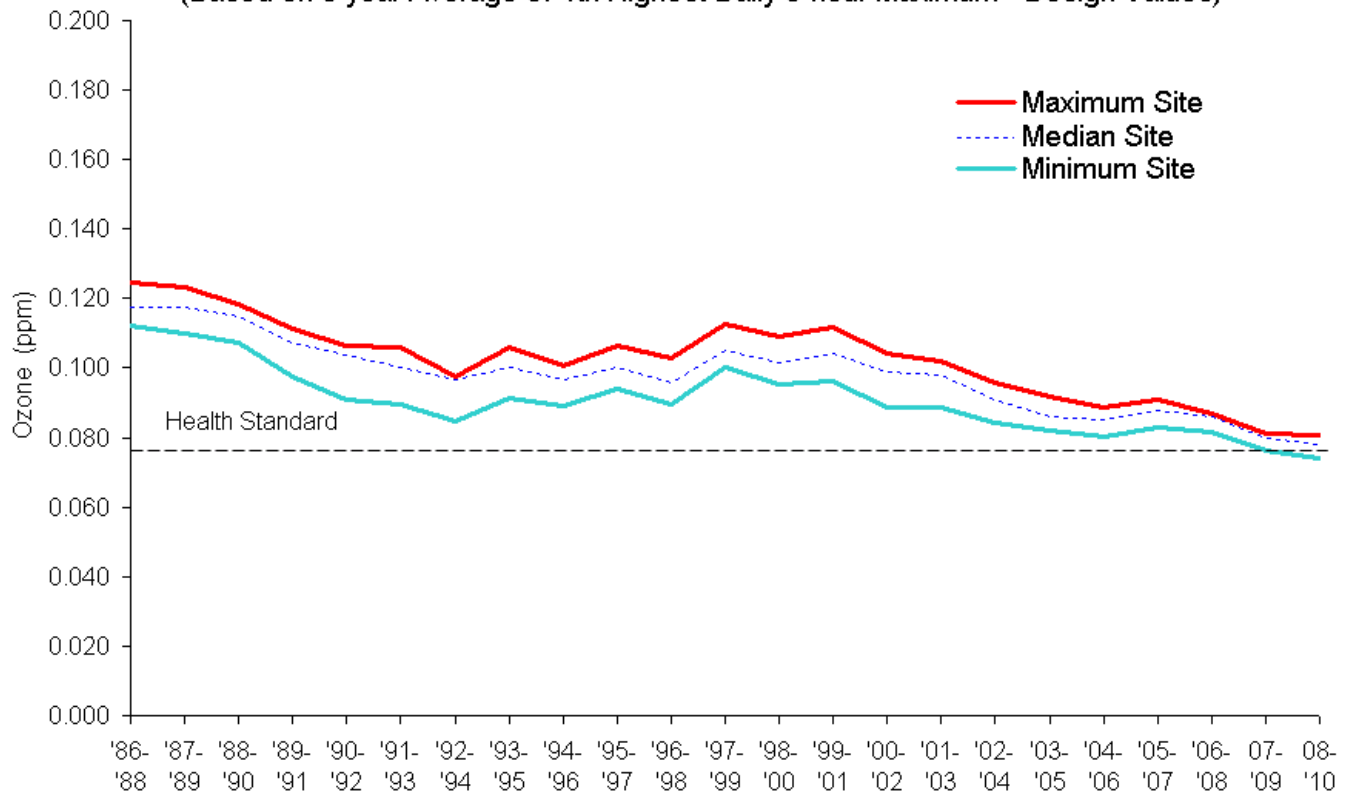
Under the new standard, attainment is determined by taking the average of the fourth highest daily maximum 8-hour average concentration that is recorded each year for three years. This becomes the design value for an area under the new standard. When plans are developed for reducing ozone concentrations, 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.

Figure 6 shows the design value for the 8-hour standards starting with the 1986-1988 period. Design values are calculated for all ozone sites in the network and the median, maximum, and minimum for each year were used in the graphics.

Figure 6

New Jersey, Ozone Air Quality, 1986 - 2010

(Based on 3 year Average of 4th Highest Daily 8-hour Maximum - Design Values)



SUMMARY OF 2010 Ozone Data Relative to the OLD 1-HOUR STANDARD

Of the 14 monitoring sites that were operated during the 2010 ozone season, only one recorded levels above the old 1-hour standard of 0.12 ppm. The highest 1-hour concentration was 0.126 ppm recorded at Ancora S.H. on August 10th. This is the first time since 2007 that any site in New Jersey recorded a one hour value above the standard. As recently as 2002, New Jersey recorded 16 days above this old 1-hour standard.

Figure 7
Highest and Second Highest Daily Ozone 1-Hour Averages

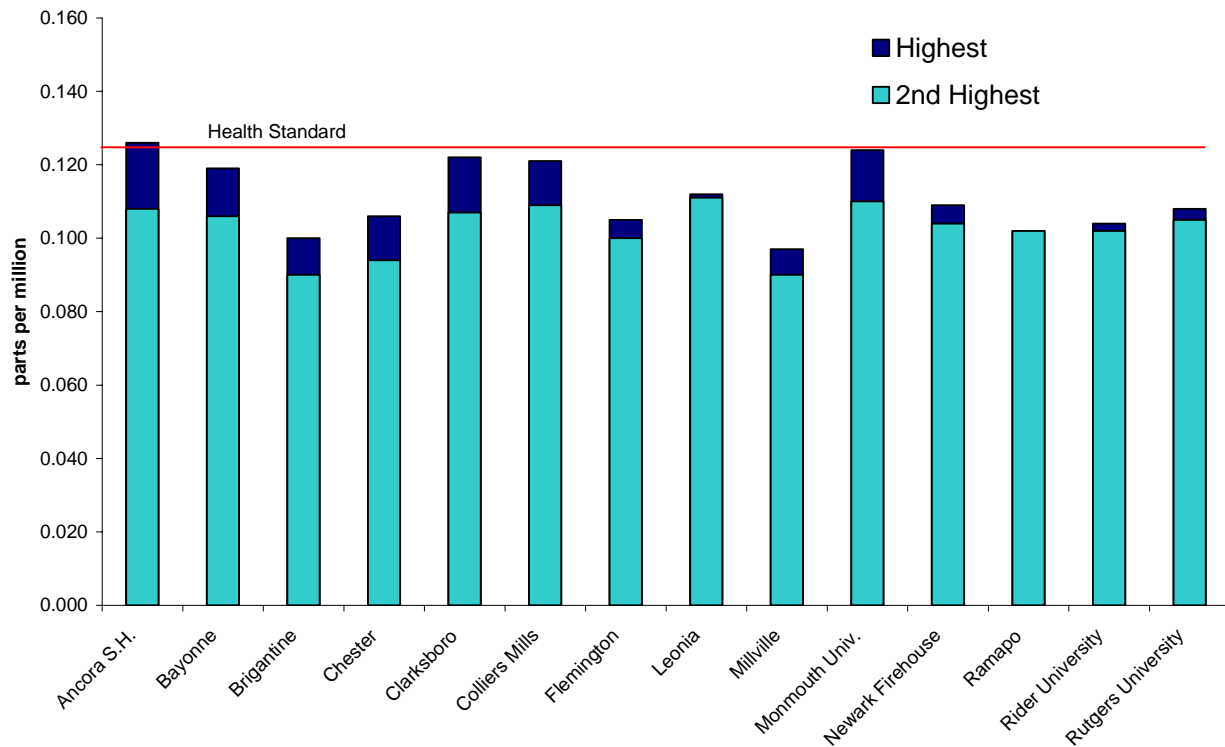


Table 3
Ozone Data – 2010
1-Hour Averages

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 2007-2009 | # of days with 1-hour Averages above 0.12ppm |
|--------------------|----------|----------------------|--------------------------------------|--|
| Ancora S.H. | .126 | .108 | .101 | 1 |
| Bayonne | .119 | .106 | .103 | 0 |
| Brigantine | .100 | .090 | .089 | 0 |
| Chester | .106 | .094 | .094 | 0 |
| Clarksboro | .122 | .107 | .107 | 0 |
| Colliers Mills | .121 | .109 | .109 | 0 |
| Flemington | .105 | .100 | .101 | 0 |
| Leonia | .112 | .111 | .111 | 0 |
| Millville | .097 | .090 | .090 | 0 |
| Monmouth Univ. | .124 | .110 | .105 | 0 |
| Newark Firehouse | .109 | .104 | .104 | 0 |
| Ramapo | .102 | .102 | .092 | 0 |
| Rider University | .104 | .102 | .098 | 0 |
| Rutgers University | .108 | .105 | .105 | 0 |
| Statewide | .126 | .124 | | 1 |

SUMMARY OF 2010 OZONE DATA RELATIVE TO THE 8-HOUR STANDARD

All 14 monitoring sites that were operated during the 2010 ozone season recorded levels above the 8-hour standard of 0.075 ppm. The highest 8-hour concentration recorded was 0.111 ppm at Bayonne on July 6th. Design values for the 8-hour standard were above the standard at 12 of 14 sites, indicating that the ozone standard is being violated throughout almost all of New Jersey. Newark Firehouse began sampling in 2009 and therefore does not have a valid design value for this period.

Figure 8
Ozone Design Values for 2008-2010

3 Year Average of the 4th Highest 8-Hour Value

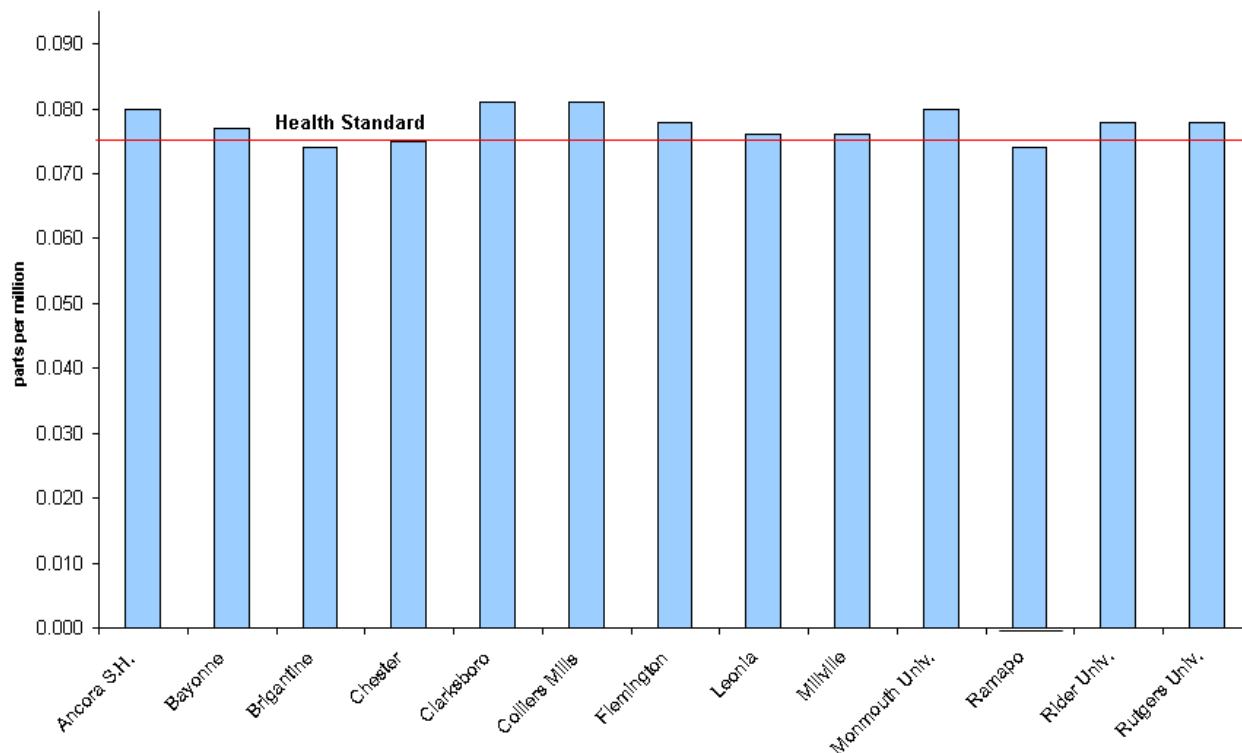


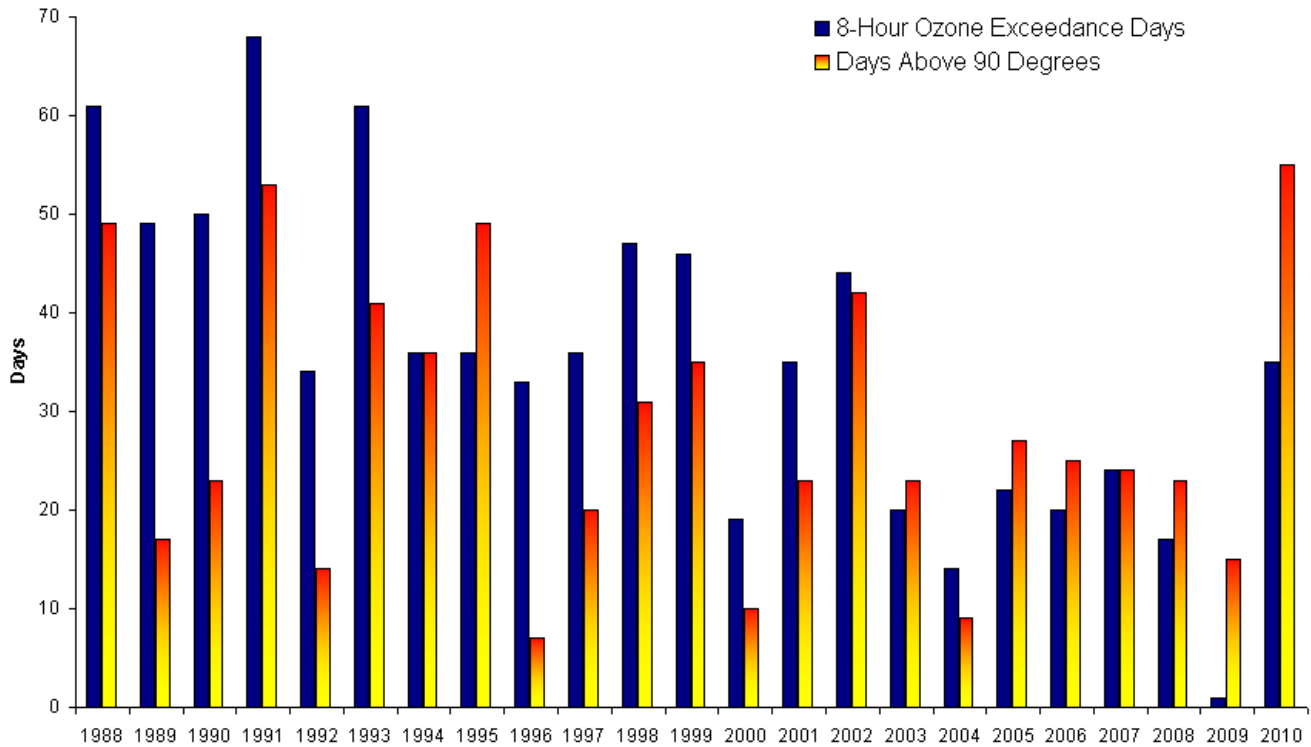
Table 4
Ozone Data – 2010
8-Hour Averages
Parts Per Million (ppm)

8-hour standard is 0.075 ppm

| Monitoring Site | 1 st Highest | 2 nd Highest | 3 rd Highest | 4 th Highest | Avg. of 4 th Highest 8-hour Averages 2008-2010 | # of days with 8-hour above 0.075ppm |
|--------------------|-------------------------|-------------------------|-------------------------|-------------------------|---|--------------------------------------|
| Ancora S.H. | .094 | .093 | .091 | .088 | .080 | 16 |
| Bayonne | .111 | .084 | .083 | .082 | .077 | 6 |
| Brigantine | .085 | .082 | .080 | .080 | .074 | 6 |
| Chester | .094 | .086 | .078 | .078 | .075 | 5 |
| Clarksboro | .097 | .094 | .085 | .083 | .081 | 14 |
| Colliers Mills | .094 | .094 | .089 | .087 | .081 | 16 |
| Flemington | .093 | .086 | .085 | .081 | .078 | 9 |
| Leonia | .085 | .083 | .077 | .076 | .076 | 5 |
| Millville | .083 | .082 | .079 | .077 | .076 | 6 |
| Monmouth Univ. | .095 | .094 | .090 | .086 | .080 | 6 |
| Newark Firehouse | .091 | .088 | .086 | .085 | ----- | 9 |
| Ramapo | .094 | .083 | .077 | .077 | .074 | 4 |
| Rider University | .095 | .088 | .087 | .086 | .078 | 15 |
| Rutgers University | .094 | .092 | .086 | .086 | .078 | 15 |
| Statewide | .111 | .083 | .080 | .080 | .092 | 35 |

Figure 9

**Number of Days 8-Hour Ozone Standard was Exceeded and
Number of Days Above 90 Degrees in New Jersey 1988 - 2010**
{Using 8-Hour 0.08 ppm standard (old) across entire time period.}



ACCOUNTING FOR THE INFLUENCE OF WEATHER

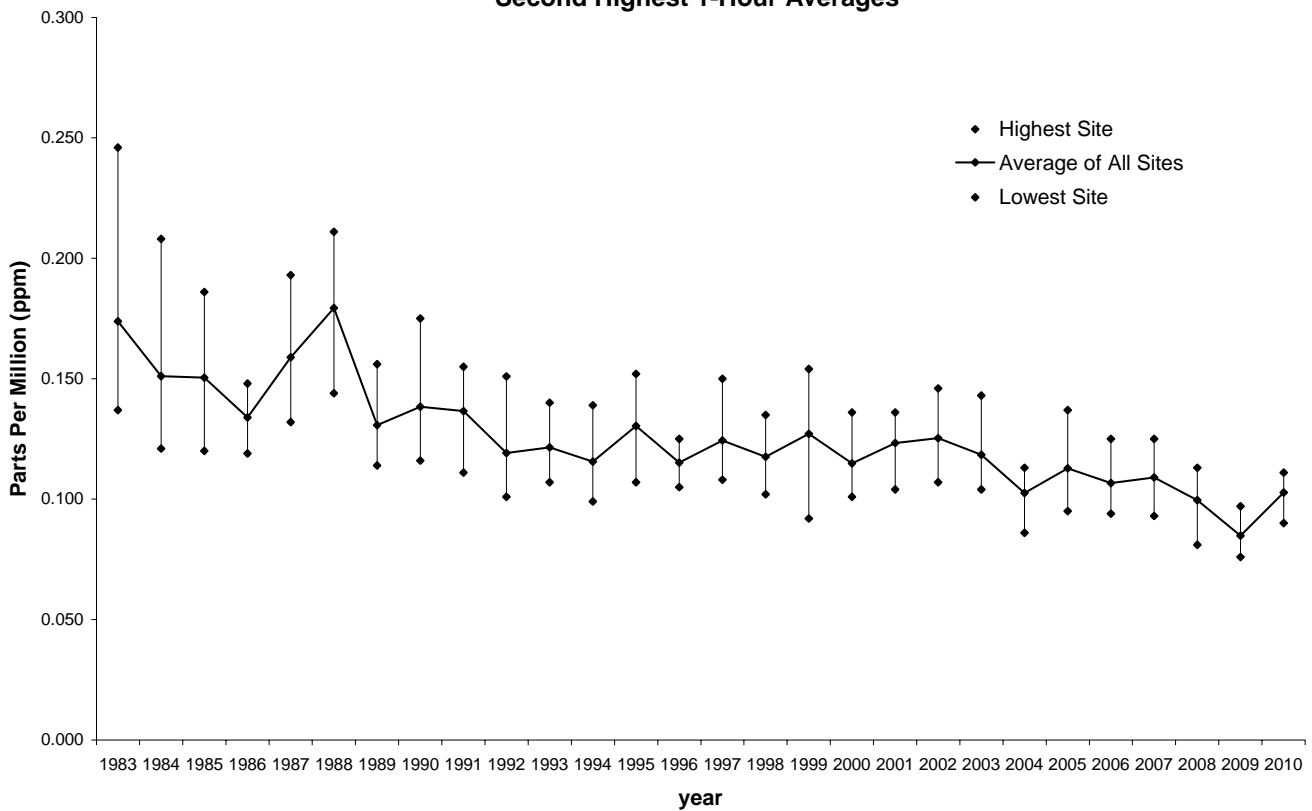
Trends in ground level ozone are influenced by many factors including weather conditions, transport, growth, and the state of the economy, in addition to changes brought about by regulatory control measures. Of these factors, weather probably has the most profound effect on year to year variations in 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 9. 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. 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 (Figure 10). Improvements have leveled off in recent years, especially with respect to maximum 8-hour average concentrations. Significant 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.

Figure 10
Ozone Concentrations in New Jersey
1983-2010
Second Highest 1-Hour Averages



OZONE NON-ATTAINMENT AREAS IN NEW JERSEY

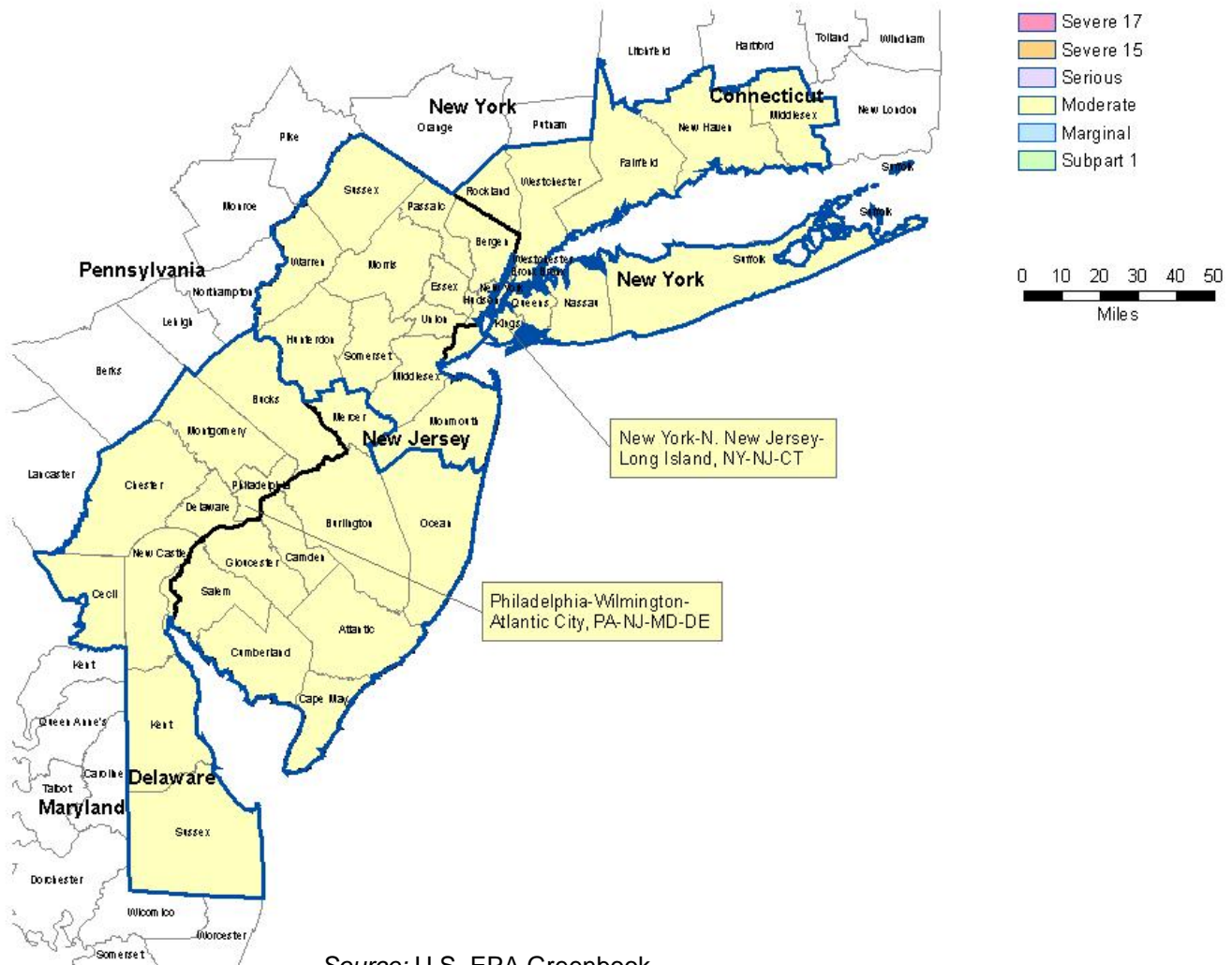
The Clean Air Act requires that all areas of the country be evaluated and then classified as attainment or non-attainment areas for each of the National Ambient Air Quality Standards. Areas can also be found to be “unclassifiable” under certain circumstances. The 1990 amendments to the act required that 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 11 below. The entire state of New Jersey is in non-attainment and is classified as being “Moderate.” A “Moderate” classification is applied when an area has a design value from 0.092 ppm to 0.106 ppm.

Figure 11

New Jersey

8-hour Ozone Nonattainment Areas in Blue Border



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2010 Sulfur Dioxide Summary

New Jersey Department of Environmental Protection

NATURE AND SOURCES

Sulfur dioxide (SO₂) is a heavy, colorless gas with a suffocating odor that easily dissolves in water to form sulfuric acid. SO₂ 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 SO₂. A pie chart summarizing the major sources of SO₂ is shown in Figure 1.

Figure 4 (page 6) shows that SO₂ concentrations in New Jersey are generally higher in the winter than in the summer due to higher emissions from space heating and other sources. As shown in Figure 5 (page 6), SO₂ 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.

HEALTH AND ENVIRONMENTAL EFFECTS

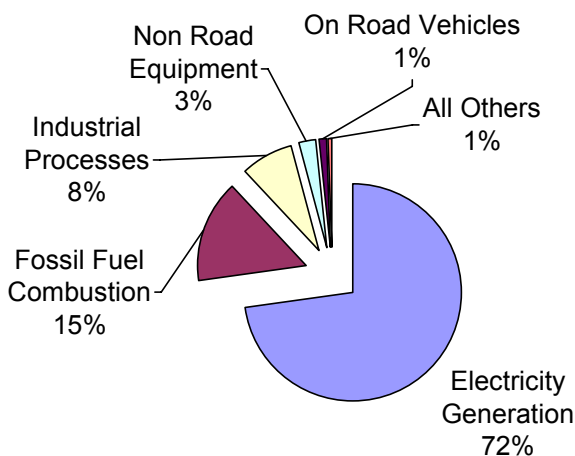
Sulfur dioxide causes irritation of the mucous membranes. This is probably the result of the action of sulfurous acid that is formed when the highly soluble SO₂ dissolves at the surface of the membranes. Groups that are especially susceptible to the harmful health effects of SO₂ include children, the elderly, and people with heart or lung disorders such as asthma. When SO₂ 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 SO₂ and based on available information, determined that no conclusion can be made as to the carcinogenicity of SO₂ 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. SO₂ 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 speeds up the decay of building materials and paints.

STANDARDS

From 1971 through June 2010, there were three National Ambient Air Quality Standards (NAAQS) for SO₂. In June 2010, based on its review of the air quality standard for oxides of sulfur as measured by SO₂, the United States Environmental Protection Agency (USEPA) revised the primary SO₂ NAAQS. USEPA has established a new 1-hour SO₂ standard at a level of 75 parts per billion (ppb). This new standard is based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations (Federal Register, 2010). The 1971 SO₂ standards remain in effect until one year after an area is

Figure 1
National Summary
SO₂ Emissions by Source Sector



Source: USEPA website
[HTTP://WWW.EPA.GOV/AIR/EMISSIONS/SO2.HTM](http://www.epa.gov/air/emissions/so2.htm)
2005 data.

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 has also set state air quality standards for SO₂. They are similar to the federal standards but are expressed in micrograms per cubic meter (µg/m³) instead of ppm. They are also based on rolling averages rather than block averages. So, for example, the state's primary 12-month standard is based on any twelve-month average recorded during the year, while the federal standard is based solely on the calendar year 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 SO₂.

MONITORING LOCATIONS

The state monitored SO₂ levels at 13 locations in 2010. These sites are shown in Figure 2. Monitoring location

changes included the start up of the Columbia WMA site in September 2010, and the permanent shutdown of the SO₂ analyzers at the Ancora State Hospital, Clarksboro, Hackensack, Millville and Perth Amboy sites on December 31, 2010.

SO₂ LEVELS IN 2010

None of the monitoring sites recorded exceedances of the primary or secondary SO₂ standards during 2010. The maximum 12-month average concentration recorded was 0.002 ppm at the Bayonne, Elizabeth Lab, and Jersey City sites. The maximum 24-hour average level recorded was 0.031 ppm at the Columbia WMA site. The highest 3-hour average recorded was 0.133 ppm at the Columbia WMA site. The highest 99th percentile of the 1-hour daily maximum concentration for 2010 was recorded at Columbia WMA (183 ppb). While this value is high, it does not amount to an exceedance because the comparison to the standard requires 3 years of data.

Three sites (Newark, Columbia WMA, and Camden) do not have sufficient data to compare with the 1-hour standard. The 10 remaining sites all have adequate amounts of data to compare to the new standard. Of those, the Elizabeth Lab location had the highest 1-hour average at 35 ppb. Summaries of the 2010 data are provided in Tables 2, 3, 4 and Figure 3 (pages 4 and 5), and Figures 6 and 7 (page 7).

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 (µg/m³)

| Averaging Period | Type | New Jersey | National^a |
|-------------------------------|-------------|----------------------------------|-----------------------------|
| 12 – month average | Primary | 80 µg/m ³ (0.03 ppm) | 0.03 ppm |
| 12 – month average | Secondary | 60 µg/m ³ (0.02 ppm) | --- |
| 24 – hour average | Primary | 365 µg/m ³ (0.14 ppm) | 0.14 ppm |
| 24 – hour average | Secondary | 260 µg/m ³ (0.10 ppm) | --- |
| 3 – hour average | Secondary | 1300 µg/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.

Figure 2
2010 Sulfur Dioxide
Monitoring Network

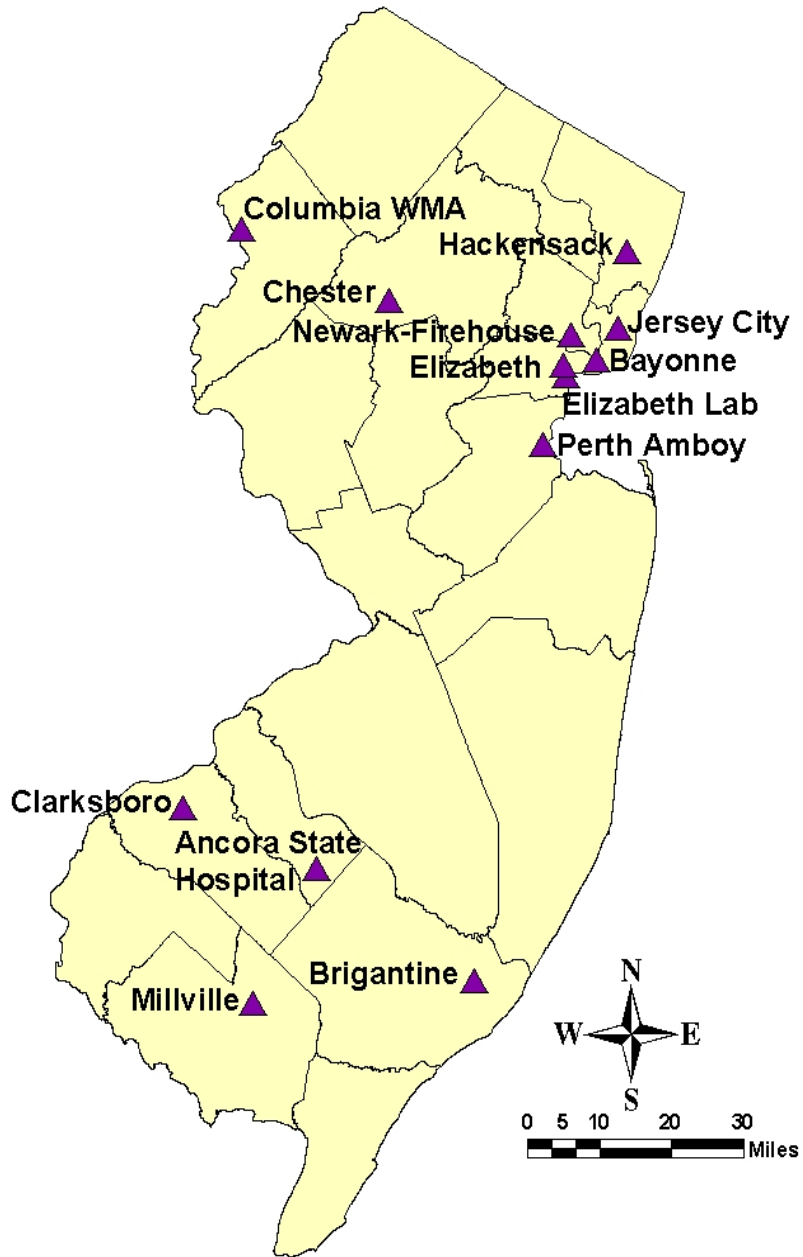


Table 2
2010 Sulfur Dioxide Data
3-Hour and Annual Averages
Parts Per Million (ppm)

| Monitoring Sites | 3-Hour Average Maximum | 3-Hour Average 2nd Highest ^a | 12-Month Average Maximum | Calendar Year Average |
|---------------------------|-------------------------------|---|---------------------------------|------------------------------|
| Ancora State Hospital | 0.015 | 0.012 | 0.000 | 0.000 |
| Bayonne | 0.022 | 0.021 | 0.002 | 0.002 |
| Brigantine | 0.014 | 0.012 | 0.0009 | 0.0009 |
| Chester | 0.032 | 0.031 | 0.001 | 0.001 |
| Clarksboro | 0.024 | 0.017 | 0.001 | 0.001 |
| Columbia WMA ^b | 0.133 | 0.114 | ---- | ---- |
| Elizabeth | 0.015 | 0.010 | 0.001 | 0.001 |
| Elizabeth Lab | 0.032 | 0.029 | 0.002 | 0.001 |
| Hackensack | 0.009 | 0.008 | 0.000 | 0.000 |
| Jersey City | 0.021 | 0.019 | 0.002 | 0.001 |
| Millville | 0.013 | 0.011 | 0.001 | 0.001 |
| Newark Firehouse | 0.018 | 0.018 | 0.0018 | 0.0018 |
| Perth Amboy | 0.014 | 0.013 | 0.001 | 0.001 |

^a – Based on non-overlapping 3 – hour moving averages.

^b – Station started collecting data September 2010 and does not have sufficient amount of data to calculate 12-Month and Calendar Year averages.

Table 3
2010 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 |
|---------------------------|--------------------------------|--|------------------------------|---|
| Ancora State Hospital | 0.006 | 0.006 | 0.006 | 0.005 |
| Bayonne | 0.012 | 0.011 | 0.010 | 0.010 |
| Brigantine | 0.0065 | 0.0064 | 0.0063 | 0.0061 |
| Chester | 0.013 | 0.011 | 0.013 | 0.010 |
| Clarksboro | 0.011 | 0.009 | 0.011 | 0.008 |
| Columbia WMA ^b | 0.031 | 0.024 | 0.031 | 0.024 |
| Elizabeth | 0.007 | 0.006 | 0.006 | 0.006 |
| Elizabeth Lab | 0.012 | 0.010 | 0.009 | 0.008 |
| Hackensack | 0.005 | 0.004 | 0.004 | 0.004 |
| Jersey City | 0.015 | 0.011 | 0.013 | 0.010 |
| Millville | 0.006 | 0.006 | 0.006 | 0.005 |
| Newark Firehouse | 0.0108 | 0.0104 | 0.0099 | 0.0095 |
| Perth Amboy | 0.008 | 0.008 | 0.008 | 0.007 |

^a – Based on non-overlapping 24 – hour moving averages.

^b – Station started collecting data September 2010.

Table 4
2010 Sulfur Dioxide Data
3-Year Average of 99th Percentile
of Daily Maximum 1-Hour Average
Parts Per Billion (ppb)

| Location | 99th Percentile of Daily Maximum | | | 3 – Year Average |
|-------------------------------|----------------------------------|------|------|------------------|
| | 2008 | 2009 | 2010 | 2008 - 2010 |
| Ancora State Hospital | 21 | 20 | 10 | 17 |
| Bayonne | 29 | 33 | 26 | 29 |
| Brigantine | 17.0 | 14.0 | 9.8 | 13.6 |
| Camden Lab ^a | 31 | --- | --- | --- |
| Chester | 26 | 29 | 26 | 27 |
| Clarksboro | 27 | 25 | 15 | 22 |
| Columbia WMA ^b | --- | --- | 183 | --- |
| Elizabeth | 20 | 22 | 11 | 18 |
| Elizabeth Lab | 41 | 34 | 30 | 35 |
| Hackensack | 17 | 17 | 9 | 14 |
| Jersey City | 28 | 22 | 19 | 23 |
| Millville | 21 | 17 | 10 | 16 |
| Newark Firehouse ^c | --- | --- | 18.0 | --- |
| Perth Amboy | 22 | 17 | 17 | 19 |

^a — Camden Lab site shut-down indefinitely in 2008.

^b — Columbia WMA site started in September 2010.

^c — Newark Firehouse site started in July 2009.

Figure 3
Sulfur Dioxide – New Jersey
2010 3-Year Design Values
Parts Per Billion (ppb)

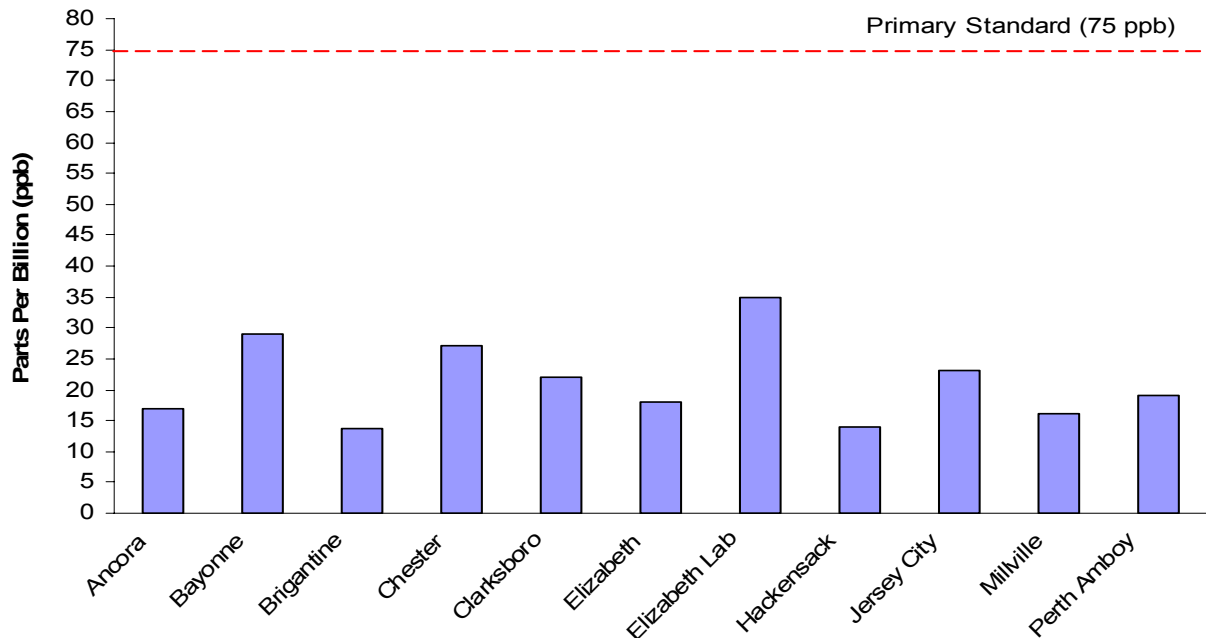


Figure 4
Sulfur Dioxide – New Jersey
2010 Monthly Variation
Parts Per Million (ppm)

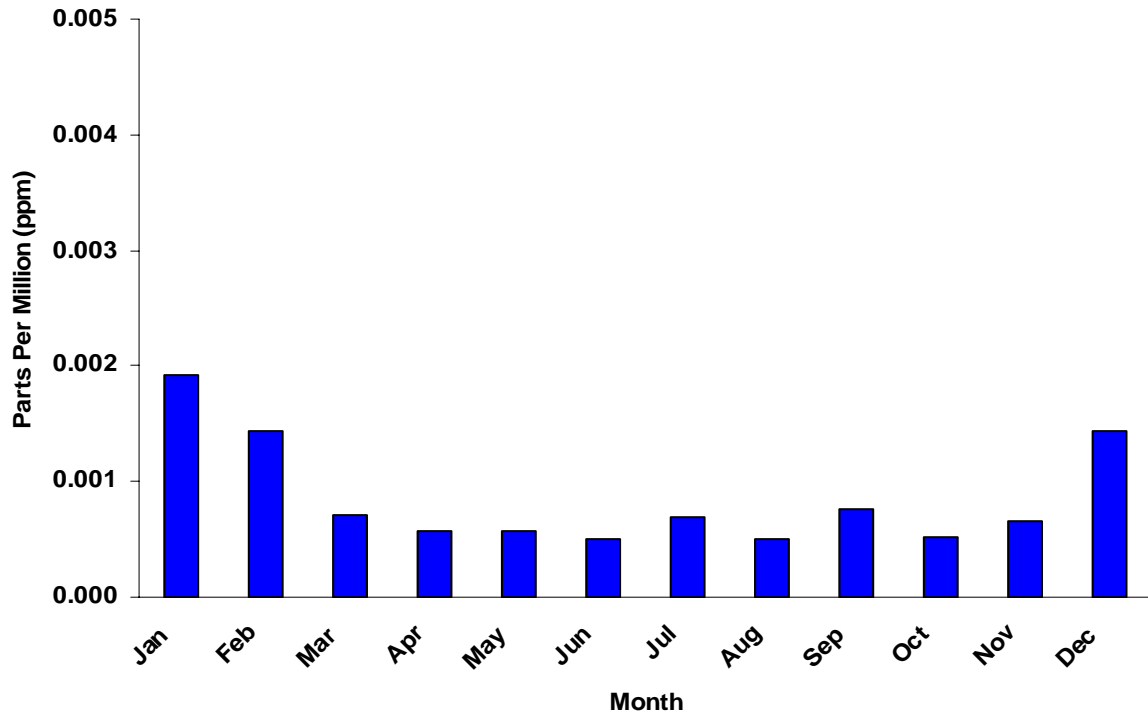


Figure 5
Sulfur Dioxide – New Jersey
2010 Hourly Variation
Parts Per Million (ppm)

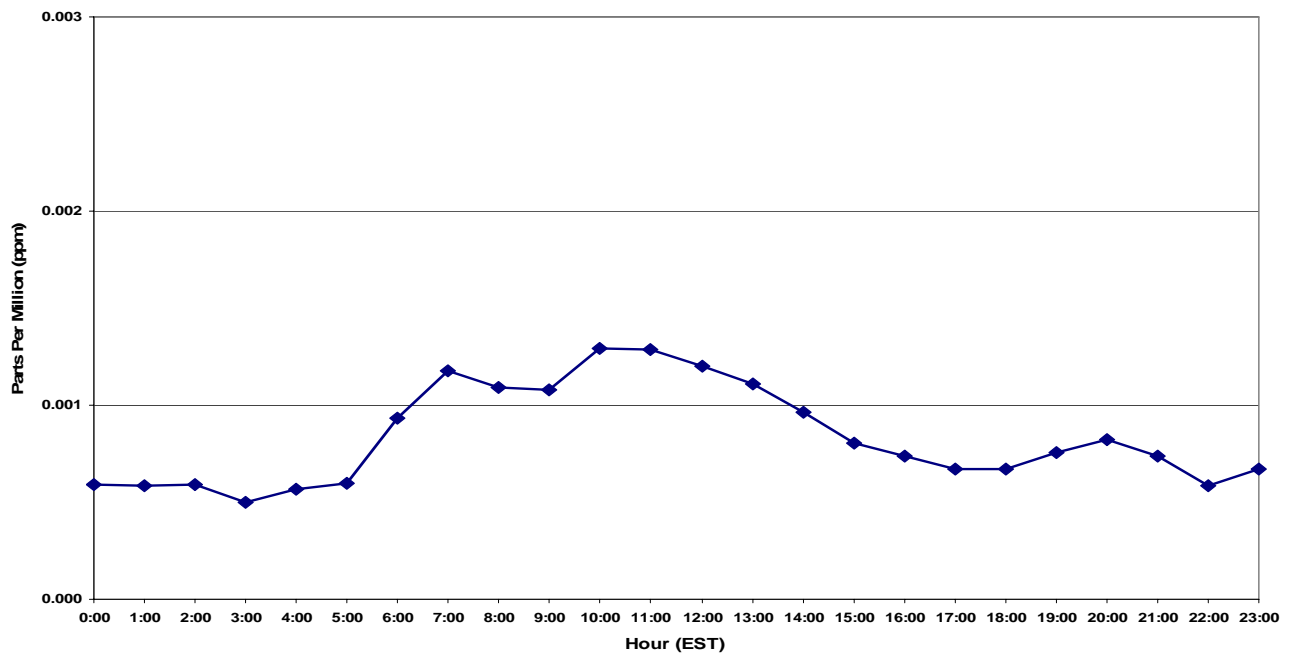


Figure 6
2010 Sulfur Dioxide Concentrations
Highest and 2nd Highest 24-Hour Averages
Parts Per Million (ppm)

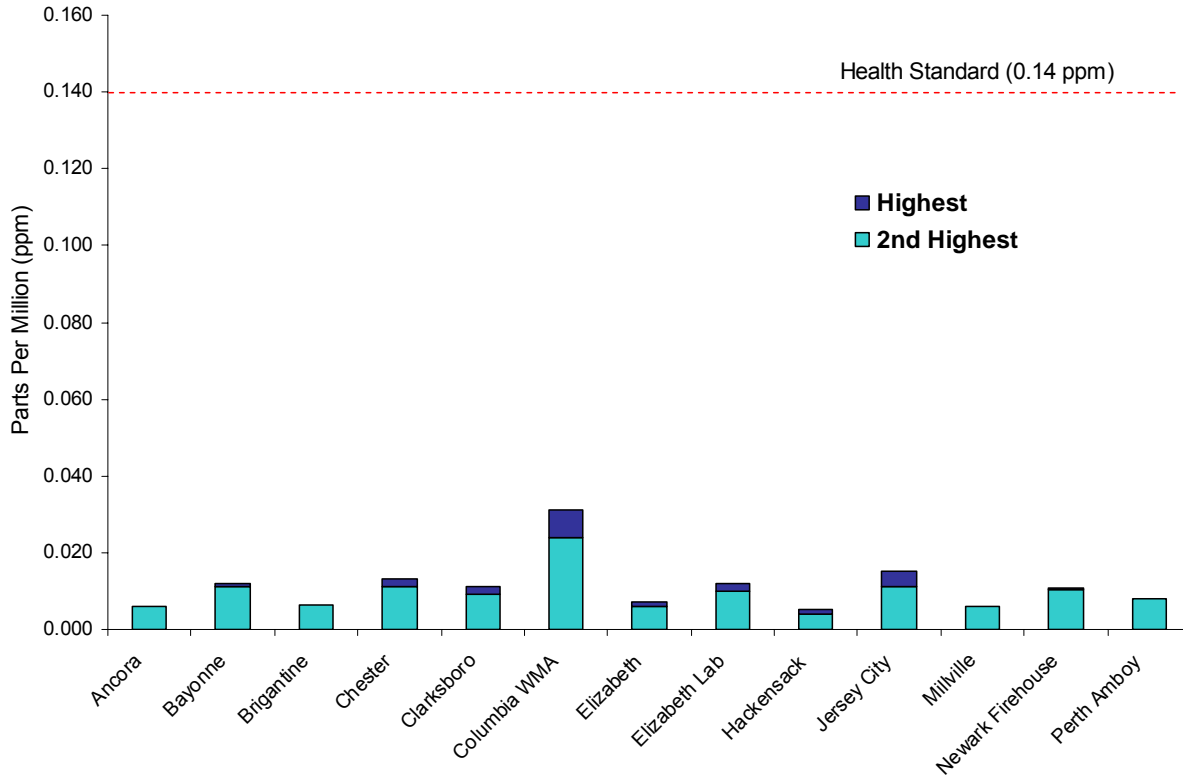
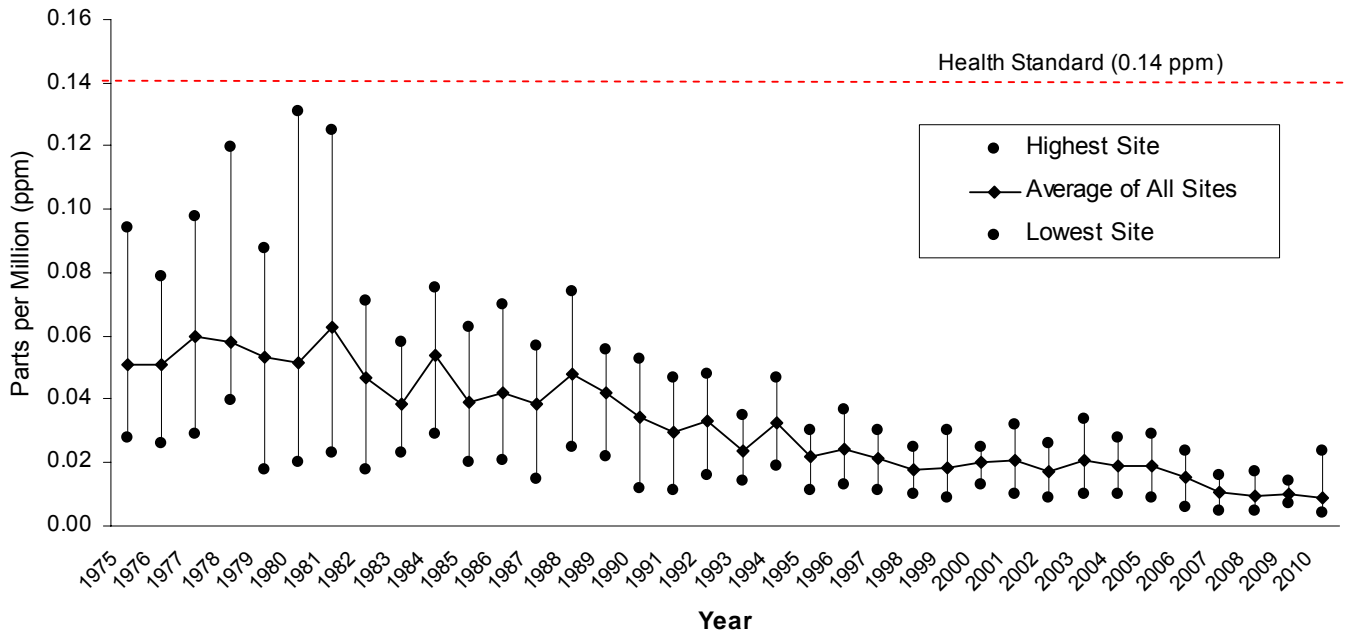


Figure 7
1975 - 2010 Sulfur Dioxide Concentrations
Second Highest Daily Average
Parts Per Million (ppm)

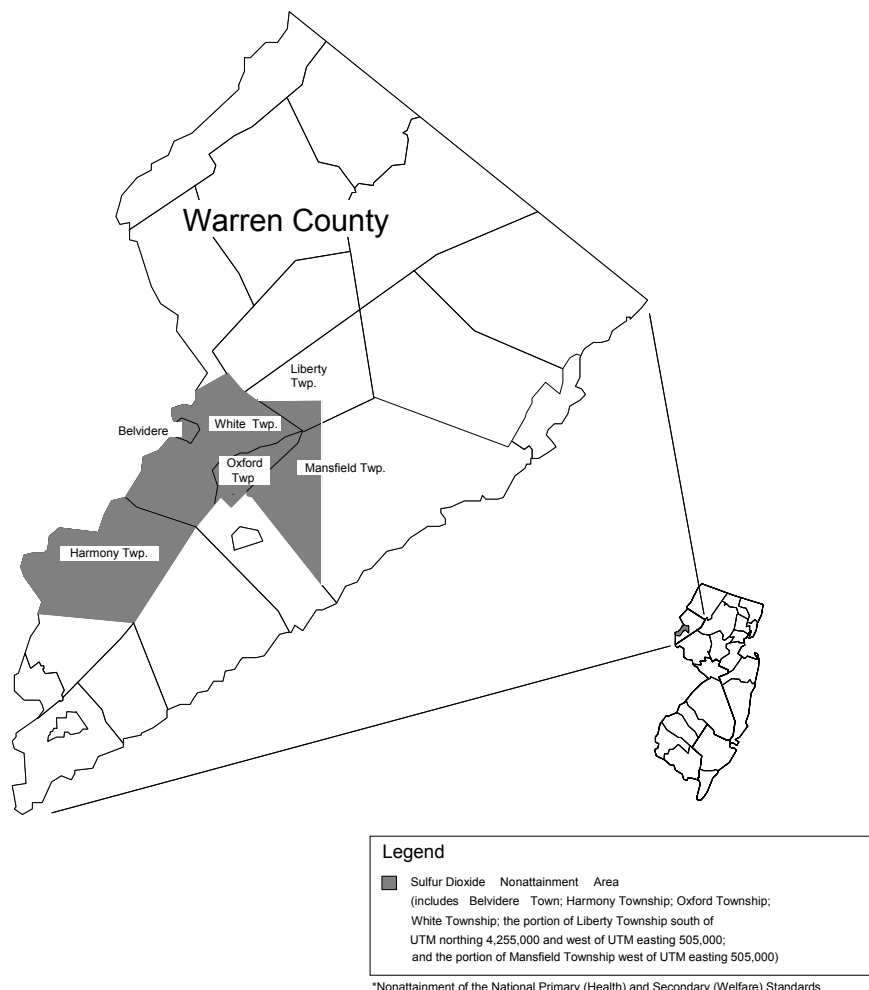


TRENDS

Since the implementation of regulations requiring the use of low sulfur fuels in New Jersey, SO₂ concentrations have improved significantly. The last time an exceedance of any of the National SO₂ standards was recorded in the state was in 1980. A trend graph of SO₂ levels showing the daily average concentrations recorded since 1975 from the highest, average, and lowest of all sites is shown in Figure 7 (page 7). The graph uses the second highest daily average, as this is the value that determines if the national health standard is being met (one exceedance per site is allowed each year).

Although there has not been a measured exceedance of the NAAQS in over two decades, there is still a small area of New Jersey that is classified as a non-attainment area for SO₂. This is the result of air quality modeling studies that predicted non-attainment of the standard within a small area of Warren County. The area is shown below in the map in Figure 8.

Figure 8
Sulfur Dioxide Non-attainment Areas in New Jersey



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2010 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. 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.

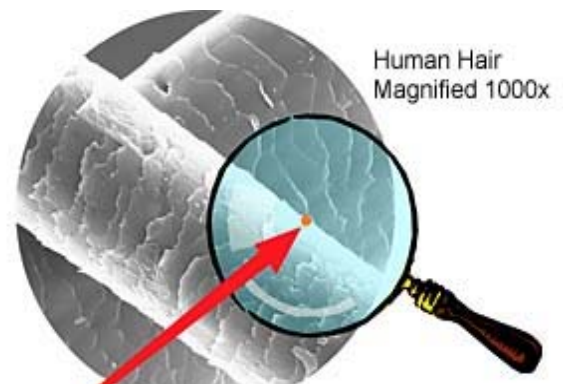
Particulates can occur naturally or be man made. Examples of naturally occurring particulates are windblown dust and sea salt. Man made particulates come from sources such as fossil fuel combustion and industrial processes. Man made sources can be divided into two categories: Primary Particulates and 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 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 section of this report.

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



$PM_{2.5}$ Particulate
Graphics Courtesy of the US Department of Energy

Figure 2a



Figure 2b



HEALTH EFFECTS

Inhalable particulates (PM₁₀) and especially Fine Particulates (PM_{2.5}) are a health concern 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 (*US EPA, 2001*).

STANDARDS

In 1971, 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 (µg/m³) and the annual geometric mean health standard was set at 75 µg/m³. The 24-hour secondary standard was set at 150 µg/m³. While EPA did not establish a secondary annual

standard for TSP they did set a guideline of 60 µg/m³ 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. Inhalable particles are defined as particles less than 10 microns in diameter (PM₁₀). The 24-hour PM₁₀ primary and secondary standards were set at 150 µg/m³, and the annual primary and secondary standards were set at 50 µg/m³. The annual standard for PM₁₀ 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, while maintaining the existing standards for PM₁₀ as well. The PM_{2.5} annual primary and secondary standards were set at 15.0 µg/m³ and the 24-hour standard was set at 65 µg/m³. In October 2006 the EPA revised the 24-hour Standard. It currently is set at 35 µg/m³. Table 1 provides a summary of the Particulate Matter standards.

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

Micrograms Per Cubic Meter (µg/m³)

| Standard | Averaging Period | Type | New Jersey | National |
|--|-----------------------|---------------------|-----------------------|------------------------|
| Total Suspended Particulates (TSP) | 12-Month [‡] | Primary | 75 µg/m ³ | --- |
| | 24-Hour | Primary | 260 µg/m ³ | --- |
| | 12-Month [‡] | Secondary | 60 µg/m ³ | --- |
| | 24-Hour | Secondary | 150 µg/m ³ | --- |
| Inhalable Particulates (PM ₁₀) | Annual [†] | Primary & Secondary | --- | 50 µg/m ³ |
| | 24-Hour Average | Primary & Secondary | --- | 150 µg/m ³ |
| Fine Particulates (PM _{2.5}) | Annual [†] | Primary & Secondary | ---- | 15.0 µg/m ³ |
| | 24-Hour Average | Primary & Secondary | ---- | 35 µg/m ³ |

[‡] Annual Geometric Mean

[†] Annual Arithmetic Mean

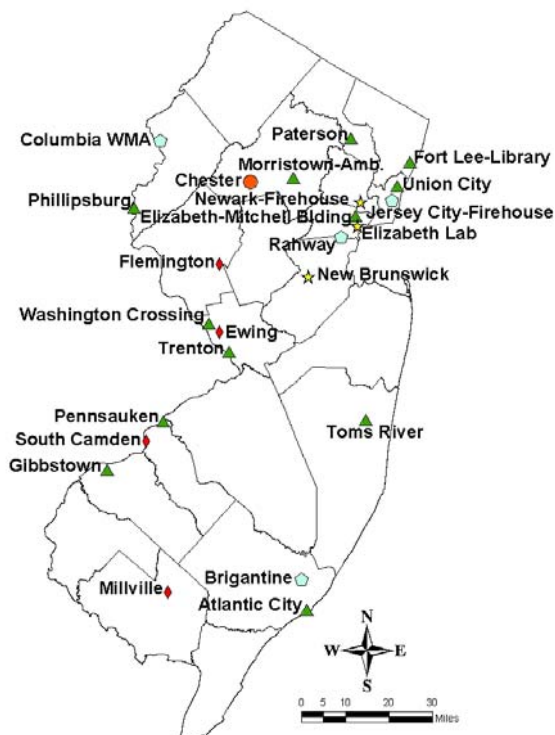
PARTICULATE MONITORING NETWORK

New Jersey's Particulate Monitoring Network consists of 24 PM_{2.5} monitoring sites, 4 PM₁₀ monitoring sites, and 7 sites where smoke shade is monitored.

20 samplers that comply with strict EPA requirements are used for collecting data that is submitted to a national database maintained by the EPA. Samplers that meet these requirements are called Federal Reference Method (FRM) samplers. These samplers pull a predetermined amount of air through a filter for a 24-hour period capturing particles on the filter. Different sample inlets determine what size particles will be captured. 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 federal health and welfare standards for particulate matter. Because these samplers are required to run for 24-hour period and can 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.njairnow.net). The NJDEP uses Tapered Element Oscillating Microbalance (TEOM) analyzers and smoke shade instruments for real-time particle reporting. The TEOM analyzers collect a sample of fine particles on an oscillating filter, and determine the concentration based on the change in the frequency at which the filter oscillates. Smoke shade instruments collect a sample of particles 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 four of these locations, a separate 24-hour filter based sampler collects fine particles 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
2010 PM_{2.5}
Monitoring Network



Fine Particulate Network

- Filter (FRM) and Speciation Sampler
- ★ Filter (FRM), Continuous and Speciation
- ◆ Filter (FRM) and Continuous
- ▲ Filter (FRM) Sampler

FINE PARTICLE SUMMARY

FINE PARTICLE MONITORING SITES

There are 20 monitoring sites in New Jersey where FRM samplers routinely collect 24-hour PM_{2.5} samples (see Figure 3). At 11 sites, continuous particulate monitors (TEOMs) measure the concentration 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). In September 2010, an FRM sampler and TEOM analyzer were established at the Columbia WMA monitoring station.

FINE PARTICLE CONCENTRATION SUMMARY

The annual mean concentration of PM_{2.5} ranged from 7.4 µg/m³ at New Brunswick to 10.6 µg/m³ at Union City. The highest daily concentration ranged from 24.9 µg/m³ at Gibbstown to 42.2 µg/m³ at Union City. Figure 4 and Table 2 depict the mean and maximum concentrations at each site. Table 2 also shows the 2010 annual design value for each site. An annual design value is calculated by averaging the average concentration from 12 consecutive quarters (3 years), in this case 2008-2010. Design values are used to determine attainment status.

No sites were in violation of the annual standard of 15.0 µg/m³. Ten monitoring sites measured exceedences of the 24-hour standard of 35 micrograms.

Figure 4
2010 Fine Particulate (PM_{2.5}) Concentration

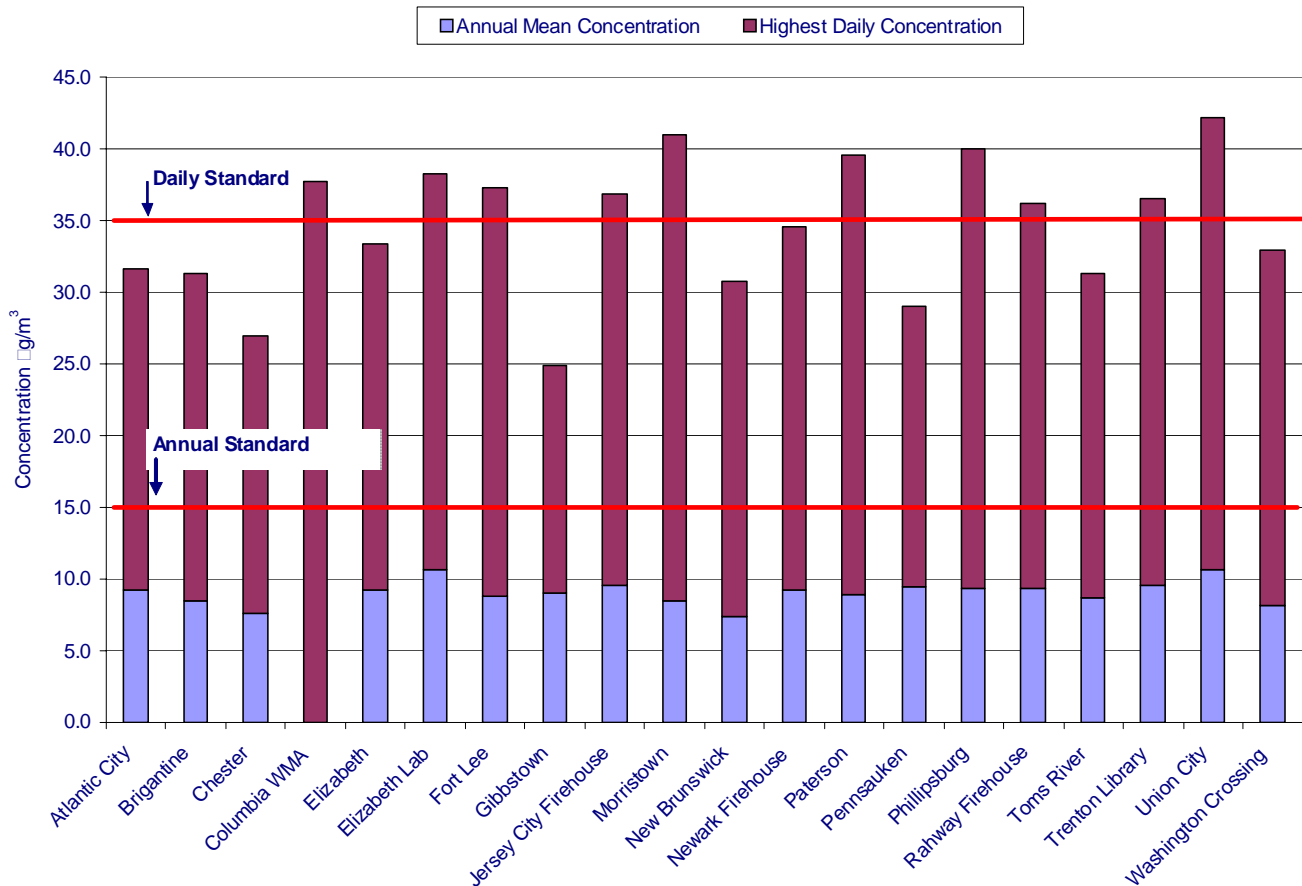


Table 2
2010 Summary of PM_{2.5} Sampler Data
Concentration in Micrograms Per Cubic Meter (µg/m³)

| Monitoring Site | Number of Samples | Annual Mean Concentration | Highest Daily Concentration | Second Highest Daily Concentration | 2010 Annual Average Design Values |
|-----------------------|-------------------|---------------------------|-----------------------------|------------------------------------|-----------------------------------|
| Atlantic City | 115 | 9.2 | 31.6 | 22.7 | 9.6 |
| Brigantine | 119 | 8.4 | 31.3 | 24.4 | 8.9 |
| Chester | 116 | 7.5 | 26.9 | 24.7 | 7.8 |
| Columbia WMA * | 78 | ---- | 37.7 | 29.7 | ---- |
| Elizabeth | 109 | 9.2 | 33.4 | 26.1 | 10.3 |
| Elizabeth Lab | 343 | 10.5 | 38.2 | 35.4 | 11.6 |
| Fort Lee | 120 | 8.8 | 37.3 | 25.1 | 9.8 |
| Gibbstown | 113 | 9.0 | 24.9 | 22.9 | 9.9 |
| Jersey City Firehouse | 347 | 9.5 | 36.8 | 33.2 | 10.6 |
| Morristown | 118 | 8.5 | 41.0 | 33.1 | 8.7 |
| New Brunswick | 118 | 7.4 | 30.7 | 23.2 | 8.8 |
| Newark Firehouse* | 118 | 9.1 | 34.5 | 27.6 | ---- |
| Paterson | 109 | 8.9 | 39.6 | 32.1 | 9.7 |
| Pennsauken | 117 | 9.4 | 29.0 | 25.2 | 10.2 |
| Phillipsburg | 114 | 9.3 | 40.0 | 26.1 | 9.7 |
| Rahway Firehouse | 117 | 9.3 | 36.2 | 27.0 | 10.2 |
| Toms River | 329 | 8.6 | 31.3 | 29.8 | 9.0 |
| Trenton Library | 360 | 9.5 | 36.5 | 35.3 | 10.0 |
| Union City | 112 | 10.6 | 42.2 | 27.4 | 11.5 |
| Washington Crossing | 108 | 8.1 | 32.9 | 19.5 | 8.7 |

* There was not enough data to calculate an annual mean concentration or an average design value.

Table 3
2010 Summary of Continuous PM_{2.5} Data
Concentration in Micrograms Per Cubic Meter (µg/m³)

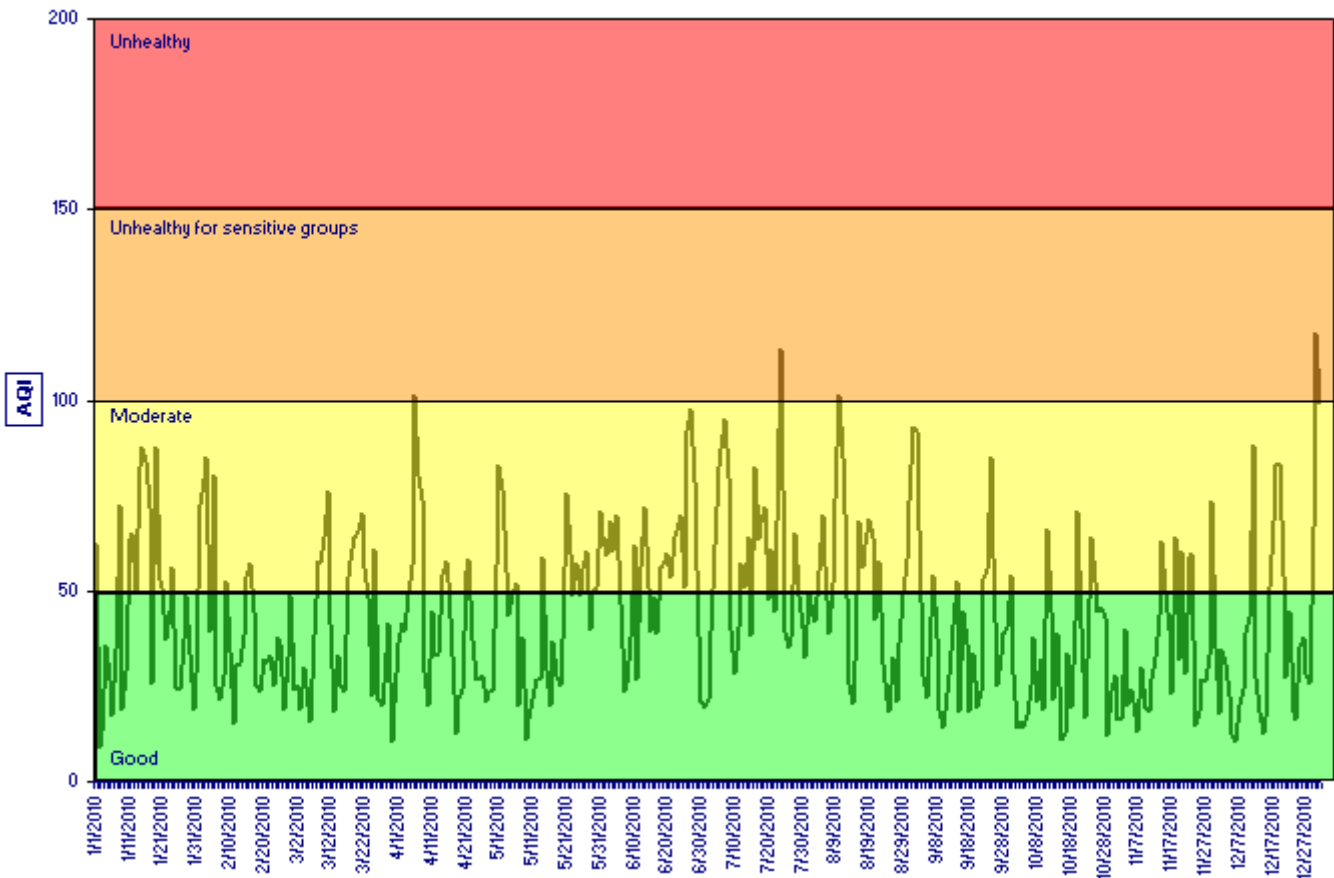
| Monitoring Site | Annual Mean Concentration | Highest Daily Concentration | Second Highest Daily Concentration |
|-----------------------|---------------------------|-----------------------------|------------------------------------|
| Brigantine | 8.0 | 30.1 | 28.9 |
| Columbia WMA* | ---- | 30.4 | 24.9 |
| Elizabeth Lab | 11.1 | 35.7 | 35.6 |
| Ewing | 8.3 | 30.2 | 27.1 |
| Flemington | 9.6 | 31.5 | 30.2 |
| Jersey City Firehouse | 10.2 | 35.3 | 35.0 |
| Millville | 8.5 | 32.3 | 31.8 |
| New Brunswick | 6.9 | 27.7 | 27.1 |
| Newark Firehouse | 8.5 | 27.7 | 25.6 |
| Rahway | 10.2 | 33.2 | 30.5 |
| South Camden | 10.4 | 37.7 | 32.2 |

*There was not enough data collected to calculate an annual mean concentration.

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 once a minute 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 maximum daily fine particulate concentration recorded in the state each day for the entire year.

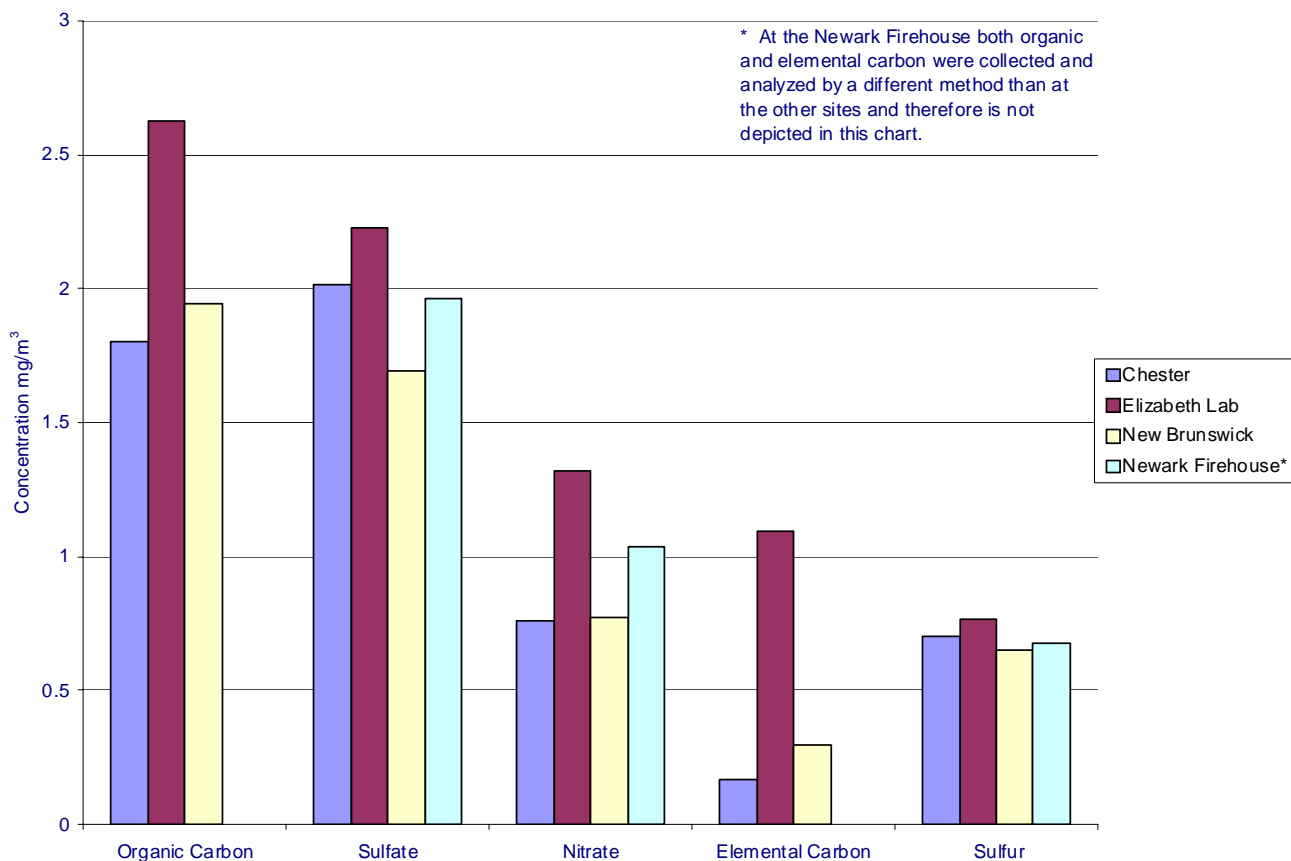
Figure 5
2010 Maximum Daily Fine Particulate Concentration
(Highest site)
Air Quality Index (AQI)



FINE PARTICLE SPECIATION SUMMARY

New Jersey's Fine Particulate Speciation Network consists of 4 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. Combined, they create the majority of the particulates total mass. Figure 6 depicts the average concentration of the five most prevalent species. High organic and elemental carbon concentrations at Elizabeth Lab are due to the sites' proximity to high traffic volume, and motor vehicles are the primary source for those species. Appendix B shows the average, maximum, and 2nd highest daily average concentrations for each species for 2010.

Figure 6
2010 Fine Particulate Analyte Composition
Annual Average
(Highest 5 Analytes Depicted)



FINE PARTICULATE NON-ATTAINMENT AREAS

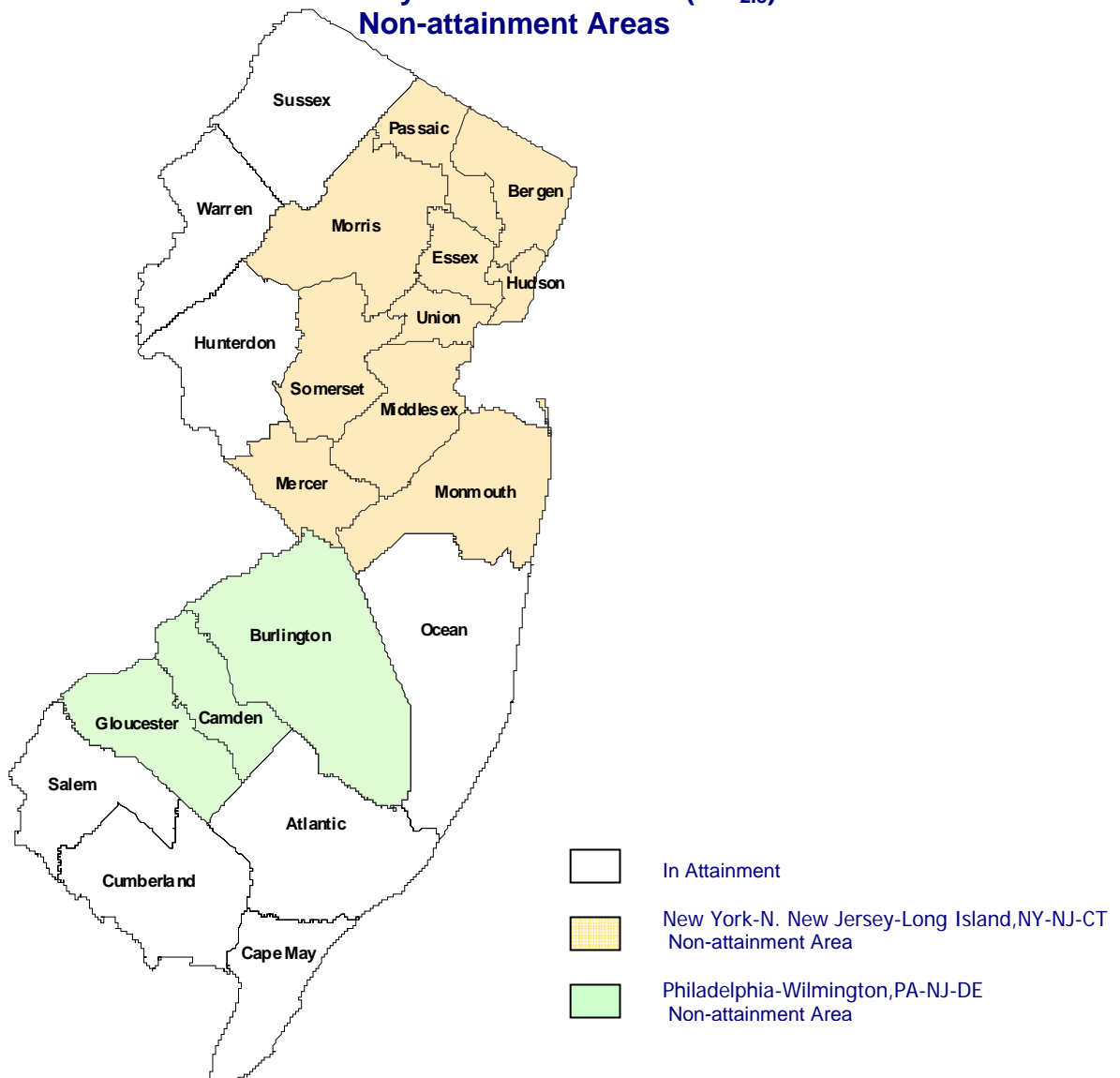
On April 5, 2005, thirteen New Jersey counties were classified as non-attainment areas. Non-attainment classification is given to an area that exceeds the air quality standard or contributes to the exceedance of that standard. In order to determine if the PM_{2.5} annual standard is met, the average of 12 consecutive quarters of valid data within 3 calendar years is compared to 15.0 µg/m³.

While the 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 additional sites in New York City that recorded violations of the PM_{2.5} Standards.

Similarly, 3 counties in the southwestern part of the state have been classified as non-attainment due to their contribution to PM_{2.5} violations in the city of Philadelphia. DEP is currently devising a strategy to lower PM_{2.5} levels in these affected areas.

Figure 7
New Jersey Particulate Matter (PM_{2.5})
Non-attainment Areas



2010 INHALABLE PARTICULATE SUMMARY

INHALABLE PARTICULATE MONITORING SITES

The Inhalable Particulate monitoring network is composed of 4 PM₁₀ sampling sites. PM₁₀ 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 PM₁₀ particulate monitoring network in New Jersey. The Atlantic City PM₁₀ sampler was shutdown in March 2010.

PM₁₀ CONCENTRATION SUMMARY

In 2010, the annual mean concentration of PM₁₀ ranged from 21µg/m³ at Trenton to 30µg/m³ at Camden RRF. Table 4 and Figure 9 show the annual mean and 24-hour maximum PM₁₀ concentrations throughout the state. All areas of the state are in attainment for the both the annual PM₁₀ standards of 50 µg/m³ and the 24-hour standard of 150 µg/m³.

Figure 8
2010 PM₁₀
Monitoring Network

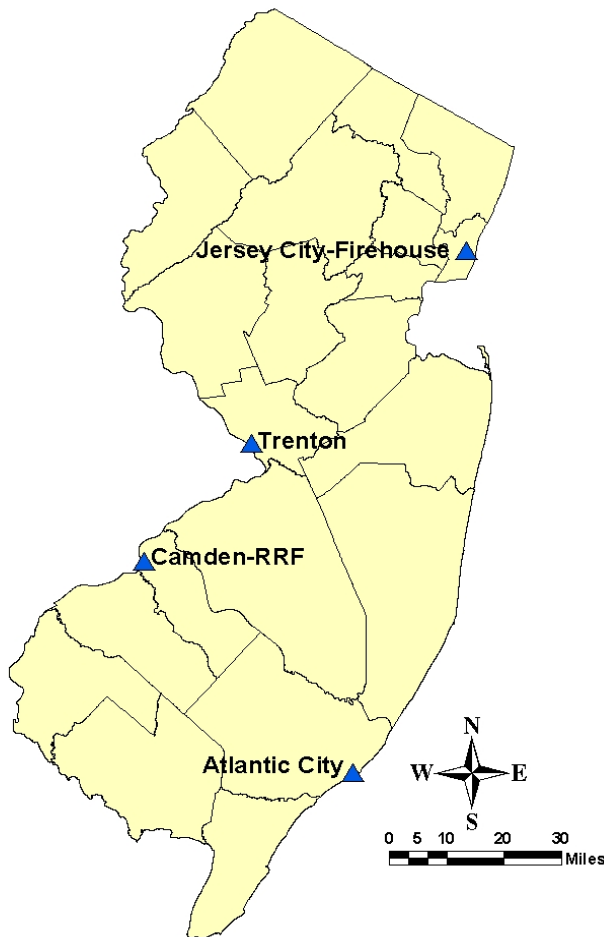


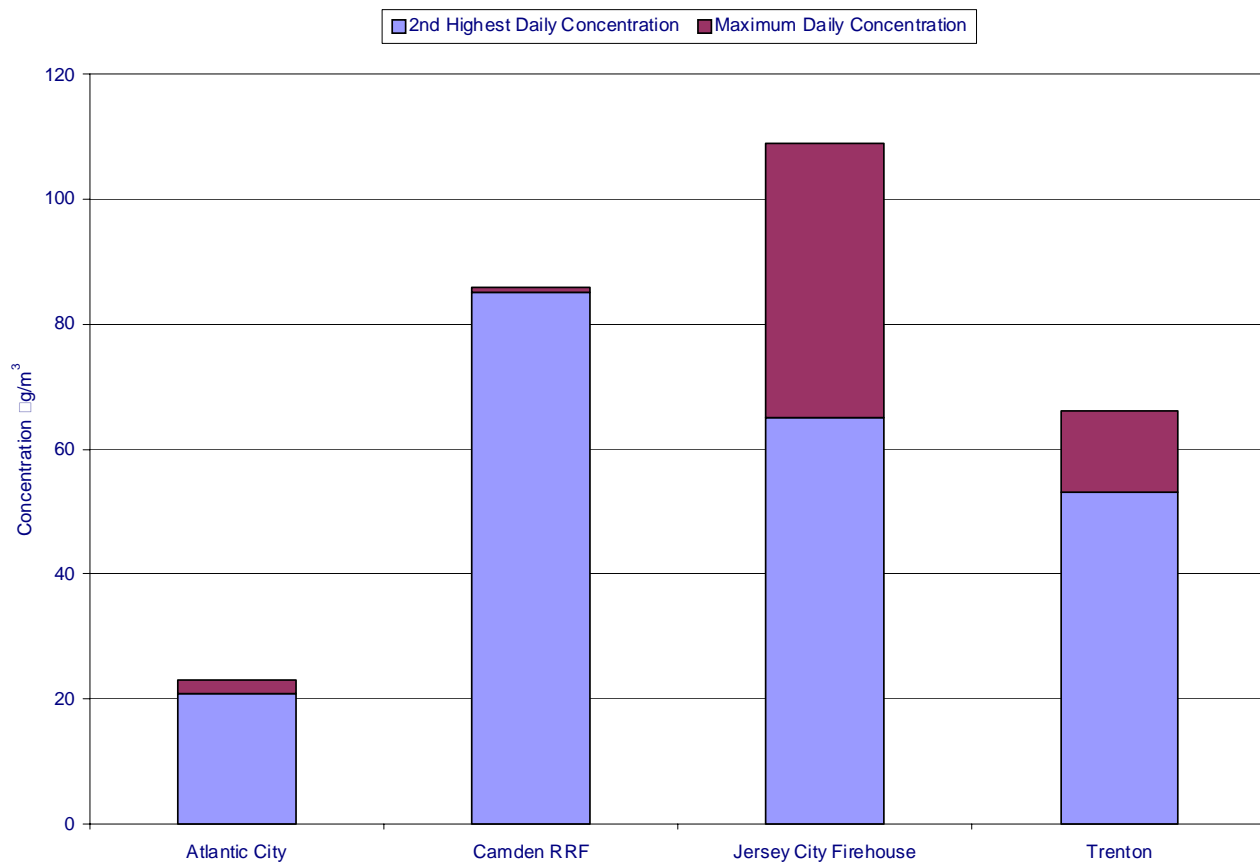
Table 4
PM₁₀ Data - 2010
Daily and Annual Averages

Micrograms Per Cubic Meter ($\mu\text{g}/\text{m}^3$)
 Daily Standard = 150 ($\mu\text{g}/\text{m}^3$)
 Annual Standard = 50 $\mu\text{g}/\text{m}^3$

| Monitoring Site | Number of Samples | Highest Daily Concentration | Second Highest Daily Concentration | Annual Mean |
|-----------------------|-------------------|-----------------------------|------------------------------------|-------------|
| Atlantic City* | 7 | 23 | 21 | ---- |
| Camden RRF | 59 | 86 | 85 | 30 |
| Jersey City-Firehouse | 51 | 109 | 65 | 29 |
| Trenton | 59 | 66 | 53 | 21 |

* Not enough data to calculate annual mean, sampler shutdown in March 2010

Figure 9
Summary of PM₁₀ Concentrations, New Jersey 2010



SMOKE SHADE SUMMARY

SMOKE SHADE MONITORING SITES

In addition to fine and coarse particulate monitoring, smoke shade is also monitored at 7 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. As a result of the 2010 Network Assessment, the Freehold, Hackensack, Morristown, and Perth Amboy smoke shade analyzers were shut down on December 31, 2010 in order to save both time and resources.

SMOKE SHADE CONCENTRATION SUMMARY

In 2010, the annual mean concentration of smoke shade ranged from 0.15 Coefficient of Haze units (COH) at Hackensack to 0.35 COH at Jersey City. 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 maximum and second highest daily average and annual mean smoke shade levels recorded at the monitoring sites in 2010.

Figure 10
2010 Smoke Shade
Monitoring Network

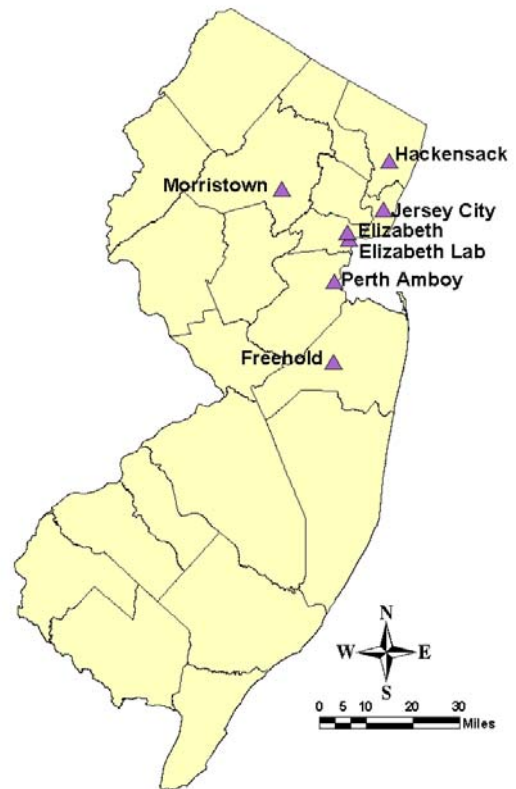


Table 5
Smoke Shade - 2010

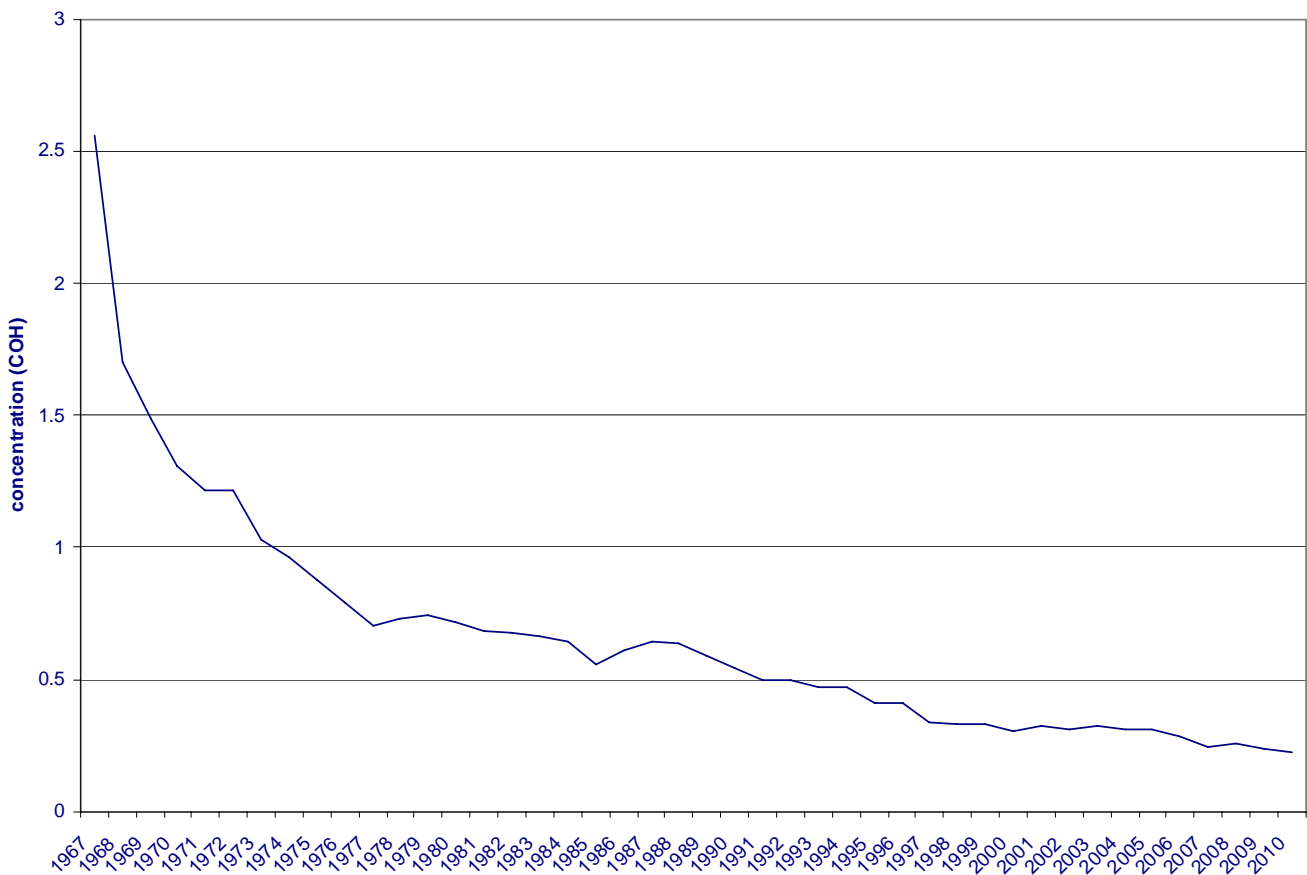
Coefficient of Haze (COHs)
No Standard

| Site | Maximum Daily Average | 2nd Highest Daily Average | Annual Mean |
|---------------|-----------------------|---------------------------|-------------|
| Elizabeth | 0.70 | 0.52 | 0.18 |
| Elizabeth Lab | 1.12 | 0.99 | 0.32 |
| Freehold | 0.76 | 0.54 | 0.22 |
| Hackensack | 0.56 | 0.5 | 0.15 |
| Jersey City | 1.15 | 1.1 | 0.35 |
| Morristown | 0.58 | 0.54 | 0.17 |
| Perth Amboy | 0.63 | 0.61 | 0.19 |

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 in effect for over 40 years and still has 7 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, PM₁₀ and PM_{2.5} health standards.

Figure 11
Long Term Trend in Particulate Levels
State Average
1967- 2010



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2010 PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS)

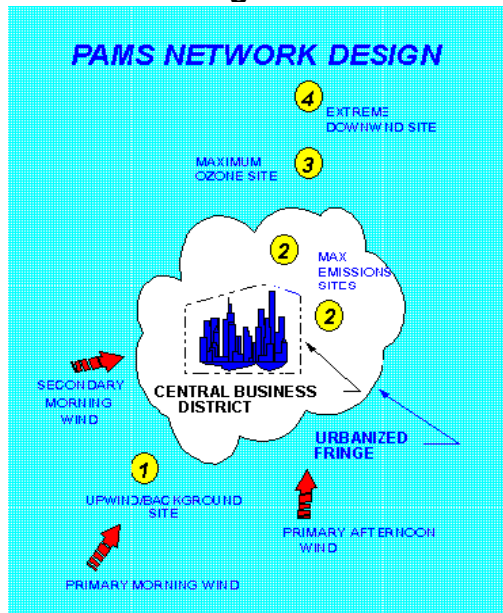
New Jersey Department of Environmental Protection

PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS)

Most ground-level ozone (O_3) is formed as the result of oxides of nitrogen (NO_x) 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 O_3 problem, track VOC and NO_x emission inventory reductions, assess air quality trends, and make attainment/nonattainment decisions. PAMS monitor both criteria and non-criteria pollutants including ozone (O_3), oxides of nitrogen (NO_x), nitric oxide (NO), nitrogen dioxide (NO_2), 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.

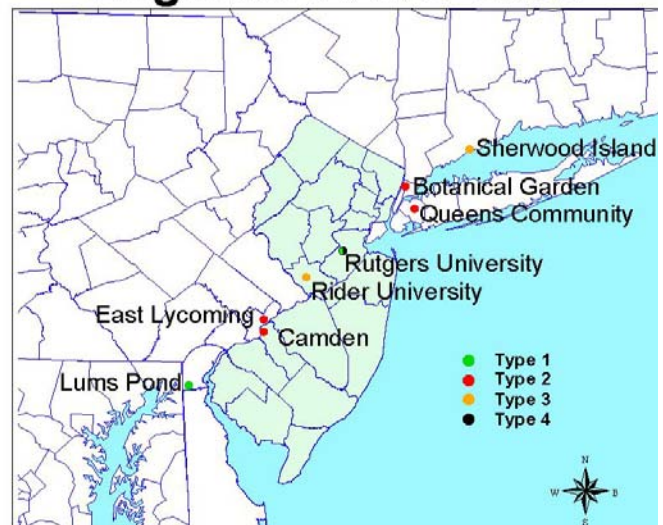
The PAMS network is designed around metropolitan areas where ozone is a significant problem, and each site in the network has a specific purpose as shown in Figure 1 below. New Jersey is part of both the Philadelphia and New York Metropolitan areas and has historically operated a total of three PAMS sites. A Type 3 maximum ozone site for the Philadelphia area is located at Rider University in Mercer County, a secondary Type 2 (or Type 2A) maximum emissions site is 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
Regional PAMS Sites



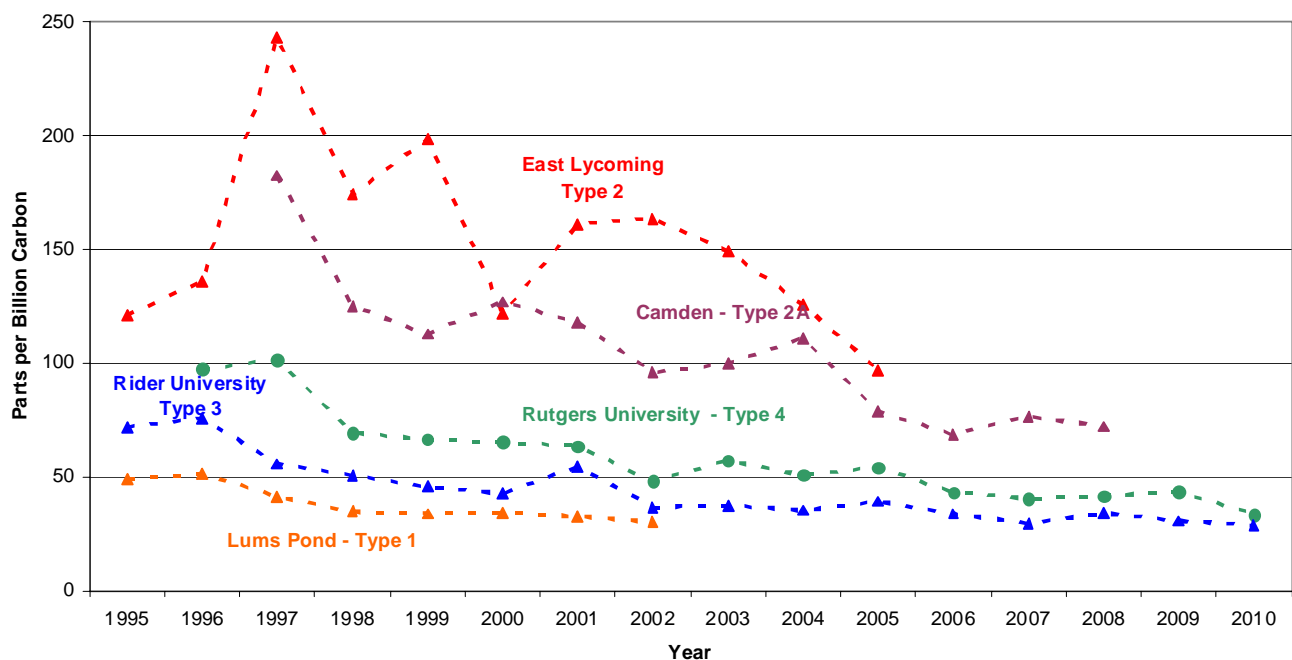
Note: Rutgers University PAMS site is both Type 4 for Philadelphia and Type 1 for New York City.

PHILADELPHIA REGION

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 did not operate during the 2009 and 2010 seasons due to our losing access to the site, which is currently being relocated.

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 1995-2010

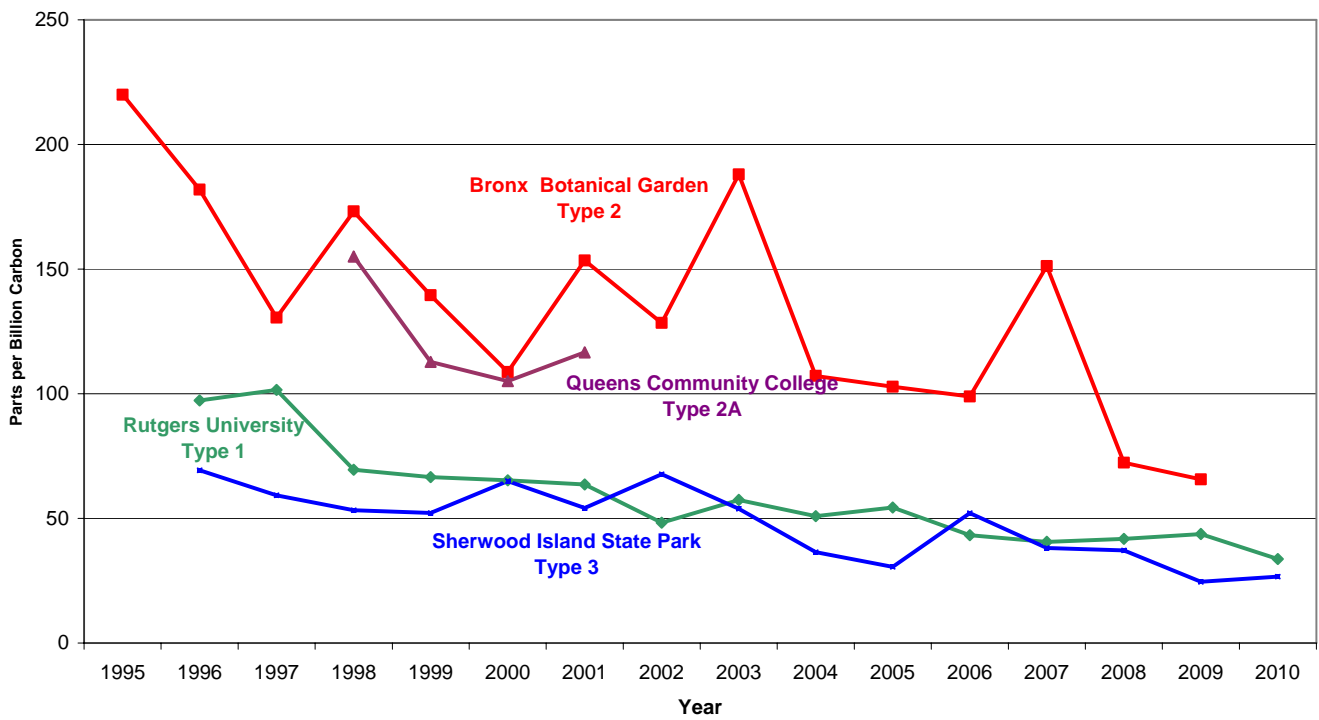


NEW YORK REGION

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.

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.

Figure 4
New York City Region
Total Non-methane Organic Carbon (TNMOC)
Seasonal Average 1995-2010



SUMMARY

In conclusion, trends for VOC values measured at all PAMS sites in the Philadelphia and New York City areas show a decline over the time period during which these measurements were made. Changes in gasoline formulation over the period as well as the effect of newer, cleaner vehicles replacing older vehicles in the automotive fleet might account for the 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, 2010

Parts Per Billion (Volume) – ppbv
Parts Per Billion (Carbon) – ppbC
Max – Maximum Avg - Average

| | <i>Rider University</i> | | | | <i>Rutgers University</i> | | | |
|---------------------|-------------------------|------|-------|------|---------------------------|------|-------|------|
| | ppbv | | ppbC | | ppbv | | ppbC | |
| | Max | Avg | Max | Avg | Max | Avg | Max | Avg |
| Acetylene | 1.27 | 0.17 | 2.54 | 0.34 | 0.74 | 0.10 | 0.94 | 0.13 |
| Benzene | 0.48 | 0.09 | 2.85 | 0.54 | 5.94 | 0.94 | 2.82 | 0.45 |
| n-Butane | 11.99 | 0.28 | 47.96 | 1.13 | 2.34 | 0.15 | 28.05 | 1.81 |
| 1-Butene | 0.18 | 0.03 | 0.73 | 0.10 | 3.78 | 0.85 | 0.69 | 0.15 |
| cis-2-Butene | 0.57 | 0.02 | 2.27 | 0.07 | 1.29 | 0.14 | 0.73 | 0.08 |
| trans-2-Butene | 0.33 | 0.02 | 1.31 | 0.08 | 2.50 | 0.31 | 0.82 | 0.10 |
| Cyclohexane | 0.20 | 0.03 | 1.21 | 0.17 | 8.48 | 0.75 | 1.71 | 0.15 |
| Cyclopentane | 0.38 | 0.04 | 1.88 | 0.18 | 3.62 | 0.30 | 1.36 | 0.11 |
| n-Decane | 0.20 | 0.02 | 2.02 | 0.18 | 7.18 | 0.41 | 1.45 | 0.08 |
| m-Diethylbenzene | 0.12 | 0.01 | 1.21 | 0.12 | 5.45 | 0.52 | 0.66 | 0.06 |
| p-Diethylbenzene | 0.10 | 0.01 | 1.03 | 0.12 | 7.67 | 0.52 | 0.79 | 0.05 |
| 2,2-Dimethylbutane | 0.09 | 0.02 | 0.46 | 0.12 | 13.70 | 0.99 | 1.26 | 0.09 |
| 2,3-Dimethylbutane | 2.13 | 0.04 | 10.64 | 0.20 | 1.08 | 0.10 | 2.29 | 0.20 |
| 2,3-Dimethylpentane | 0.33 | 0.03 | 2.28 | 0.23 | 4.05 | 0.48 | 1.32 | 0.16 |
| 2,4-Dimethylpentane | 0.29 | 0.03 | 2.02 | 0.20 | 4.44 | 0.36 | 1.28 | 0.10 |
| Ethane | 5.54 | 1.89 | 11.08 | 3.77 | 3.17 | 0.83 | 17.57 | 4.61 |
| Ethylbenzene | 0.21 | 0.03 | 1.66 | 0.21 | 8.67 | 1.02 | 1.80 | 0.21 |
| Ethylene (Ethene) | 1.76 | 0.30 | 3.52 | 0.61 | 3.55 | 0.43 | 6.24 | 0.76 |
| m-Ethyltoluene | 0.36 | 0.05 | 3.25 | 0.41 | 4.21 | 0.22 | 1.52 | 0.08 |
| o-Ethyltoluene | 0.07 | 0.01 | 0.65 | 0.12 | 6.09 | 0.60 | 0.44 | 0.04 |
| p-Ethyltoluene | 0.11 | 0.03 | 1.02 | 0.24 | 36.35 | 3.03 | 4.12 | 0.34 |
| n-Heptane | 0.31 | 0.04 | 2.17 | 0.26 | 7.48 | 0.79 | 2.32 | 0.25 |
| Hexane | 1.77 | 0.07 | 10.63 | 0.44 | 3.45 | 0.25 | 6.12 | 0.44 |
| 1-Hexene | 0.51 | 0.02 | 3.08 | 0.14 | 4.11 | 0.17 | 2.11 | 0.09 |
| Isobutane | 1.48 | 0.16 | 5.93 | 0.64 | 57.13 | 0.65 | 84.69 | 0.96 |
| Isopentane | 10.67 | 0.31 | 53.36 | 1.56 | 3.10 | 0.20 | 33.07 | 2.12 |
| Isoprene | 7.69 | 0.50 | 38.46 | 2.51 | 2.63 | 0.50 | 20.24 | 3.86 |
| Isopropylbenzene | 0.20 | 0.02 | 1.76 | 0.16 | 2.86 | 0.26 | 0.56 | 0.05 |
| Methylcyclohexane | 0.25 | 0.03 | 1.78 | 0.21 | 8.49 | 0.87 | 2.16 | 0.22 |
| Methylcyclopentane | 0.66 | 0.05 | 3.95 | 0.33 | 5.23 | 0.44 | 3.44 | 0.29 |
| 2-Methylheptane | 1.85 | 0.09 | 11.10 | 0.52 | 3.52 | 0.31 | 6.51 | 0.57 |
| 3-Methylheptane | 1.12 | 0.06 | 6.72 | 0.34 | 3.47 | 0.33 | 3.89 | 0.37 |

Table 1 (Continued)
 Summary of Photochemical Assessment Monitoring (PAMS) Data
 June, July, and August, 2010

Parts Per Billion (Volume) – ppbv
 Parts Per Billion (Carbon) – ppbC
 Max – Maximum Avg - Average

| | Rider University | | | | Rutgers University | | | |
|------------------------|-------------------------|------------|-------------|------------|---------------------------|------------|-------------|------------|
| | ppbv | | ppbC | | ppbv | | ppbC | |
| | Max | Avg | Max | Avg | Max | Avg | Max | Avg |
| 2-Methylhexane | 0.11 | 0.01 | 0.87 | 0.12 | 8.92 | 0.76 | 0.97 | 0.08 |
| 3-Methylhexane | 0.14 | 0.02 | 1.12 | 0.13 | 6.57 | 0.55 | 0.92 | 0.08 |
| 2-Methylpentane | 0.31 | 0.03 | 2.18 | 0.23 | 5.62 | 0.62 | 1.75 | 0.19 |
| 3-Methylpentane | 0.36 | 0.04 | 2.55 | 0.27 | 5.85 | 0.68 | 2.13 | 0.25 |
| n-Nonane | 0.15 | 0.02 | 1.36 | 0.16 | 13.10 | 0.60 | 1.98 | 0.09 |
| n-Octane | 0.27 | 0.02 | 2.19 | 0.17 | 5.48 | 0.49 | 1.50 | 0.14 |
| n-Pentane | 4.44 | 0.17 | 22.20 | 0.84 | 5.04 | 0.26 | 22.36 | 1.14 |
| 1-Pentene | 0.34 | 0.02 | 1.70 | 0.11 | 3.91 | 0.41 | 1.33 | 0.14 |
| cis-2-Pentene | 0.33 | 0.04 | 1.65 | 0.21 | 4.79 | 0.20 | 1.58 | 0.07 |
| trans-2-Pentene | 0.67 | 0.02 | 3.36 | 0.11 | 4.87 | 0.16 | 3.27 | 0.11 |
| Propane | 15.36 | 0.97 | 46.08 | 2.90 | 1.71 | 0.23 | 26.19 | 3.48 |
| n-Propylbenzene | 0.08 | 0.01 | 0.71 | 0.13 | 5.83 | 0.54 | 0.46 | 0.04 |
| Propylene (Propene) | 0.87 | 0.15 | 2.60 | 0.44 | 6.99 | 0.87 | 6.06 | 0.76 |
| Styrene | 0.12 | 0.02 | 0.98 | 0.17 | 12.00 | 0.97 | 1.47 | 0.12 |
| Toluene | 3.32 | 0.20 | 23.23 | 1.37 | 3.35 | 0.53 | 11.11 | 1.76 |
| 1,2,3-Trimethylbenzene | 0.85 | 0.06 | 7.66 | 0.57 | 6.70 | 0.38 | 5.70 | 0.33 |
| 1,2,4-Trimethylbenzene | 1.42 | 0.04 | 12.78 | 0.38 | 1.28 | 0.08 | 1.82 | 0.12 |
| 1,3,5-Trimethylbenzene | 0.12 | 0.02 | 1.06 | 0.18 | 9.17 | 0.63 | 1.08 | 0.07 |
| 2,2,4-Trimethylpentane | 0.78 | 0.09 | 6.21 | 0.69 | 6.30 | 0.82 | 4.89 | 0.64 |
| 2,3,4-Trimethylpentane | 0.28 | 0.03 | 2.23 | 0.23 | 4.91 | 0.73 | 1.37 | 0.20 |
| n-Undecane | 0.39 | 0.02 | 4.31 | 0.22 | 26.59 | 0.48 | 10.42 | 0.19 |
| m/p-Xylene | 0.68 | 0.07 | 5.42 | 0.58 | 8.09 | 0.88 | 5.48 | 0.60 |
| o-Xylene | 0.25 | 0.03 | 1.98 | 0.25 | 7.52 | 0.86 | 1.86 | 0.21 |

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2010 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) 2009 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 to address 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 non-cancer 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 toxicity values are developed by the

USEPA and other agencies, using health studies on a chemical. For carcinogens, 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 non-carcinogen 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 4 through 7. 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 can give 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 2005 NATA 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 34%. Area sources (residential, commercial, and small industrial sources) represent 28% of the inventory, and major point sources (such as factories and power plants) account for the remaining 5%.

ESTIMATING AIR TOXICS EXPOSURE

The second step in USEPA's NATA project is to use the emissions information in an air dispersion model to estimate air toxic concentrations across the country. The map in Figure 2 shows the 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, but in general, larger populations result in greater emissions of, and exposure to, air toxics.

Analysis of the NATA state and county average air toxics concentrations indicates that twenty-one chemicals were predicted to exceed their health benchmarks, or level of concern, in one or more counties in 2005. Twenty of these are considered to be cancer-causing (carcinogenic) chemicals, and one (acrolein) is not. Estimated air concentrations of these 21 pollutants vary around the state, depending on the types of sources that emit them. This is summarized in Table 1.

Figure 1
2005 Air Toxics Emissions Source Estimates for New Jersey

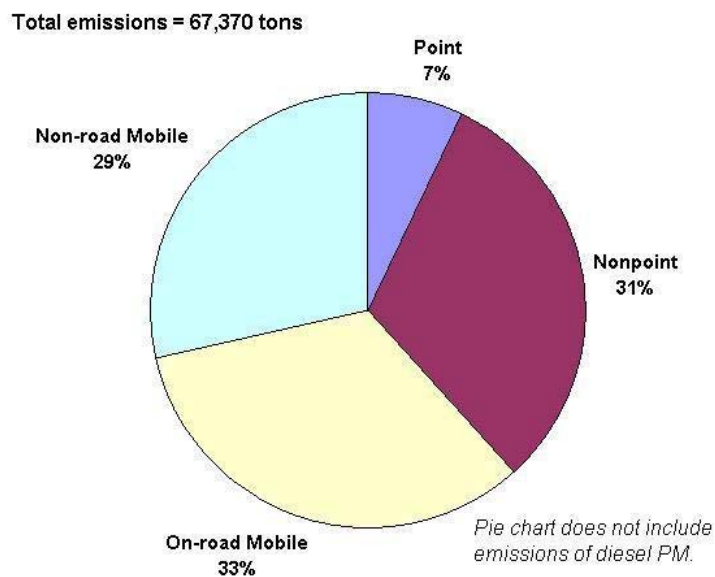


Figure 2. Benzene
2005 NATA Predicted Concentrations for NJ

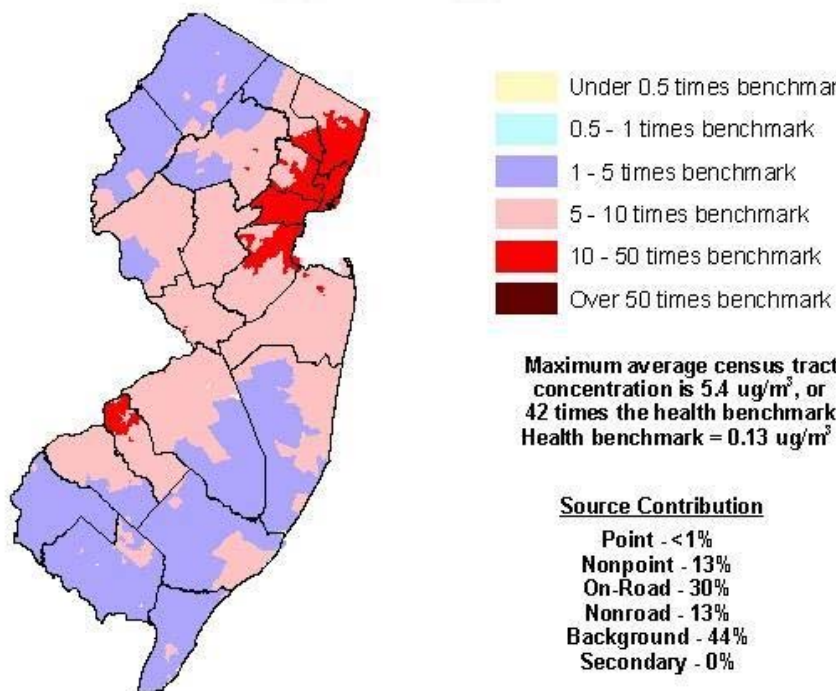


Table 1
Air Toxics of Greatest Concern in New Jersey
Based on 2005 National-Scale Air Toxics Assessment

| 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 | Nonpoint, Point |
| PAH/POM | 18 | Nonpoint |
| Perchloroethylene | 8 | Nonpoint, Background |
| 1,1,2-Trichloroethane | 1 (Salem) | Nonpoint |

NJ AIR TOXICS MONITORING PROGRAM RESULTS FOR 2010

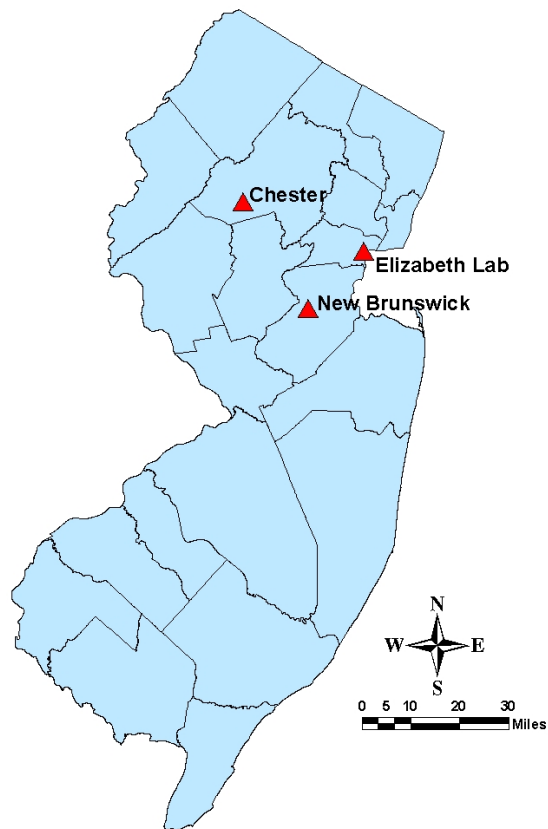
NJDEP has established three air toxics monitoring sites around the state. They are located in Elizabeth, New Brunswick and Chester (see Figure 3). The Camden Lab site, which had been measuring several toxic volatile organic compounds (VOCs) since 1989, was shut down on September 29, 2008, because the NJDEP lost access to the station. The Elizabeth Lab site began measuring VOCs in 2000, and the New Brunswick and Chester sites became operational in July 2001. Analysis of toxic metals at each site also began in 2001. Metals data can be found in Appendix B (Fine Particulate Speciation Summary 2010) of the Air Quality Report.

2010 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 three New Jersey monitoring sites. All values are in micrograms per cubic meter ($\mu\text{g}/\text{m}^3$). More detail can be found in Tables 5 through 7, including additional statistics, detection limit information, health benchmarks used by NJDEP, risk ratios, and concentrations in parts per billion by volume (ppbv). The ppbv units are more common for monitoring results, while $\mu\text{g}/\text{m}^3$ 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 8.

Reported averages for which significant portions of the data (more than 50%) were below the detection limit should be viewed with extreme caution. Median values (the value of the middle sample value when the results are ranked) are reported 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 most of the air toxics health benchmarks).

The Chester had the lowest concentrations for the bulk of the prevalent air toxics. The highest concentrations for most compounds were split between Elizabeth and New Brunswick, with the majority occurring at Elizabeth. Chester

Figure 3
2010 Air Toxics
Monitoring Network



had the most individual compounds detected, mainly from a collection on May 20th, 2010 that detected multiple compounds that were only found above detection limits on that particular day.

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 2010 New Jersey acrolein data in this report, the concentrations are highly uncertain and should be used with caution.

Table 2
New Jersey Air Toxics Summary – 2010

Annual Average Concentration
micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) ^a

| Pollutant | CAS # | Chester | Elizabeth Lab | New Brunswick |
|----------------------------|--------------|----------------|----------------------|----------------------|
| Acetaldehyde | 75-07-0 | 1.30 | 2.72 | 2.91 |
| Acetone | 67-64-1 | 2.34 | 3.52 | 3.34 |
| Acetonitrile | 75-05-8 | 1.21 | 1.43 | 1.69 |
| Acetylene | 74-86-2 | 0.50 | 1.12 | 0.74 |
| Acrolein ^b | 107-02-8 | 0.71 | 1.08 | 2.55 |
| Acrylonitrile | 107-13-1 | (0.04) | (0.02) | (0.14) |
| Benzaldehyde | 100-52-7 | 0.07 | 0.17 | 0.05 |
| Benzene | 71-43-2 | 0.47 | 1.00 | 0.65 |
| Bromochloromethane | 74-97-5 | (0.0009) | - | - |
| Bromodichloromethane | 75-27-4 | - | - | (0.003) |
| Bromoform | 75-25-2 | - | - | (0.0006) |
| Bromomethane | 74-83-9 | 0.03 | 0.05 | 0.04 |
| 1,3-Butadiene | 106-99-0 | (0.01) | 0.12 | 0.05 |
| Butyraldehyde | 123-72-8 | 0.20 | 0.48 | 0.23 |
| Carbon Disulfide | 75-15-0 | 12.53 | 2.85 | 1.24 |
| Carbon Tetrachloride | 56-23-5 | 0.64 | 0.60 | 0.56 |
| Chlorobenzene | 108-90-7 | - | - | 0.0007 |
| Chloroethane | 75-00-3 | (0.005) | (0.02) | 0.03 |
| Chloroform | 67-66-3 | 0.08 | 0.13 | 0.12 |
| Chloromethane | 74-87-3 | 1.24 | 1.29 | 1.28 |
| Chloromethylbenzene | 100-44-7 | (0.0008) | - | - |
| Chloroprene | 126-99-8 | - | (0.001) | - |
| Crotonaldehyde | 123-73-9 | 0.30 | 0.37 | 0.20 |
| Dibromochloromethane | 594-18-3 | (0.003) | (0.002) | (0.005) |
| 1,2-Dibromoethane | 106-93-4 | (0.001) | (0.002) | (0.0008) |
| m-Dichlorobenzene | 541-73-1 | (0.0009) | - | (0.002) |
| o-Dichlorobenzene | 95-50-1 | (0.0007) | (0.0005) | (0.002) |
| p-Dichlorobenzene | 106-46-7 | (0.01) | 0.08 | 0.05 |
| Dichlorodifluoromethane | 75-71-8 | 2.80 | 2.84 | 2.81 |
| 1,1-Dichloroethane | 75-34-3 | (0.001) | (0.0004) | (0.002) |
| 1,2-Dichloroethane | 107-06-02 | (0.02) | (0.02) | (0.02) |
| 1,1-Dichloroethene | 75-35-4 | (0.0009) | (0.002) | (0.0004) |
| cis-1,2-Dichloroethylene | 156-59-2 | (0.01) | (0.009) | - |
| trans-1,2-Dichloroethylene | 156-60-5 | (0.0006) | (0.007) | (0.01) |
| Dichloromethane | 75-09-2 | 0.41 | 0.61 | 0.75 |
| 1,2-Dichloropropane | 78-87-5 | - | - | (0.001) |
| Dichlorotetrafluoroethane | 1320-37-2 | 0.12 | 0.13 | 0.13 |
| Ethyl Acrylate | 140-88-5 | - | (0.001) | - |
| Ethyl tert-Butyl Ether | 637-92-3 | (0.0004) | - | (0.0005) |

^a Numbers in parenthesis indicate averages based on less than 50% detection and dashes represent 100% non-detects

^b Acrolein concentrations are highly uncertain because of problems with collection and analysis methods

Table 2 (Continued)
New Jersey Air Toxics Summary – 2010

Annual Average Concentration
micrograms per cubic meter ($\mu\text{g}/\text{m}^3$)^a

| Pollutant | CAS # | Chester | Elizabeth Lab | New Brunswick |
|---------------------------|--------------|----------------|----------------------|----------------------|
| Ethylbenzene | 100-41-4 | 0.09 | 0.42 | 0.22 |
| Formaldehyde | 50-00-0 | 1.63 | 4.44 | 1.63 |
| Hexachloro-1,3-butadiene | 87-68-3 | (0.001) | - | (0.002) |
| Hexaldehyde | 66-25-1 | 0.08 | 0.33 | 0.06 |
| Isovaleraldehyde | 590-86-3 | (0.0007) | - | (0.0008) |
| Methyl Ethyl Ketone | 78-93-3 | 0.73 | 1.30 | 1.25 |
| Methyl Isobutyl Ketone | 108-10-1 | 0.05 | 0.15 | 0.14 |
| Methyl Methacrylate | 80-62-6 | (0.002) | (0.04) | (0.001) |
| Methyl tert-Butyl Ether | 1634-04-4 | - | (0.003) | (0.002) |
| n-Octane | 111-65-9 | 0.06 | 0.31 | 0.14 |
| Propionaldehyde | 123-38-6 | 0.23 | 0.54 | 0.17 |
| Propylene | 115-07-1 | 0.39 | 4.37 | 0.71 |
| Styrene | 100-42-5 | 0.04 | 0.29 | 0.11 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | (0.001) | (0.0006) | (0.001) |
| Tetrachloroethylene | 127-18-4 | 0.07 | 0.20 | 0.12 |
| Tolualdehydes | | 0.07 | 0.16 | 0.05 |
| Toluene | 108-88-3 | 0.58 | 3.27 | 1.19 |
| 1,2,4-Trichlorobenzene | 102-82-1 | (0.002) | - | (0.002) |
| 1,1,1-Trichloroethane | 71-55-6 | 0.04 | 0.06 | 0.06 |
| 1,1,2-Trichloroethane | 79-00-5 | (0.009) | - | - |
| Trichloroethylene | 79-01-6 | (0.003) | (0.03) | (0.02) |
| Trichlorofluoromethane | 75-69-4 | 1.55 | 1.61 | 1.58 |
| Trichlorotrifluoroethane | 76-131 | 0.71 | 0.71 | 0.71 |
| 1,2,4-Trimethylbenzene | 95-63-6 | 0.07 | 0.43 | 0.20 |
| 1,3,5-Trimethylbenzene | 108-67-8 | 0.03 | 0.15 | 0.08 |
| Valeraldehyde | 110-62-3 | 0.07 | 0.25 | 0.06 |
| Vinyl chloride | 75-01-4 | - | (0.0002) | (0.002) |
| m,p-Xylene | 1330-20-7 | 0.17 | 1.11 | 0.53 |
| o-Xylene | 95-47-6 | 0.08 | 0.45 | 0.21 |

^a Numbers in parenthesis indicate averages based on less than 50% detection and dashes represent 100% non-detects

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 air 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.

Elizabeth Lab had eleven compounds with annual average concentrations that exceeded their health benchmarks, New Brunswick had nine and Chester had eight. The toxic air pollutants that exceeded their health benchmarks at all sites are acetaldehyde, acrolein, acrylonitrile, benzene, carbon tetrachloride, chloroform, chloromethane, and formaldehyde.

The top five toxic compounds of concern based on annual risk ratios are listed in Table 3. Formaldehyde contributed the highest risks at every site, but note that the magnitude of the risks varied substantially. Carbon

tetrachloride and acetaldehyde and were common to all four sites as well. Since the acrolein concentrations were determined to be highly uncertain, acrolein risk ratios were excluded from this table. Where available, risk ratios are displayed in Tables 5-7 for each site.

TRENDS AND COMPARISONS

The closed site in Camden was the New Jersey monitoring location that had the longest history of measuring air toxics. The graph in Figure 4 shows the change in concentrations for three of the most prevalent air toxics, benzene, toluene, and xylene, from 1990 to 2008. The graph shows that while average concentrations can vary significantly from year to year, the overall trend is downward. High individual samples may also result in high annual averages in some years. Concentrations of most air toxics have declined significantly over the last ten years. Because air toxics comprise such a large and diverse group of compounds, however, these general trends may not hold for other compounds.

Table 3
Analytes with the Five Highest Risk Ratios^{a,b,c}
at NJ’s Air Toxics Monitoring Sites in 2010

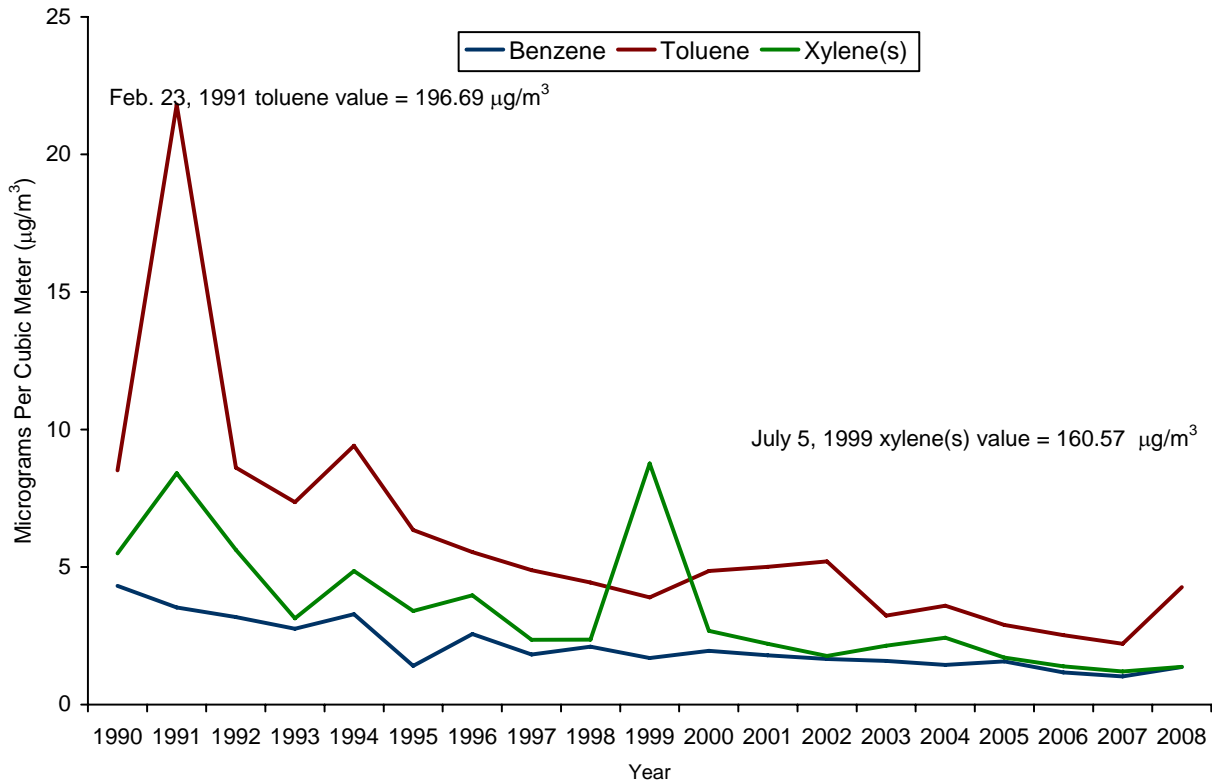
| Rank | Chester | | Elizabeth Lab | | New Brunswick | |
|------|----------------------|------------|----------------------|------------|----------------------|------------|
| | Analyte | Risk Ratio | Analyte | Risk Ratio | Analyte | Risk Ratio |
| 1 | Formaldehyde | 21 | Formaldehyde | 58 | Formaldehyde | 21 |
| 2 | Carbon Tetrachloride | 9.5 | Carbon Tetrachloride | 8.9 | Acrylonitrile | 9.4 |
| 3 | Benzene | 3.6 | Benzene | 7.7 | Carbon Tetrachloride | 8.3 |
| 4 | Acetaldehyde | 2.9 | Acetaldehyde | 6.1 | Acetaldehyde | 6.5 |
| 5 | Acrylonitrile | 2.5 | 1-3 Butadiene | 3.6 | Benzene | 5.0 |

^a The risk ratio for a chemical is a comparison of the annual mean air concentration to a long-term health benchmark.

^b The long-term 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.

^c Acrolein concentrations are highly uncertain because of problems with collection and analysis methods therefore acrolein was excluded from this table. Health benchmarks for acrolein are available in Tables 5-7.

Figure 4
Historical Annual Averages for Selected Hazardous Air
Pollutants (HAPs) at Camden from 1990-2008^a



^a Annual concentrations for Camden in 2008 calculated from data spanning January 1st to October 21st.

The graphs in Figures 5 through 8 below show concentrations of some of the air toxics in New Jersey with the highest risk ratios (see Table 3): benzene, acetaldehyde, carbon tetrachloride, and formaldehyde. These graphs compare data from our three different monitoring sites (and Camden through 2008) over the past seven or more years. (Acrolein data began to be reported in 2005.) As seen in Figures 4 and 5, benzene concentrations have been gradually decreasing over the past decade. Most benzene now comes from mobile and area sources, and is transported in from other regions. Acetaldehyde, shown in Figure 6, is also emitted primarily by on-road mobile sources such as cars.

Figure 5. Benzene Monitored Concentrations 1990-2010

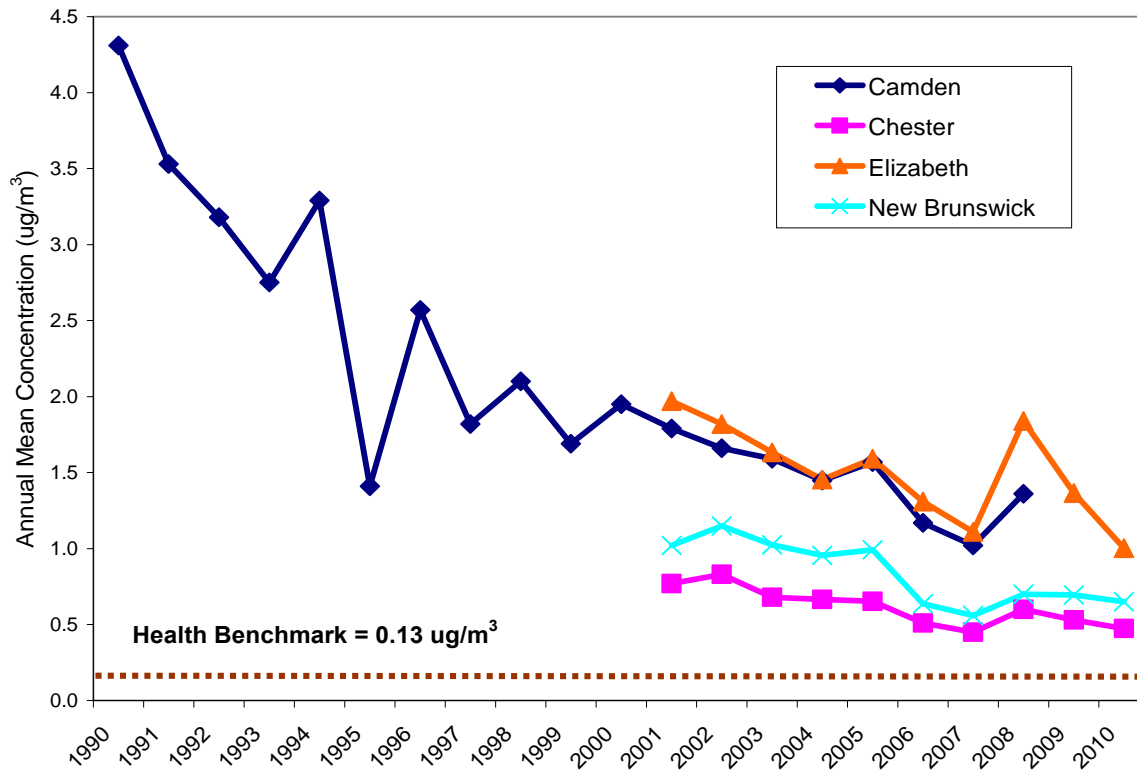
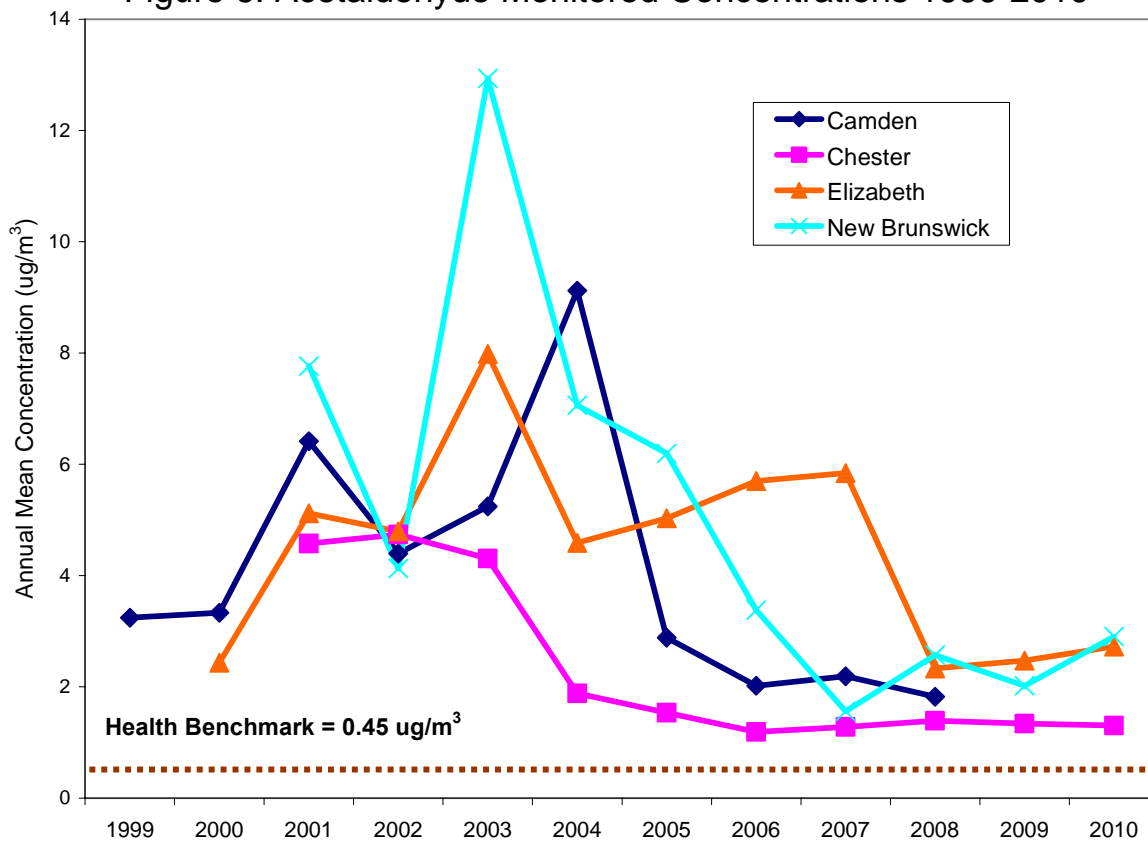
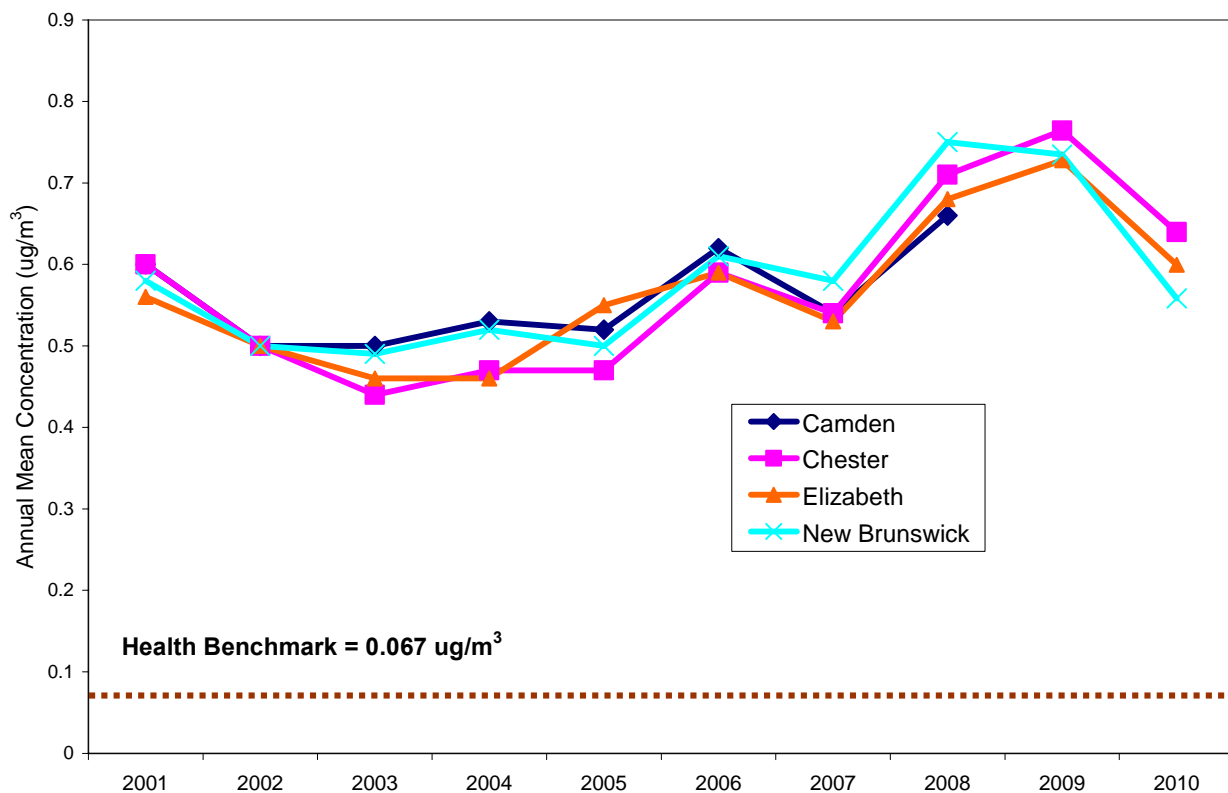


Figure 6. Acetaldehyde Monitored Concentrations 1999-2010



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

Figure 7. Carbon Tetrachloride Monitored Concentrations 2001-2010



Formaldehyde (Figure 8) 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, and urea-formaldehyde resins. In New Jersey the primary emitters of formaldehyde are on-road mobile sources, although secondary formation and transport can contribute significantly to high outdoor concentrations. Monitored concentrations in New Jersey average around 30 times over the health benchmark (thirty in a million risk level).

Figure 8. Formaldehyde Monitored Concentrations 1996-2010

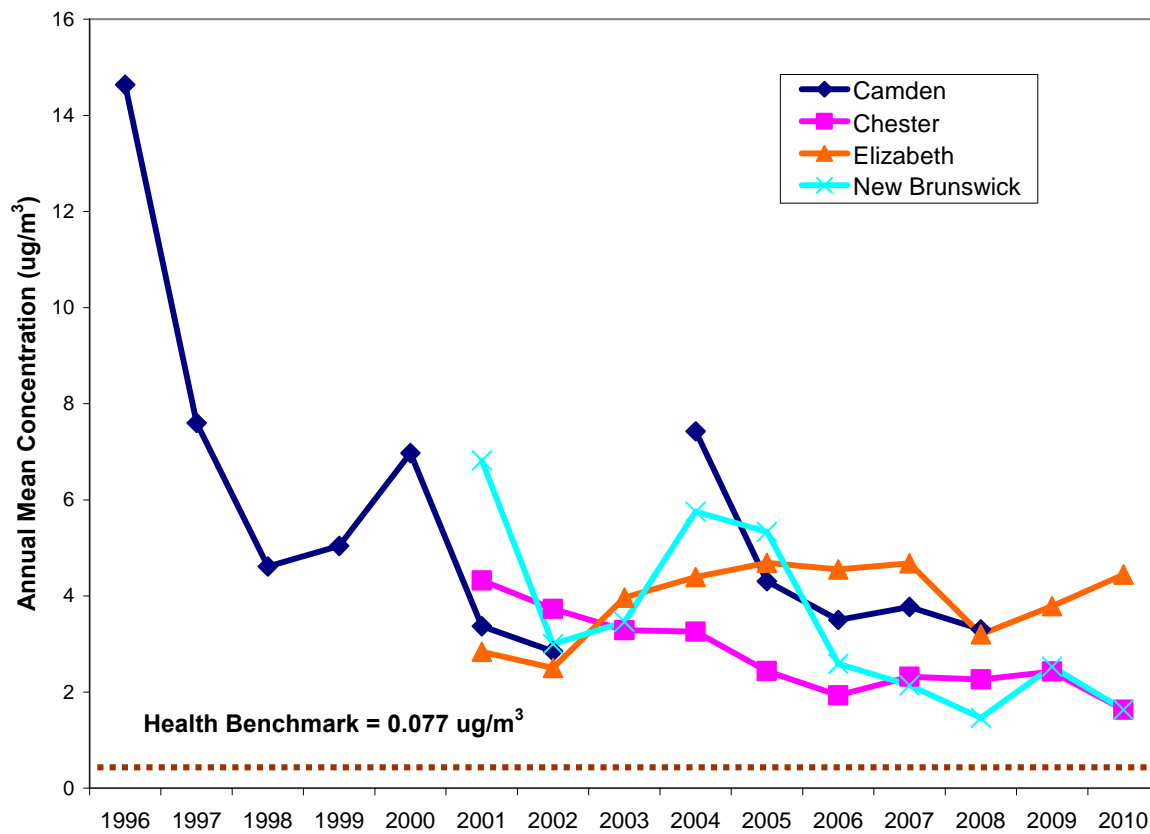


Figure 9 below shows a comparison of annual average concentrations measured at New Jersey's four air toxics monitoring sites in 2005 with annual average concentrations predicted by USEPA's 2005 NATA (at the monitoring site census tract). The comparison for five chemicals (acetaldehyde, benzene, chloromethane, ethylbenzene and formaldehyde) at all four monitoring sites shows agreement within a factor of 2 or less.

Figure 9
2005 NJ Monitored Air Toxics Concentrations
Compared to NATA Predicted Concentrations

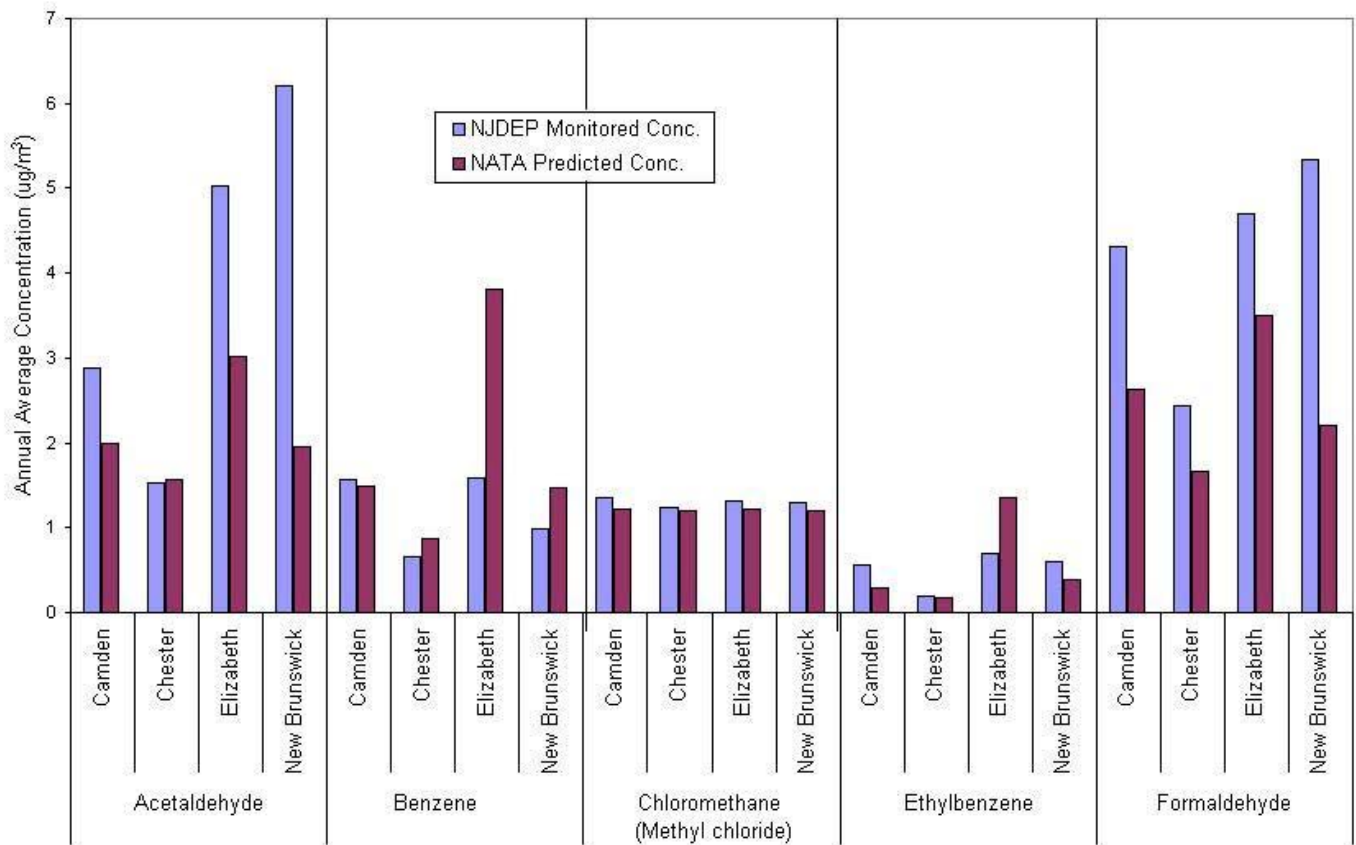


Table 4
2010 Air Toxics Data for Chester, NJ

| Analyte^a | CAS No. | Annual Mean (ppbv)^{b,c} | Annual Median (ppbv)^b | 24-Hour Max. (ppbv) | Annual Mean (µg/m³)^{b,c} | Annual Median (µg/m³)^c | 24-Hour Max. (µg/m³) | Health Benchmark (µg/m³)^d | Annual Mean Risk Ratio^e | Detection Limit (µg/m³) | % Above Minimum Detection Limit^f |
|-----------------------------|----------------|---|---|----------------------------|---|---|--|--|---|---|--|
| Acetaldehyde | 75-07-0 | 0.72 | 0.64 | 2.20 | 1.30 | 1.14 | 3.96 | 0.45 | 2.9 | 0.016 | 100 |
| Acetone | 67-64-1 | 0.98 | 0.88 | 5.68 | 2.34 | 2.08 | 13.49 | 31000 | 0.0001 | 0.019 | 100 |
| Acetonitrile | 75-05-8 | 0.72 | 0.26 | 25.70 | 1.21 | 0.44 | 43.15 | 60 | 0.02 | 0.097 | 100 |
| Acetylene | 74-86-2 | 0.47 | 0.45 | 1.11 | 0.50 | 0.48 | 1.18 | | | 0.013 | 100 |
| Acrolein^g | 107-02-8 | 0.31 | 0.14 | 4.18 | 0.71 | 0.33 | 9.58 | 0.02 | 36 | 0.034 | 95 |
| Acrylonitrile | 107-13-1 | (0.02) | 0 | 0.11 | (0.04) | 0 | 0.23 | 0.015 | 2.5 | 0.033 | 28 |
| Benzaldehyde | 100-52-7 | 0.02 | 0.01 | 0.04 | 0.07 | 0.06 | 0.19 | | | 0.009 | 100 |
| Benzene | 71-43-2 | 0.15 | 0.14 | 0.30 | 0.47 | 0.45 | 0.96 | 0.13 | 3.6 | 0.019 | 100 |
| Bromochloromethane | 74-97-5 | (0.0002) | 0 | 0.01 | (0.0009) | 0 | 0.05 | | | 0.026 | 2 |
| Bromomethane | 74-83-9 | 0.008 | 0.01 | 0.02 | 0.03 | 0.04 | 0.09 | 5 | 0.01 | 0.008 | 63 |
| 1,3-Butadiene | 106-99-0 | (0.004) | 0 | 0.03 | (0.01) | 0 | 0.06 | 0.033 | 0.3 | 0.007 | 30 |
| Butyraldehyde | 123-72-8 | 0.07 | 0.06 | 0.16 | 0.20 | 0.19 | 0.47 | | | 0.009 | 100 |
| Carbon Disulfide | 75-15-0 | 4.02 | 2.85 | 9.74 | 12.53 | 8.88 | 30.33 | 700 | 0.02 | 0.006 | 100 |
| Carbon Tetrachloride | 56-23-5 | 0.10 | 0.10 | 0.15 | 0.64 | 0.62 | 0.91 | 0.067 | 9.5 | 0.013 | 100 |
| Chloroethane | 75-00-3 | (0.002) | 0 | 0.03 | (0.005) | 0 | 0.08 | 10000 | 0.0000005 | 0.005 | 9 |
| Chloroform | 67-66-3 | 0.02 | 0.02 | 0.04 | 0.08 | 0.09 | 0.21 | 0.043 | 1.8 | 0.010 | 77 |
| Chloromethane | 74-87-3 | 0.60 | 0.59 | 0.88 | 1.24 | 1.22 | 1.82 | 0.56 | 2.2 | 0.012 | 100 |
| Chloromethylbenzene | 100-44-7 | (0.0002) | 0 | 0.009 | (0.0008) | 0 | 0.05 | 0.02 | 0.04 | 0.010 | 2 |
| Crotonaldehyde | 123-73-9 | 0.10 | 0.03 | 0.83 | 0.30 | 0.07 | 2.39 | | | 0.009 | 100 |
| Dibromochloromethane | 594-18-3 | (0.0003) | 0 | 0.009 | (0.003) | 0 | 0.09 | | | 0.010 | 4 |
| 1,2-Dibromoethane | 106-93-4 | (0.0002) | 0 | 0.008 | (0.001) | 0 | 0.06 | 0.0017 | 0.8 | 0.008 | 4 |
| m-Dichlorobenzene | 541-73-1 | (0.0002) | 0 | 0.007 | (0.0009) | 0 | 0.04 | | | 0.024 | 4 |
| o-Dichlorobenzene | 95-50-1 | (0.0001) | 0 | 0.007 | (0.0007) | 0 | 0.04 | 200 | 0.000004 | 0.024 | 2 |
| p-Dichlorobenzene | 106-46-7 | (0.002) | 0 | 0.03 | (0.01) | 0 | 0.16 | 0.091 | 0.1 | 0.024 | 21 |
| Dichlorodifluoromethane | 75-71-8 | 0.57 | 0.56 | 0.73 | 2.80 | 2.77 | 3.61 | 200 | 0.01 | 0.020 | 100 |
| 1,1-Dichloroethane | 75-34-3 | (0.0003) | 0 | 0.01 | (0.001) | 0 | 0.04 | 0.63 | 0.002 | 0.008 | 4 |
| 1,2-Dichloroethane | 107-06-2 | (0.004) | 0 | 0.02 | (0.02) | 0 | 0.09 | 0.038 | 0.4 | 0.008 | 23 |
| 1,1-Dichloroethene | 75-35-4 | (0.0002) | 0 | 0.007 | (0.0009) | 0 | 0.03 | 200 | 0.000005 | 0.012 | 4 |
| cis-1,2-Dichloroethylene | 156-59-2 | (0.002) | 0 | 0.14 | (0.01) | 0 | 0.56 | | | 0.067 | 2 |
| trans-1,2-Dichloroethylene | 156-60-5 | (0.0001) | 0 | 0.008 | (0.0006) | 0 | 0.03 | | | 0.012 | 2 |
| Dichloromethane | 75-09-2 | 0.12 | 0.09 | 0.56 | 0.41 | 0.32 | 1.94 | 2.1 | 0.2 | 0.028 | 100 |
| Dichlorotetrafluoroethane | 1320-37-2 | 0.02 | 0.02 | 0.03 | 0.12 | 0.13 | 0.17 | | | 0.007 | 100 |
| Ethyl tert-Butyl Ether | 637-92-3 | (0.00009) | 0 | 0.005 | (0.0004) | 0 | 0.02 | | | 0.029 | 2 |
| Ethylbenzene | 100-41-4 | 0.02 | 0.02 | 0.07 | 0.09 | 0.09 | 0.30 | 0.4 | 0.2 | 0.017 | 93 |
| Formaldehyde | 50-00-0 | 1.33 | 0.94 | 5.25 | 1.63 | 1.16 | 6.45 | 0.077 | 21 | 0.017 | 100 |
| Hexachloro-1,3-butadiene | 87-68-3 | (0.0001) | 0 | 0.006 | (0.001) | 0 | 0.06 | 0.045 | 0.02 | 0.128 | 2 |

Table 4 (Continued)
2010 Air Toxic Data for Chester, NJ

| Analyte^a | CAS No. | Annual Mean (ppbv)^{b,c} | Annual Median (ppbv)^b | 24-Hour Max. (ppbv) | Annual Mean ($\mu\text{g}/\text{m}^3$)^{b,c} | Annual Median ($\mu\text{g}/\text{m}^3$)^c | 24-hour Max. ($\mu\text{g}/\text{m}^3$) | Health Benchmark ($\mu\text{g}/\text{m}^3$)^d | Annual Mean Risk Ratio^e | Detection Limit ($\mu\text{g}/\text{m}^3$) | % Above Minimum Detection Limit^f |
|----------------------------|----------------|---|---|----------------------------|--|--|---|---|---|--|--|
| Hexaldehyde | 66-25-1 | 0.02 | 0.02 | 0.05 | 0.08 | 0.07 | 0.22 | | | 0.008 | 100 |
| Isovaleraldehyde | 590-86-3 | (0.0002) | 0 | 0.01 | (0.0007) | 0 | 0.04 | | | 0.007 | 2 |
| Methyl Ethyl Ketone | 78-93-3 | 0.25 | 0.23 | 0.80 | 0.73 | 0.67 | 2.35 | 5000 | 0.0001 | 0.115 | 100 |
| Methyl Isobutyl Ketone | 108-10-1 | 0.01 | 0.01 | 0.04 | 0.05 | 0.04 | 0.17 | 3000 | 0.00002 | 0.020 | 56 |
| Methyl Methacrylate | 80-62-6 | (0.0005) | 0 | 0.03 | (0.002) | 0 | 0.11 | 700 | 0.000003 | 0.099 | 2 |
| n-Octane | 111-65-9 | 0.01 | 0.02 | 0.04 | 0.06 | 0.07 | 0.19 | | | 0.019 | 68 |
| Propionaldehyde | 123-38-6 | 0.10 | 0.08 | 0.25 | 0.23 | 0.19 | 0.60 | 8 | 0.03 | 0.012 | 100 |
| Propylene | 115-07-1 | 0.22 | 0.21 | 0.62 | 0.39 | 0.36 | 1.07 | 3000 | 0.0001 | 0.064 | 100 |
| Styrene | 100-42-5 | 0.01 | 0.01 | 0.07 | 0.04 | 0.04 | 0.31 | 1.8 | 0.02 | 0.013 | 61 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | (0.0001) | 0 | 0.008 | (0.001) | 0 | 0.05 | 0.017 | 0.1 | 0.021 | 2 |
| Tetrachloroethylene | 127-18-4 | 0.01 | 0.01 | 0.05 | 0.07 | 0.07 | 0.31 | 0.17 | 0.4 | 0.020 | 67 |
| Tolualdehydes | | 0.01 | 0.01 | 0.07 | 0.07 | 0.06 | 0.35 | | | 0.029 | 63 |
| Toluene | 108-88-3 | 0.15 | 0.13 | 1.01 | 0.58 | 0.49 | 3.81 | 5000 | 0.0001 | 0.030 | 100 |
| 1,2,4-Trichlorobenzene | 102-82-1 | (0.0002) | 0 | 0.007 | (0.002) | 0 | 0.05 | 4 | 0.0004 | 0.052 | 4 |
| 1,1,1-Trichloroethane | 71-55-6 | 0.008 | 0.01 | 0.02 | 0.04 | 0.05 | 0.10 | 1000 | 0.00004 | 0.005 | 68 |
| 1,1,2-Trichloroethane | 79-00-5 | (0.0002) | 0 | 0.009 | (0.0009) | 0 | 0.05 | 0.063 | 0.01 | 0.016 | 2 |
| Trichloroethylene | 79-01-6 | (0.0006) | 0 | 0.01 | (0.003) | 0 | 0.08 | 0.5 | 0.01 | 0.011 | 7 |
| Trichlorofluoromethane | 75-69-4 | 0.28 | 0.27 | 0.36 | 1.55 | 1.53 | 2.04 | 700 | 0.002 | 0.011 | 100 |
| Trichlorotrifluoroethane | 76-131 | 0.09 | 0.09 | 0.12 | 0.71 | 0.69 | 0.93 | 30000 | 0.00002 | 0.023 | 100 |
| 1,2,4-Trimethylbenzene | 95-63-6 | 0.01 | 0.02 | 0.04 | 0.07 | 0.08 | 0.19 | | | 0.025 | 88 |
| 1,3,5-Trimethylbenzene | 108-67-8 | 0.007 | 0.007 | 0.02 | 0.03 | 0.03 | 0.08 | | | 0.020 | 72 |
| Valeraldehyde | 110-62-3 | 0.02 | 0.02 | 0.06 | 0.07 | 0.05 | 0.19 | | | 0.007 | 100 |
| m,p-Xylene | 1330-20-7 | 0.04 | 0.04 | 0.11 | 0.17 | 0.17 | 0.49 | 100 | 0.002 | 0.030 | 95 |
| o-Xylene | 95-47-6 | 0.02 | 0.02 | 0.04 | 0.08 | 0.08 | 0.19 | 100 | 0.001 | 0.013 | 86 |

^a Analytes in bold text had annual means above the long-term health benchmark.

^b Numbers in parentheses are arithmetic means (or averages) based on less than 50 percent detection.

^c 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.

^d The long-term 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.

^e 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.

^f There were 57 total VOC samples and 59 total carbonyl samples collected in 2010 in Chester.

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

Table 5
2010 Air Toxics Data for Elizabeth, NJ

| Analyte ^a | CAS No. | Annual Mean (ppbv) ^{b,c} | Annual Median (ppbv) ^b | 24-Hour Max. (ppbv) | Annual Mean ($\mu\text{g}/\text{m}^3$) ^{b,c} | Annual Median ($\mu\text{g}/\text{m}^3$) ^c | 24-Hour Max. ($\mu\text{g}/\text{m}^3$) | Long-Term Health Benchmark ($\mu\text{g}/\text{m}^3$) ^d | Annual Mean Risk Ratio ^e | Detection Limit ($\mu\text{g}/\text{m}^3$) | % Above Minimum Detection Limit ^f |
|-----------------------------|-----------|-----------------------------------|-----------------------------------|---------------------|---|---|---|--|-------------------------------------|--|--|
| Acetaldehyde | 75-07-0 | 1.51 | 1.31 | 4.70 | 2.72 | 2.36 | 8.47 | 0.45 | 6.1 | 0.016 | 100 |
| Acetone | 67-64-1 | 1.48 | 1.23 | 6.26 | 3.52 | 2.92 | 14.87 | 31000 | 0.0001 | 0.019 | 100 |
| Acetonitrile | 75-05-8 | 0.85 | 0.80 | 2.20 | 1.43 | 1.35 | 3.69 | 60 | 0.02 | 0.097 | 100 |
| Acetylene | 74-86-2 | 1.05 | 0.91 | 3.05 | 1.12 | 0.97 | 3.25 | | | 0.013 | 100 |
| Acrolein^g | 107-02-8 | 0.47 | 0.34 | 6.96 | 1.08 | 0.77 | 15.96 | 0.02 | 54 | 0.034 | 97 |
| Acrylonitrile | 107-13-1 | (0.009) | 0 | 0.09 | (0.02) | 0 | 0.20 | 0.015 | 1.3 | 0.033 | 17 |
| Benzaldehyde | 100-52-7 | 0.04 | 0.03 | 0.19 | 0.17 | 0.14 | 0.83 | | | 0.009 | 100 |
| Benzene | 71-43-2 | 0.31 | 0.29 | 0.89 | 1.00 | 0.93 | 2.83 | 0.13 | 7.7 | 0.019 | 100 |
| Bromomethane | 74-83-9 | 0.01 | 0.01 | 0.10 | 0.05 | 0.05 | 0.38 | 5 | 0.01 | 0.008 | 75 |
| 1,3-Butadiene | 106-99-0 | 0.05 | 0.05 | 0.11 | 0.12 | 0.11 | 0.25 | 0.033 | 3.6 | 0.007 | 100 |
| Butyraldehyde | 123-72-8 | 0.16 | 0.14 | 0.78 | 0.48 | 0.40 | 2.30 | | | 0.009 | 100 |
| Carbon Disulfide | 75-15-0 | 0.92 | 0.93 | 1.64 | 2.85 | 2.90 | 5.11 | 700 | 0.004 | 0.006 | 100 |
| Carbon Tetrachloride | 56-23-5 | 0.10 | 0.10 | 0.13 | 0.60 | 0.60 | 0.83 | 0.067 | 8.9 | 0.013 | 98 |
| Chloroethane | 75-00-3 | (0.006) | 0 | 0.06 | (0.02) | 0 | 0.15 | 10000 | 0.000002 | 0.005 | 29 |
| Chloroform | 67-66-3 | 0.03 | 0.03 | 0.06 | 0.13 | 0.13 | 0.28 | 0.043 | 2.9 | 0.010 | 85 |
| Chloromethane | 74-87-3 | 0.62 | 0.61 | 0.85 | 1.29 | 1.26 | 1.76 | 0.56 | 2.3 | 0.012 | 100 |
| Chloroprene | 126-99-8 | (0.0003) | 0 | 0.02 | (0.001) | 0 | 0.07 | 7 | 0.0002 | 0.011 | 2 |
| Crotonaldehyde | 123-73-9 | 0.13 | 0.05 | 0.66 | 0.37 | 0.15 | 1.90 | | | 0.009 | 100 |
| Dibromochloromethane | 594-18-3 | (0.0002) | 0 | 0.007 | (0.002) | 0 | 0.07 | | | 0.010 | 5 |
| 1,2-Dibromoethane | 106-93-4 | (0.0002) | 0 | 0.006 | (0.002) | 0 | 0.05 | 0.0017 | 0.9 | 0.008 | 3 |
| o-Dichlorobenzene | 95-50-1 | (0.00008) | 0 | 0.005 | (0.0005) | 0 | 0.03 | 200 | 0.000003 | 0.024 | 2 |
| p-Dichlorobenzene | 106-46-7 | 0.01 | 0.01 | 0.05 | 0.08 | 0.08 | 0.29 | 0.091 | 0.9 | 0.024 | 69 |
| Dichlorodifluoromethane | 75-71-8 | 0.57 | 0.57 | 0.84 | 2.84 | 2.79 | 4.16 | 200 | 0.01 | 0.020 | 100 |
| 1,1-Dichloroethane | 75-34-3 | (0.0001) | 0 | 0.006 | (0.0004) | 0 | 0.02 | 0.63 | 0.001 | 0.008 | 2 |
| 1,2-Dichloroethane | 107-06-2 | (0.004) | 0 | 0.03 | (0.02) | 0 | 0.11 | 0.038 | 0.4 | 0.008 | 19 |
| 1,1-Dichloroethene | 75-35-4 | (0.0006) | 0 | 0.02 | (0.002) | 0 | 0.09 | 200 | 0.00001 | 0.012 | 5 |
| cis-1,2-Dichloroethylene | 156-59-2 | (0.002) | 0 | 0.14 | (0.009) | 0 | 0.56 | | | 0.067 | 2 |
| trans-1,2-Dichloroethylene | 156-60-5 | (0.002) | 0 | 0.09 | (0.007) | 0 | 0.35 | | | 0.012 | 5 |
| Dichloromethane | 75-09-2 | 0.17 | 0.15 | 0.46 | 0.61 | 0.54 | 1.60 | 2.1 | 0.3 | 0.028 | 100 |
| Dichlorotetrafluoroethane | 1320-37-2 | 0.02 | 0.02 | 0.03 | 0.13 | 0.13 | 0.17 | | | 0.007 | 100 |
| Ethyl Acrylate | 140-88-5 | (0.0003) | 0 | 0.02 | (0.001) | 0 | 0.08 | 2 | 0.001 | 0.025 | 2 |
| Ethylbenzene | 100-41-4 | 0.10 | 0.09 | 0.18 | 0.42 | 0.41 | 0.79 | 0.4 | 1.0 | 0.017 | 100 |
| Formaldehyde | 50-00-0 | 3.62 | 3.08 | 12.00 | 4.44 | 3.78 | 14.74 | 0.077 | 58 | 0.017 | 100 |
| Hexaldehyde | 66-25-1 | 0.08 | 0.05 | 0.89 | 0.33 | 0.18 | 3.63 | | | 0.008 | 100 |
| Methyl Ethyl Ketone | 78-93-3 | 0.44 | 0.38 | 1.33 | 1.30 | 1.11 | 3.92 | 5000 | 0.0003 | 0.115 | 100 |

Table 5 (Continued)
2010 Air Toxics Data for Elizabeth, NJ

| Analyte ^a | CAS No. | Annual Mean (ppbv) ^{b,c} | Annual Median (ppbv) ^b | 24-Hour Max. (ppbv) | Annual Mean ($\mu\text{g}/\text{m}^3$) ^{b,c} | Annual Median ($\mu\text{g}/\text{m}^3$) ^c | 24-Hour Max. ($\mu\text{g}/\text{m}^3$) | Long-Term Health Benchmark ($\mu\text{g}/\text{m}^3$) ^d | Annual Mean Risk Ratio ^e | Detection Limit ($\mu\text{g}/\text{m}^3$) | % Above Minimum Detection Limit ^f |
|----------------------------|-----------|-----------------------------------|-----------------------------------|---------------------|---|---|---|--|-------------------------------------|--|--|
| Methyl Isobutyl Ketone | 108-10-1 | 0.04 | 0.03 | 0.15 | 0.15 | 0.14 | 0.63 | 3000 | 0.0001 | 0.020 | 95 |
| Methyl Methacrylate | 80-62-6 | 0.01 | 0 | 0.25 | 0.04 | 0 | 0.89 | 700 | 0.0001 | 0.099 | 14 |
| Methyl tert-Butyl Ether | 1634-04-4 | (0.0007) | 0 | 0.03 | (0.003) | 0 | 0.11 | 3.8 | 0.001 | 0.050 | 3 |
| n-Octane | 111-65-9 | 0.07 | 0.06 | 0.17 | 0.31 | 0.28 | 0.80 | | | 0.019 | 97 |
| Propionaldehyde | 123-38-6 | 0.23 | 0.20 | 0.74 | 0.54 | 0.46 | 1.76 | 8 | 0.1 | 0.012 | 100 |
| Propylene | 115-07-1 | 2.54 | 0.88 | 66.00 | 4.37 | 1.52 | 113.59 | 3000 | 0.001 | 0.064 | 100 |
| Styrene | 100-42-5 | 0.07 | 0.06 | 0.25 | 0.29 | 0.26 | 1.05 | 1.8 | 0.2 | 0.013 | 100 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | (0.00008) | 0 | 0.005 | (0.0006) | 0 | 0.03 | 0.017 | 0.03 | 0.021 | 2 |
| Tetrachloroethylene | 127-18-4 | 0.03 | 0.02 | 0.07 | 0.20 | 0.16 | 0.47 | 0.17 | 1.2 | 0.020 | 97 |
| Tolualdehydes | | 0.03 | 0.03 | 0.14 | 0.16 | 0.14 | 0.68 | | | 0.029 | 86 |
| Toluene | 108-88-3 | 0.87 | 0.78 | 2.11 | 3.27 | 2.94 | 7.95 | 5000 | 0.001 | 0.030 | 100 |
| 1,1,1-Trichloroethane | 71-55-6 | 0.01 | 0.01 | 0.02 | 0.06 | 0.06 | 0.11 | 1000 | 0.0001 | 0.005 | 81 |
| Trichloroethylene | 79-01-6 | (0.005) | 0 | 0.04 | (0.03) | 0 | 0.21 | 0.5 | 0.1 | 0.011 | 36 |
| Trichlorofluoromethane | 75-69-4 | 0.29 | 0.29 | 0.44 | 1.61 | 1.60 | 2.49 | 700 | 0.002 | 0.011 | 100 |
| Trichlorotrifluoroethane | 76-131 | 0.09 | 0.09 | 0.13 | 0.71 | 0.71 | 0.97 | 30000 | 0.00002 | 0.023 | 100 |
| 1,2,4-Trimethylbenzene | 95-63-6 | 0.09 | 0.08 | 0.20 | 0.43 | 0.41 | 0.96 | | | 0.025 | 100 |
| 1,3,5-Trimethylbenzene | 108-67-8 | 0.03 | 0.03 | 0.06 | 0.15 | 0.15 | 0.31 | | | 0.020 | 100 |
| Valeraldehyde | 110-62-3 | 0.07 | 0.05 | 0.57 | 0.25 | 0.17 | 1.99 | | | 0.007 | 100 |
| Vinyl chloride | 75-01-4 | (0.00008) | 0 | 0.005 | (0.0002) | 0 | 0.01 | 0.11 | 0.002 | 0.005 | 2 |
| m,p-Xylene | 1330-20-7 | 0.26 | 0.26 | 0.53 | 1.11 | 1.13 | 2.31 | 100 | 0.01 | 0.030 | 100 |

^a Analytes in bold text had annual means above the long-term health benchmark.

^b Numbers in parentheses are arithmetic means (or averages) based on less than 50 percent detection.

^c 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.

^d The long-term 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.

^e 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.

^f There were 59 total VOC samples and 59 total carbonyl samples collected in 2010 in Elizabeth.

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

Table 6
2010 Air Toxics Data for New Brunswick, NJ

| Analyte ^a | CAS No. | Annual Mean (ppbv) ^{b,c} | Annual Median (ppbv) ^b | 24-Hour Max. (ppbv) | Annual Mean ($\mu\text{g}/\text{m}^3$) ^{b,c} | Annual Median ($\mu\text{g}/\text{m}^3$) ^c | 24-Hour Max. ($\mu\text{g}/\text{m}^3$) | Long-Term Health Benchmark ($\mu\text{g}/\text{m}^3$) ^d | Annual Mean Risk Ratio ^e | Detection Limit ($\mu\text{g}/\text{m}^3$) | % Above Minimum Detection Limit ^f |
|-----------------------------|-----------|-----------------------------------|-----------------------------------|---------------------|---|---|---|--|-------------------------------------|--|--|
| Acetaldehyde | 75-07-0 | 1.61 | 1.47 | 3.77 | 2.91 | 2.64 | 6.79 | 0.45 | 6.5 | 0.016 | 100 |
| Acetone | 67-64-1 | 1.41 | 1.28 | 2.64 | 3.34 | 3.03 | 6.27 | 31000 | 0.0001 | 0.019 | 100 |
| Acetonitrile | 75-05-8 | 1.00 | 0.42 | 15.90 | 1.69 | 0.70 | 26.70 | 60 | 0.03 | 0.097 | 100 |
| Acetylene | 74-86-2 | 0.69 | 0.60 | 2.10 | 0.74 | 0.64 | 2.23 | | | 0.013 | 100 |
| Acrolein^g | 107-02-8 | 1.11 | 0.30 | 41.60 | 2.55 | 0.69 | 95.39 | 0.02 | 128 | 0.034 | 100 |
| Acrylonitrile | 107-13-1 | (0.06) | 0 | 1.36 | (0.14) | 0 | 2.95 | 0.015 | 9.4 | 0.033 | 42 |
| Benzaldehyde | 100-52-7 | 0.01 | 0.01 | 0.07 | 0.05 | 0.05 | 0.28 | | | 0.009 | 76 |
| Benzene | 71-43-2 | 0.20 | 0.20 | 0.39 | 0.65 | 0.63 | 1.25 | 0.13 | 5.0 | 0.019 | 100 |
| Bromodichloromethane | 75-27-4 | (0.0005) | 0 | 0.01 | (0.003) | 0 | 0.08 | | | 0.013 | 5 |
| Bromoform | 75-25-2 | (0.00005) | 0 | 0.003 | (0.0006) | 0 | 0.03 | 0.91 | 0.001 | 0.021 | 2 |
| Bromomethane | 74-83-9 | 0.01 | 0.01 | 0.03 | 0.04 | 0.04 | 0.13 | 5 | 0.01 | 0.008 | 76 |
| 1,3-Butadiene | 106-99-0 | 0.02 | 0.02 | 0.08 | 0.05 | 0.04 | 0.18 | 0.033 | 1.5 | 0.007 | 96 |
| Butyraldehyde | 123-72-8 | 0.08 | 0.06 | 0.60 | 0.23 | 0.19 | 1.78 | | | 0.009 | 100 |
| Carbon Disulfide | 75-15-0 | 0.40 | 0.33 | 2.35 | 1.24 | 1.01 | 7.32 | 700 | 0.002 | 0.006 | 100 |
| Carbon Tetrachloride | 56-23-5 | 0.09 | 0.09 | 0.15 | 0.56 | 0.57 | 0.92 | 0.067 | 8.3 | 0.013 | 98 |
| Chlorobenzene | 108-90-7 | (0.0001) | 0 | 0.008 | (0.0007) | 0 | 0.04 | 1000 | 0.000001 | 0.009 | 2 |
| Chloroethane | 75-00-3 | (0.01) | 0 | 0.15 | (0.03) | 0 | 0.40 | 10000 | 0.000003 | 0.005 | 33 |
| Chloroform | 67-66-3 | 0.02 | 0.02 | 0.08 | 0.12 | 0.12 | 0.39 | 0.043 | 2.8 | 0.010 | 87 |
| Chloromethane | 74-87-3 | 0.62 | 0.61 | 0.83 | 1.28 | 1.25 | 1.71 | 0.56 | 2.3 | 0.012 | 100 |
| Crotonaldehyde | 123-73-9 | 0.07 | 0.03 | 0.28 | 0.20 | 0.09 | 0.81 | | | 0.009 | 97 |
| Dibromochloromethane | 594-18-3 | (0.0005) | 0 | 0.01 | (0.005) | 0 | 0.10 | | | 0.010 | 11 |
| 1,2-Dibromoethane | 106-93-4 | (0.0001) | 0 | 0.006 | (0.0008) | 0 | 0.05 | 0.0017 | 0.5 | 0.008 | 2 |
| m-Dichlorobenzene | 541-73-1 | (0.0004) | 0 | 0.007 | (0.002) | 0 | 0.04 | | | 0.024 | 7 |
| o-Dichlorobenzene | 95-50-1 | (0.0003) | 0 | 0.007 | (0.002) | 0 | 0.04 | 200 | 0.00001 | 0.024 | 7 |
| p-Dichlorobenzene | 106-46-7 | 0.008 | 0.009 | 0.02 | 0.05 | 0.05 | 0.14 | 0.091 | 0.5 | 0.024 | 58 |
| Dichlorodifluoromethane | 75-71-8 | 0.57 | 0.57 | 0.68 | 2.81 | 2.84 | 3.36 | 200 | 0.01 | 0.020 | 100 |
| 1,1-Dichloroethane | 75-34-3 | (0.0004) | 0 | 0.01 | (0.002) | 0 | 0.04 | 0.63 | 0.003 | 0.008 | 5 |
| 1,2-Dichloroethane | 107-06-2 | (0.004) | 0 | 0.02 | (0.02) | 0 | 0.10 | 0.038 | 0.4 | 0.008 | 20 |
| 1,1-Dichloroethene | 75-35-4 | (0.0001) | 0 | 0.006 | (0.0004) | 0 | 0.02 | 200 | 0.000002 | 0.012 | 2 |
| trans-1,2-Dichloroethylene | 156-60-5 | (0.004) | 0 | 0.21 | (0.01) | 0 | 0.82 | | | 0.012 | 2 |
| Dichloromethane | 75-09-2 | 0.22 | 0.15 | 1.27 | 0.75 | 0.50 | 4.41 | 2.1 | 0.4 | 0.028 | 100 |
| 1,2-Dichloropropane | 78-87-5 | (0.0002) | 0 | 0.01 | (0.001) | 0 | 0.06 | 0.1 | 0.01 | 0.014 | 2 |
| Dichlorotetrafluoroethane | 1320-37-2 | 0.02 | 0.02 | 0.03 | 0.13 | 0.13 | 0.17 | | | 0.007 | 100 |
| Ethyl tert-Butyl Ether | 637-92-3 | (0.0001) | 0 | 0.006 | (0.0005) | 0 | 0.03 | | | 0.029 | 2 |
| Ethylbenzene | 100-41-4 | 0.05 | 0.05 | 0.14 | 0.22 | 0.20 | 0.62 | 0.4 | 0.6 | 0.017 | 100 |

Table 6 (Continued)
2009 Air Toxics Data for New Brunswick, NJ

| Analyte ^a | Cas # | Annual Mean (ppbv) ^{b,c} | Annual Median (ppbv) ^b | 24-Hour Max. (ppbv) | Annual Mean (µg/m ³) ^{b,c} | Annual Median (µg/m ³) ^c | 24-Hour Max. (µg/m ³) | Long-Term Health Benchmark (µg/m ³) ^d | Annual Mean Risk Ratio ^e | Detection Limit (µg/m ³) | % Above Minimum Detection Limit ^f |
|---------------------------|-----------|-----------------------------------|-----------------------------------|---------------------|---|---|-----------------------------------|--|-------------------------------------|--------------------------------------|--|
| Formaldehyde | 50-00-0 | 1.33 | 1.11 | 3.91 | 1.63 | 1.36 | 4.80 | 0.077 | 21 | 0.017 | 100 |
| Hexachloro-1,3-butadiene | 87-68-3 | (0.0001) | 0 | 0.008 | (0.002) | 0 | 0.09 | 0.045 | 0.03 | 0.128 | 2 |
| Hexaldehyde | 66-25-1 | 0.01 | 0.01 | 0.05 | 0.06 | 0.06 | 0.21 | | | 0.008 | 83 |
| Isovaleraldehyde | 590-86-3 | (0.0002) | 0 | 0.01 | (0.0008) | 0 | 0.05 | | | 0.007 | 2 |
| Methyl Ethyl Ketone | 78-93-3 | 0.43 | 0.37 | 1.41 | 1.25 | 1.09 | 4.15 | 5000 | 0.0003 | 0.115 | 100 |
| Methyl Isobutyl Ketone | 108-10-1 | 0.03 | 0.02 | 0.31 | 0.14 | 0.10 | 1.27 | 3000 | 0.00005 | 0.020 | 84 |
| Methyl Methacrylate | 80-62-6 | (0.0004) | 0 | 0.01 | (0.001) | 0 | 0.05 | 700 | 0.000002 | 0.099 | 4 |
| Methyl tert-Butyl Ether | 1634-04-4 | (0.0005) | 0 | 0.02 | (0.002) | 0 | 0.07 | 3.8 | 0.0005 | 0.050 | 4 |
| n-Octane | 111-65-9 | 0.03 | 0.03 | 0.06 | 0.14 | 0.14 | 0.28 | | | 0.019 | 87 |
| Propionaldehyde | 123-38-6 | 0.07 | 0.06 | 0.27 | 0.17 | 0.14 | 0.64 | 8 | 0.02 | 0.012 | 100 |
| Propylene | 115-07-1 | 0.41 | 0.39 | 1.09 | 0.71 | 0.67 | 1.88 | 3000 | 0.0002 | 0.064 | 100 |
| Styrene | 100-42-5 | 0.03 | 0.02 | 0.15 | 0.11 | 0.10 | 0.62 | 1.8 | 0.1 | 0.013 | 96 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | (0.0002) | 0 | 0.009 | (0.001) | 0 | 0.06 | 0.017 | 0.1 | 0.021 | 2 |
| Tetrachloroethylene | 127-18-4 | 0.02 | 0.02 | 0.04 | 0.12 | 0.12 | 0.26 | 0.17 | 0.7 | 0.020 | 95 |
| Tolualdehydes | | 0.01 | 0.004 | 0.06 | 0.05 | 0.02 | 0.30 | | | 0.029 | 50 |
| Toluene | 108-88-3 | 0.32 | 0.25 | 1.52 | 1.19 | 0.95 | 5.73 | 5000 | 0.0002 | 0.030 | 100 |
| 1,2,4-Trichlorobenzene | 102-82-1 | (0.0002) | 0 | 0.007 | (0.002) | 0 | 0.05 | 4 | 0.0004 | 0.052 | 4 |
| 1,1,1-Trichloroethane | 71-55-6 | 0.01 | 0.01 | 0.04 | 0.06 | 0.06 | 0.20 | 1000 | 0.0001 | 0.005 | 82 |
| Trichloroethylene | 79-01-6 | (0.003) | 0 | 0.02 | (0.02) | 0 | 0.09 | 0.5 | 0.03 | 0.011 | 33 |
| Trichlorofluoromethane | 75-69-4 | 0.28 | 0.28 | 0.36 | 1.58 | 1.58 | 2.01 | 700 | 0.002 | 0.011 | 100 |
| Trichlorotrifluoroethane | 76-131 | 0.09 | 0.09 | 0.12 | 0.71 | 0.70 | 0.90 | 30000 | 0.00002 | 0.023 | 100 |
| 1,2,4-Trimethylbenzene | 95-63-6 | 0.04 | 0.04 | 0.08 | 0.20 | 0.19 | 0.41 | | | 0.025 | 100 |
| 1,3,5-Trimethylbenzene | 108-67-8 | 0.02 | 0.02 | 0.03 | 0.08 | 0.07 | 0.15 | | | 0.020 | 98 |
| Valeraldehyde | 110-62-3 | 0.02 | 0.02 | 0.04 | 0.06 | 0.06 | 0.12 | | | 0.007 | 95 |
| Vinyl chloride | 75-01-4 | (0.0007) | 0 | 0.01 | (0.002) | 0 | 0.03 | 0.11 | 0.02 | 0.005 | 11 |
| m,p-Xylene | 1330-20-7 | 0.12 | 0.10 | 0.33 | 0.53 | 0.44 | 1.42 | 100 | 0.01 | 0.030 | 100 |
| o-Xylene | 95-47-6 | 0.05 | 0.04 | 0.12 | 0.21 | 0.17 | 0.51 | 100 | 0.002 | 0.013 | 100 |

^a Analytes in bold text had annual means above the long-term health benchmark.

^b Numbers in parentheses are arithmetic means (or averages) based on less than 50 percent detection.

^c 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.

^d The long-term 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/agpp/risk.html.

^e 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.

^f There were 55 total VOC samples and 58 total carbonyl samples collected in 2010 in New Brunswick.

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

Table 7
Analytes with 100 Percent Non-Detects in 2010

| Analyte | CAS # | Detection Limit ($\mu\text{g}/\text{m}^3$) | Location | | |
|---------------------------|-----------|--|----------|-----------|---------------|
| | | | Chester | Elizabeth | New Brunswick |
| tert-Amyl Methyl Ether | 994-05-8 | 0.029 | X | X | X |
| Bromochloromethane | 74-97-5 | 0.026 | | X | X |
| Bromodichloromethane | 75-27-4 | 0.013 | X | X | |
| Bromoform | 75-25-2 | 0.021 | X | X | |
| Chlorobenzene | 108-90-7 | 0.009 | X | X | |
| Chloromethylbenzene | 100-44-7 | 0.010 | | X | X |
| Chloroprene | 126-99-8 | 0.011 | X | | X |
| m-Dichlorobenzene | 541-73-1 | 0.024 | | X | |
| cis-1,2-Dichloroethylene | 156-59-2 | 0.067 | | | X |
| 1,2-Dichloropropane | 78-87-5 | 0.014 | X | X | |
| cis-1,3-Dichloropropene | 542-75-6 | 0.014 | X | X | X |
| trans-1,3-Dichloropropene | 542-75-6 | 0.014 | X | X | X |
| 2,5-Dimethylbenzaldehyde | 5799-94-2 | 0.005 | X | X | X |
| Ethyl Acrylate | 140-88-5 | 0.025 | X | | X |
| Ethyl tert-Butyl Ether | 637-92-3 | 0.029 | | X | |
| Hexachloro-1,3-butadiene | 87-68-3 | 0.128 | | X | |
| Isovaleraldehyde | 590-86-3 | 0.007 | | X | |
| Methyl tert-Butyl Ether | 1634-04-4 | 0.050 | X | | |
| 1,2,4-Trichlorobenzene | 102-82-1 | 0.052 | | X | |
| 1,1,2-Trichloroethane | 79-00-5 | 0.016 | | X | X |
| Vinyl chloride | 75-01-4 | 0.005 | X | | |

In 2010, 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.

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2010 Atmospheric Deposition Summary

New Jersey Department of Environmental Protection

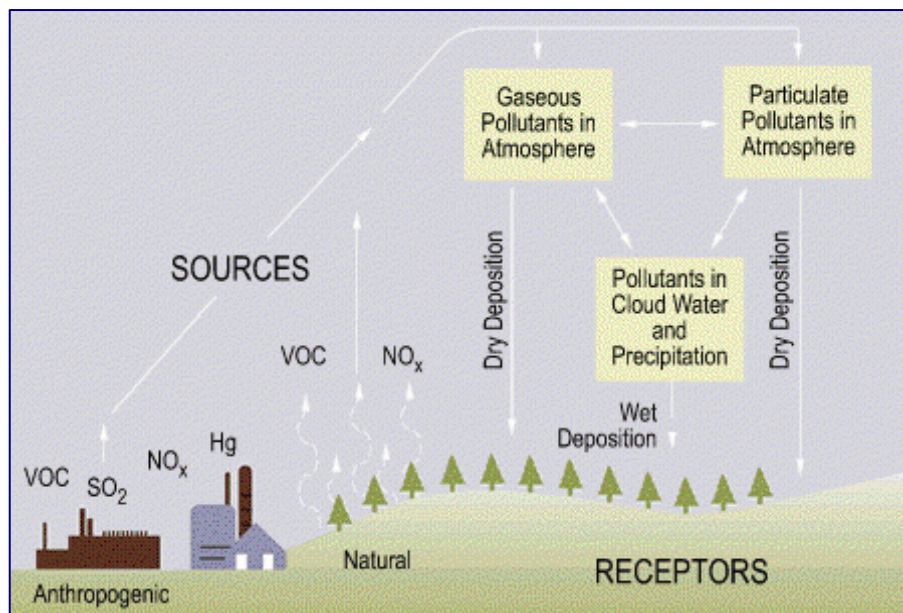
NATURE AND SOURCES

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 www.state.nj.us/dep/dsr/njmainfish.htm. VOCs are a very diverse group of compounds, some of which are toxic, including known carcinogens.

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.

Figure 1



Source: USEPA Clean Air Markets

Web Site: <http://www.epa.gov/airmarkets/acidrain/index.html#what>

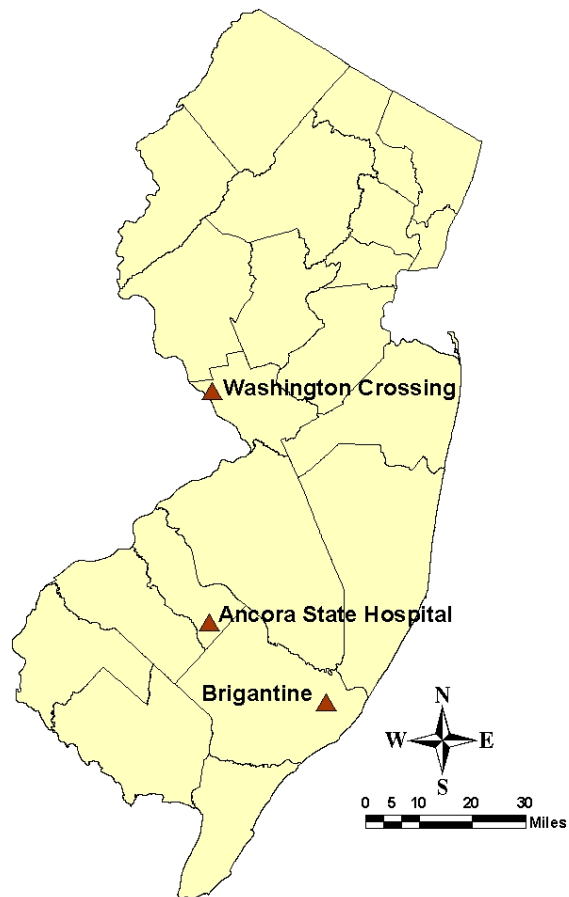
MONITORING LOCATIONS

Figure 2 shows the three active deposition monitoring sites in New Jersey for 2010: Washington Crossing State Park, Ancora State Hospital, 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.

Washington Crossing State Park 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. 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, 2010)

In addition to the NADP sites, the State also collects samples from a weekly sampler at the Ancora State Hospital site in Camden County. These samples are normally analyzed at the Department's own laboratory. Because of ongoing equipment issues, these additional samples are not being analyzed by the State.

Figure 2
Acid Precipitation Monitoring
Network - 2010



SUMMARY OF 2010 DATA

A summary of the 2010 wet deposition data is provided in Table 1. Raw data was obtained from the NADP website (NADP, 2010). 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 value recorded at the Washington Crossing State Park weekly sampler was 4.94 and the Edwin B.

Forsythe NWR sampler recorded a mean pH of 4.93.

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 - 2010
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 | 38.43 | 4.97 | 17.96 | 0.094 | 0.190 | 0.070 | 1.643 | 0.101 | 0.448 | 2.904 | 0.865 |
| Spring | 32.46 | 5.28 | 20.33 | 0.192 | 0.252 | 0.099 | 2.138 | 0.241 | 0.543 | 3.711 | 1.106 |
| Summer | 13.69 | 4.58 | 18.95 | 0.150 | 0.063 | 0.096 | 0.414 | 0.398 | 1.238 | 0.790 | 1.633 |
| Fall | 25.30 | 4.87 | 14.63 | 0.212 | 0.076 | 0.050 | 0.480 | 0.398 | 1.153 | 0.887 | 1.344 |
| Annual | 95.56 | 4.93 | 19.64 | 0.169 | 0.188 | 0.088 | 1.554 | 0.258 | 0.768 | 2.746 | 1.208 |

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 | 32.77 | 5.01 | 7.05 | 0.042 | 0.020 | 0.019 | 0.221 | 0.058 | 0.434 | 0.396 | 0.368 |
| Spring | 37.16 | 5.07 | 8.37 | 0.091 | 0.036 | 0.043 | 0.254 | 0.218 | 0.595 | 0.499 | 0.660 |
| Summer | 12.20 | 4.65 | 15.22 | 0.107 | 0.034 | 0.029 | 0.156 | 0.347 | 1.240 | 0.294 | 1.252 |
| Fall | 23.37 | 4.93 | 9.47 | 0.116 | 0.026 | 0.020 | 0.112 | 0.259 | 0.837 | 0.204 | 0.879 |
| Annual | 96.63 | 4.94 | 9.42 | 0.086 | 0.033 | 0.034 | 0.227 | 0.208 | 0.705 | 0.429 | 0.718 |

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).

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.sws.uiuc.edu/ . | |

Figure 3
Sulfate (SO₄) NADP/NTN Site NJ99 (Washington Crossing State Park)
Annual Wet Depositions (1981 - 2010)
Kilograms Per Hectare (kg/ha)

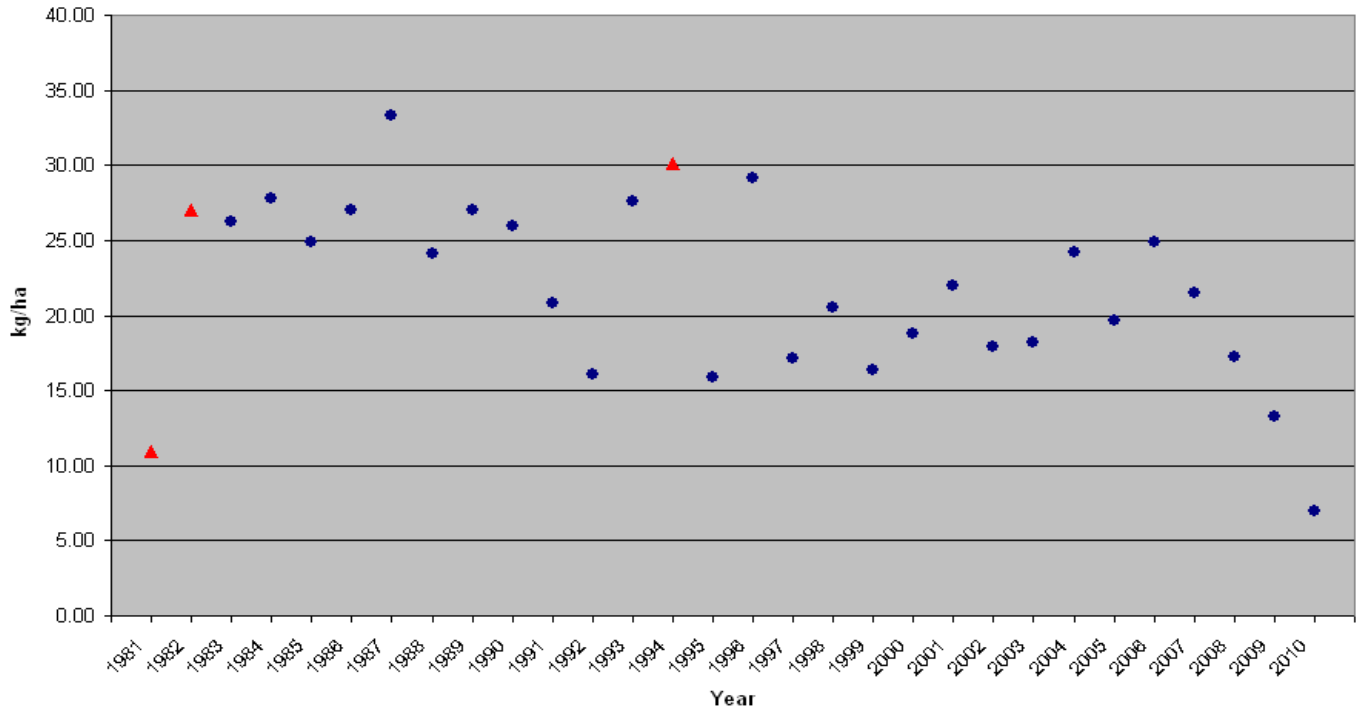


Figure 4
Sulfate (SO₄) NADP/NTN Site NJ00 (Edwin B. Forsythe National Wildlife Refuge)
Annual Wet Depositions (1998 - 2010)
Kilograms Per Hectare (kg/ha)

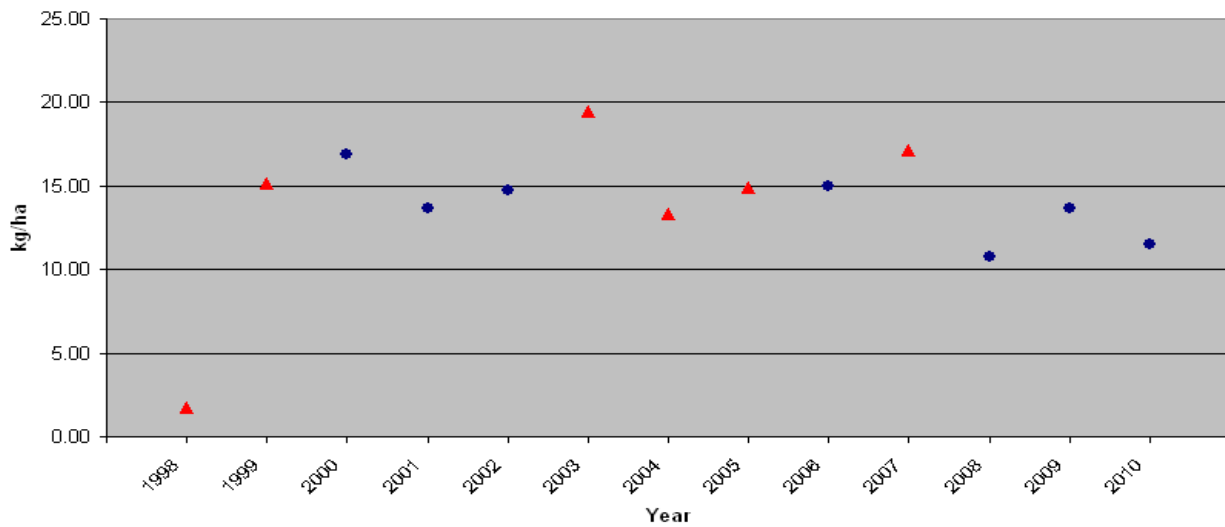


Figure 5
Ammonium (NH₄) NADP/NTN Site NJ99 (Washington Crossing State Park)
Annual Wet Depositions (1981 - 2010)
Kilograms Per Hectare (kg/ha)

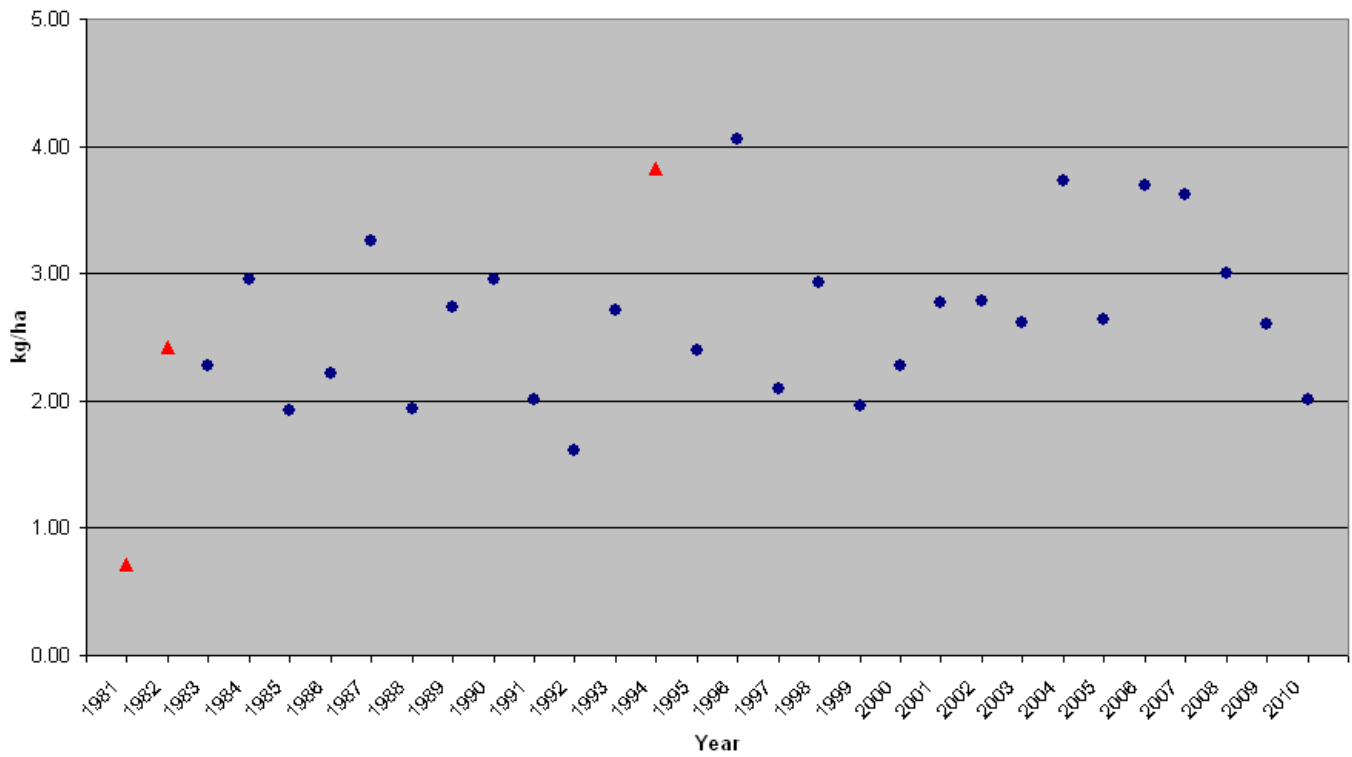


Figure 6
Ammonium (NH₄) NADP/NTN Site NJ00 (Edwin B. Forsythe National Wildlife Refuge)
Annual Wet Depositions (1998 - 2010)
Kilograms Per Hectare (kg/ha)

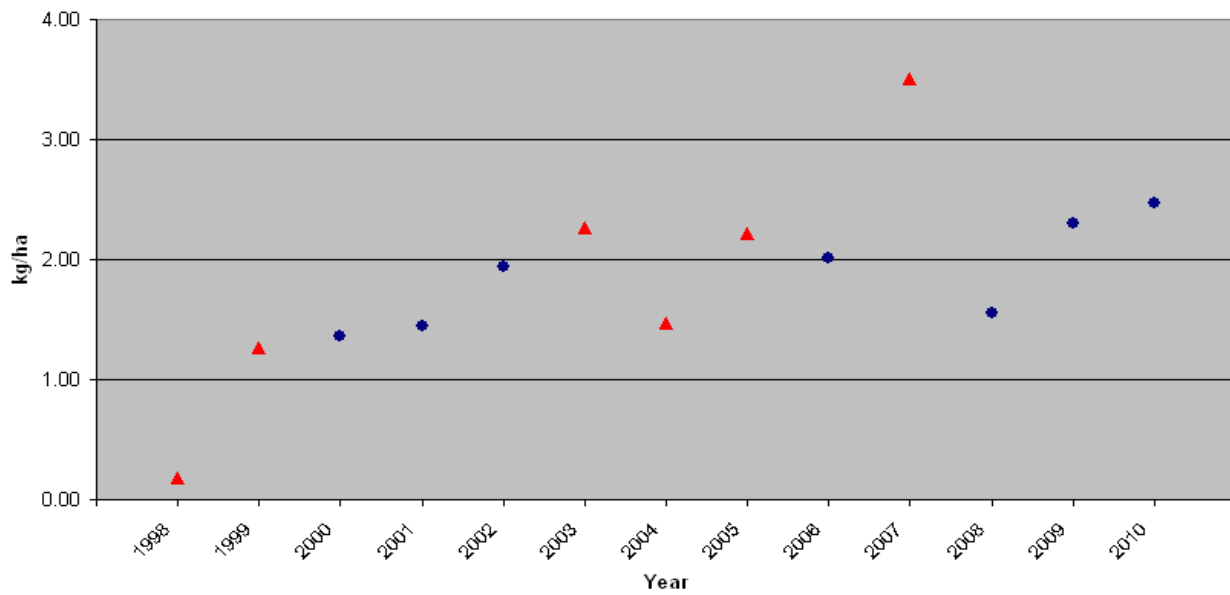


Figure 7
 Nitrate (NO₃) NADP/NTN Site NJ99 (Washington Crossing State Park)
 Annual Wet Depositions (1981 - 2010)
 Kilograms Per Hectare (kg/ha)

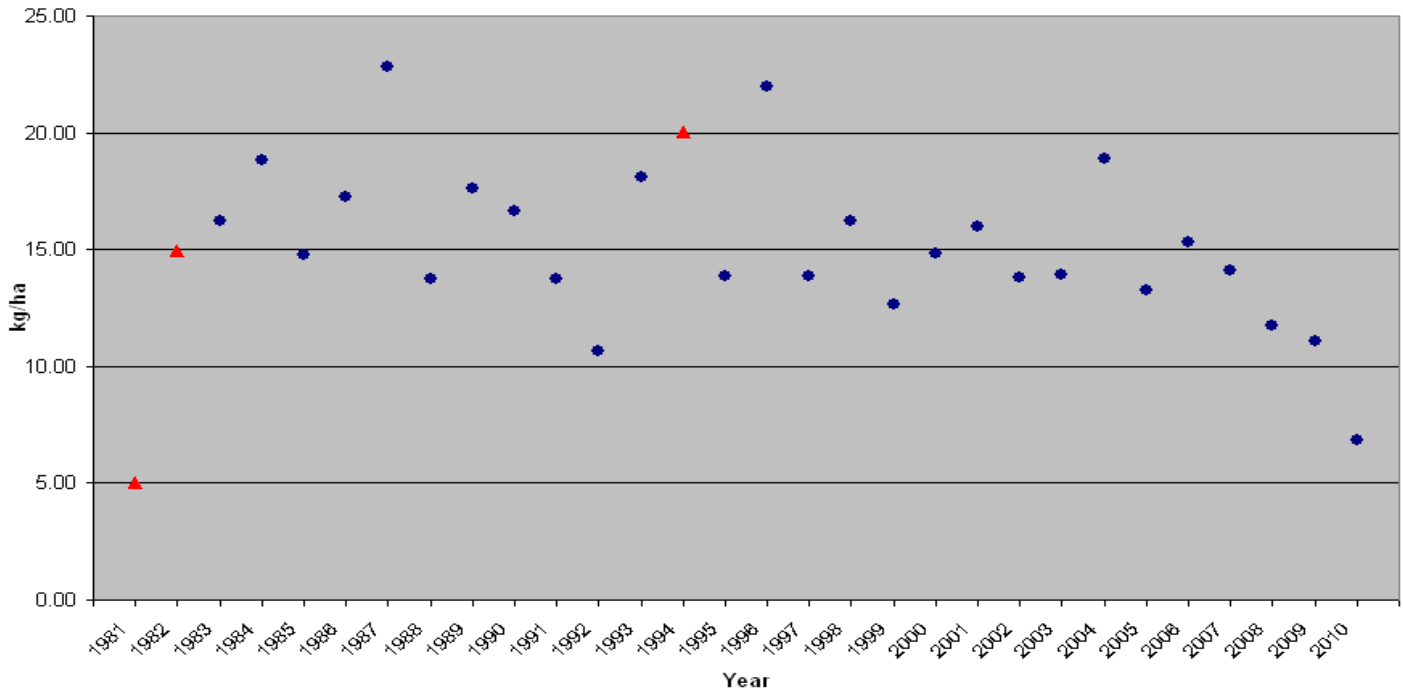
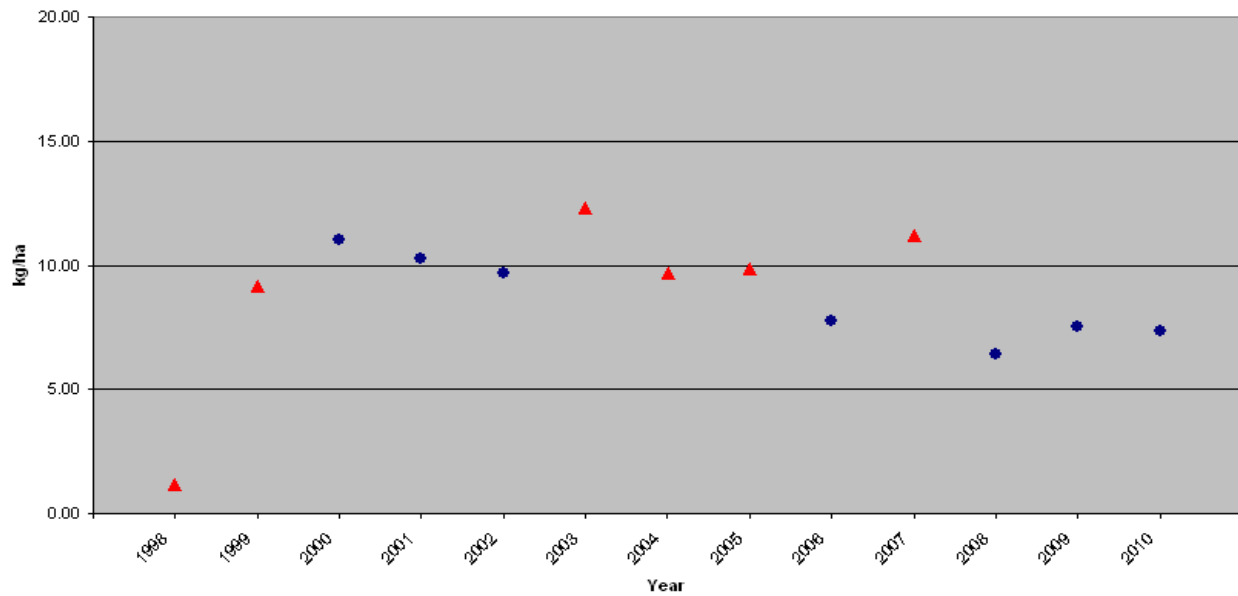


Figure 8
 Nitrate (NO₃) NADP/NTN Site NJ00 (Edwin B. Forsythe National Wildlife Refuge)
 Annual Wet Depositions (1998 - 2010)
 Kilograms Per Hectare (kg/ha)



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2010 Regional Haze & Visibility Summary

New Jersey Department of Environmental Protection

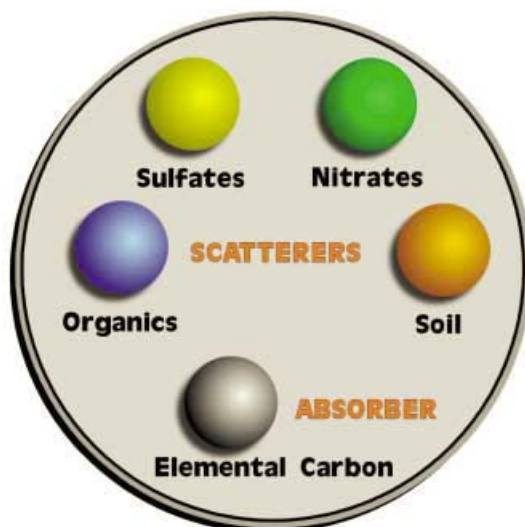
THE BASICS OF HAZE

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 at the ocean surface and windblown dust and soot from wildfires and volcanoes. Man-made sources, which are the primary cause of visibility impairment includes 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 borders on prevailing winds causing the problem of regional haze.

Figure 1
Contributors to Visibility Impairment



(Malm, 1999)

ANATOMY OF REGIONAL HAZE

Data collected over the last decade shows that fine particle concentrations are highest in the industrialized and densely populated areas of the Northeast and Mid-Atlantic. These particles are a major contributor to visibility impairment at all times of the year. 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.

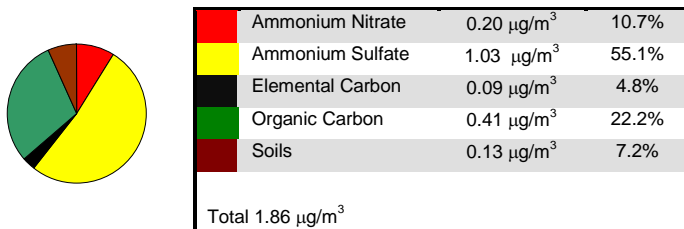
Soils are very similar to dust. It enters the air from dirt roads, fields, and other open spaces as a result of wind, traffic, and other surface activities. Whereas other types of particles form from the condensation and growth of microscopic particles and gasses, crustal material results from the crushing 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 effect of haze.

PARTICLES AND VISIBILITY

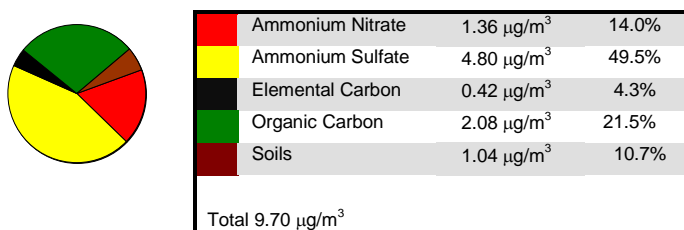
Figure 2 (below) shows the makeup of fine particles collected at the Interagency Monitoring of Protected Visual Environments (IMPROVE) site located north of Atlantic City in the Edwin B. Forsythe National Wildlife Refuge (Brigantine).

Figure 2
Composition of Fine Particles on Days with Good Visibility Compared to Days with Poor Visibility
Brigantine, NJ
July 2009 – June 2010

Average Fine Mass Composition on Days with Good Visibility



Average Fine Mass Composition on Days with Poor Visibility



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 2010 indicate that sulfates accounted for a little more than half of the total fine particle mass. Higher sulfate values in the summer can be attributed to the greater photochemical conversion of sulfur dioxide (SO_2) to sulfate that result from the increased. (Malm, 1999)

HOW IS HAZE REGULATED?

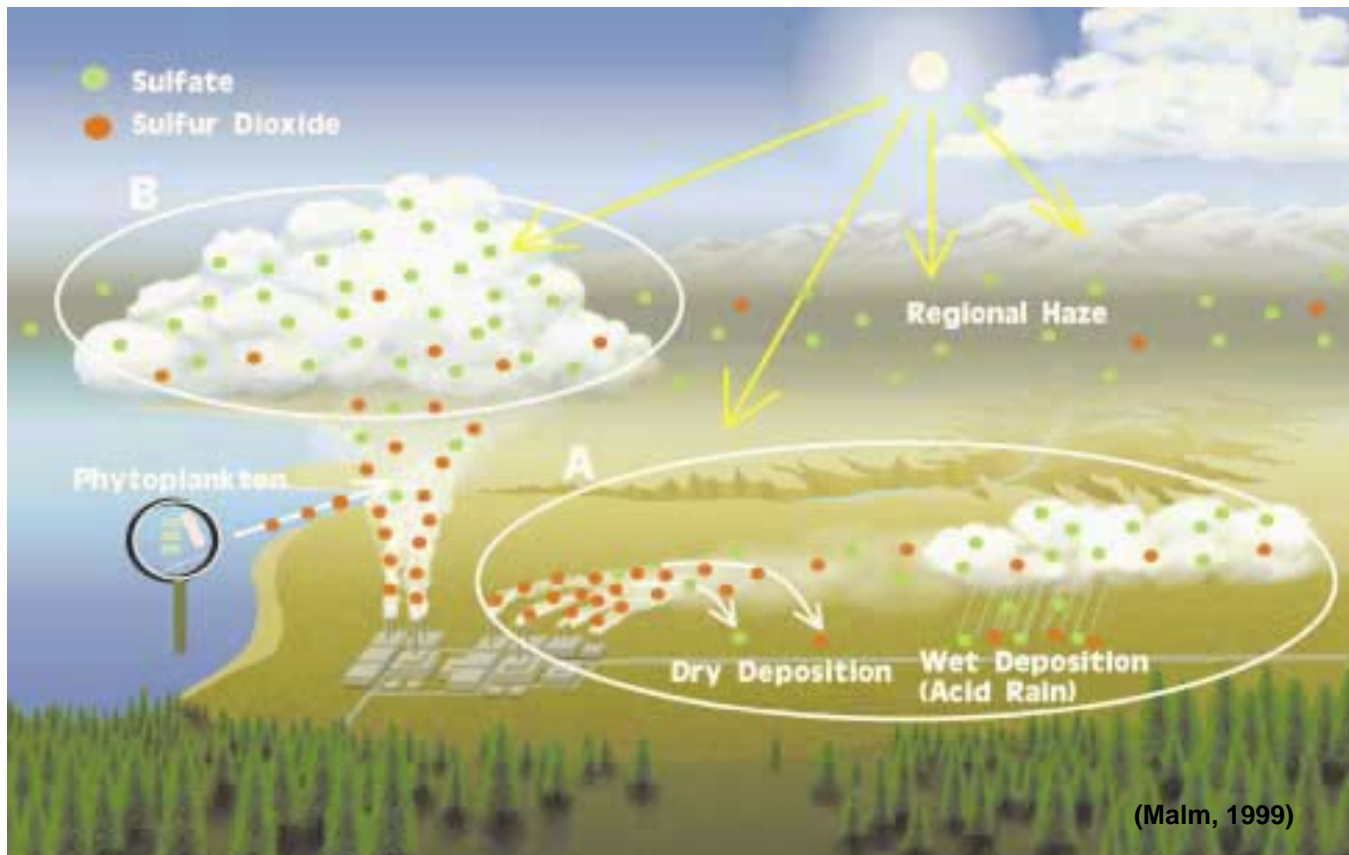
In 1999, the U.S. Environmental Protection Agency announced a major effort to improve air quality in national parks and wilderness areas aimed at achieving national visibility goals by 2064. The Regional Haze Rule calls for state and federal agencies to work together to improve visibility in 156 National 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, 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 in September 2008 and was finalized in July 2009 for its Class I Area in Brigantine.

ENVIRONMENTAL EFFECTS

Regional haze is most closely associated with its effects on prized vistas such as the Grand Canyon, Acadia National Park, or 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 3). 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 3
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 4). The Manhattan skyline appears non-existent when conditions conducive to haze formation are in place (Figure 5).

Visibility Camera – New Jersey Transit Building

Figure 4



Figure 5



The IMPROVE site located within the Edwin B. Forsythe National Wildlife Refuge in Brigantine monitors haze and visibility using several types of instruments, including a digital camera and a nephelometer. Figure 6 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 below in Figure 7 and the skyline seems to have vanished in the haze.

Visibility Camera – Brigantine National Wildlife Refuge

Figure 6



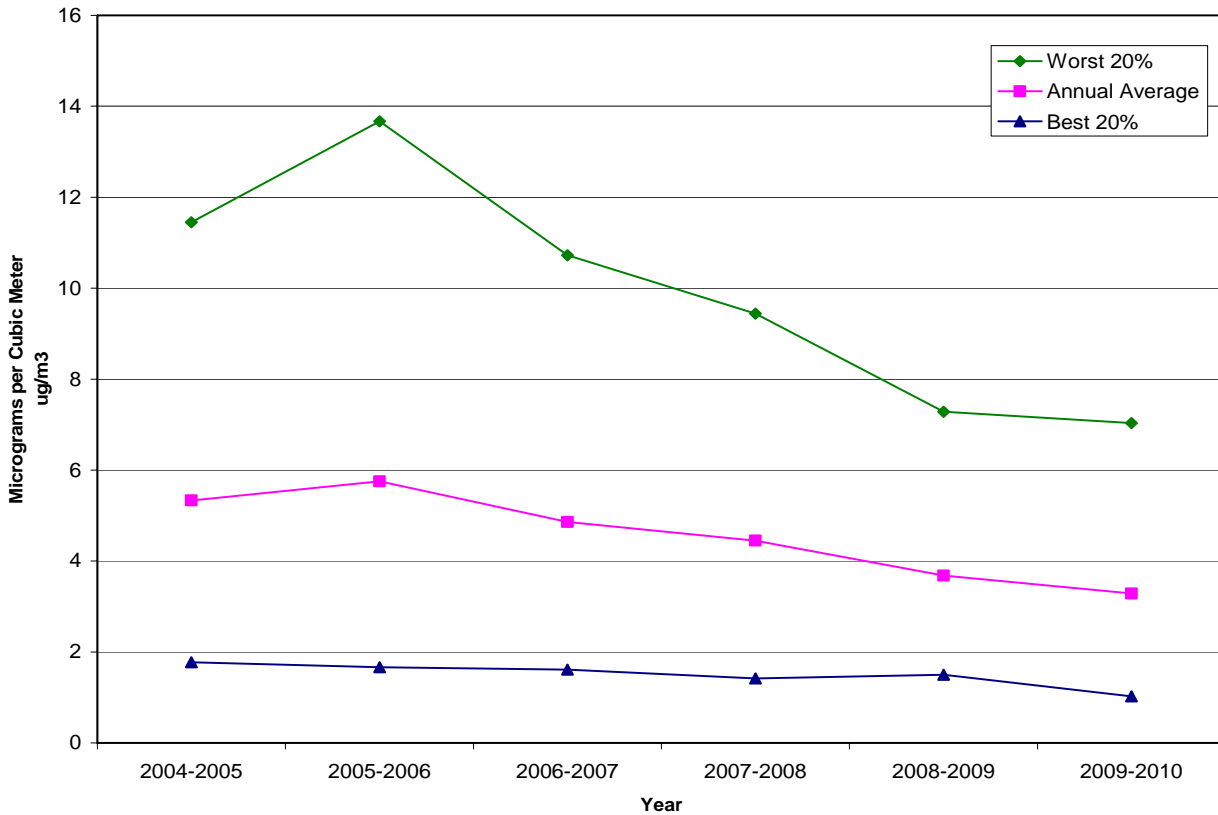
Figure 7



The graph below (Figure 8) 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.

Figure 8
Sulfate Trend Summary**
Brigantine, NJ
2004-2010



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

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2010 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 planners in locating air monitoring stations.

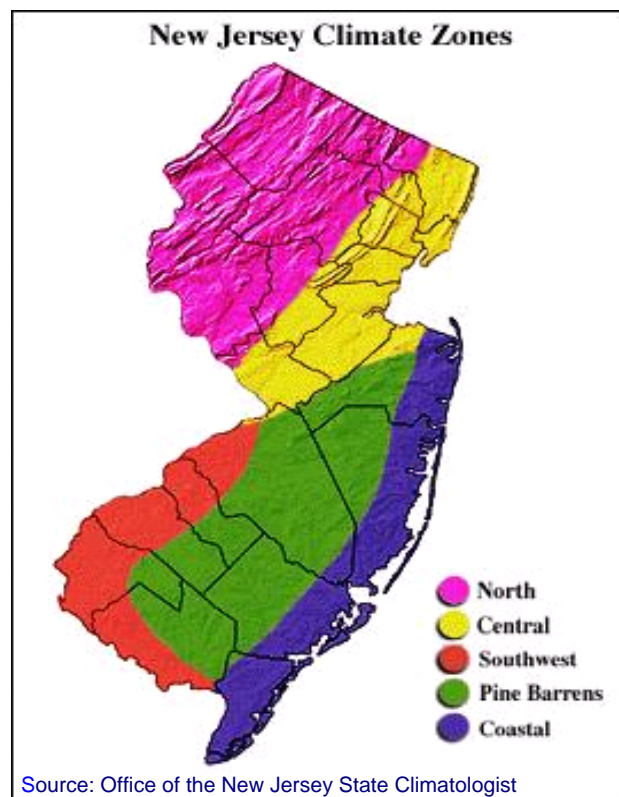
CLIMATOLOGY IN NEW JERSEY

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 wet, dry, hot, and cold airstreams, 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 the zones. These climate zones are shown in Figure 1.

Figure 1



MONITORING LOCATIONS

The NJDEP maintains a network of six meteorological monitoring locations. Not all meteorological parameters are measured at each site. These parameters are measured at Elizabeth Lab, East Orange, Chester, Newark Firehouse, Flemington, and Rider University. Figure 2 provides a map of the monitoring stations. In addition, total weekly precipitation is measured in Washington Crossing and Ancora State Hospital.

NORTHERN METEOROLOGICAL STATIONS

The Elizabeth Lab meteorological station monitors wind speed and wind direction. The East Orange meteorological station monitors temperature and relative humidity. The Chester meteorological station monitors solar radiation. In Table 1, the 2010 meteorological data are combined and presented for East Orange, Newark Firehouse, and Chester. Figure 3 shows the monthly maximum, mean and minimum temperatures in East Orange, and Figure 4 compares the monthly mean temperature with the 30-year mean temperatures measured at Newark airport. The Newark Firehouse meteorological station monitors barometric pressure, temperature, relative humidity, wind speed, wind direction, and solar radiation. This data is summarized in Table 1.

CENTRAL METEOROLOGICAL STATIONS

The Rider University and Flemington meteorological stations monitor barometric pressure, temperature, relative humidity, wind speed, wind direction, and solar radiation. This data is summarized in Table 2. Figure 5 shows the monthly maximum, mean and minimum temperatures at Flemington, and Figure 6 compares the monthly mean temperature with the 30-year mean temperatures measured at the Lehigh Valley International Airport in Allentown, PA. Figure 7 shows the monthly maximum, mean and minimum temperatures at Rider University, and Figure 8 compares the monthly mean temperature with the 30-year mean temperatures measured at Philadelphia International airport.

Figure 2
2010 Meteorological Monitoring Network

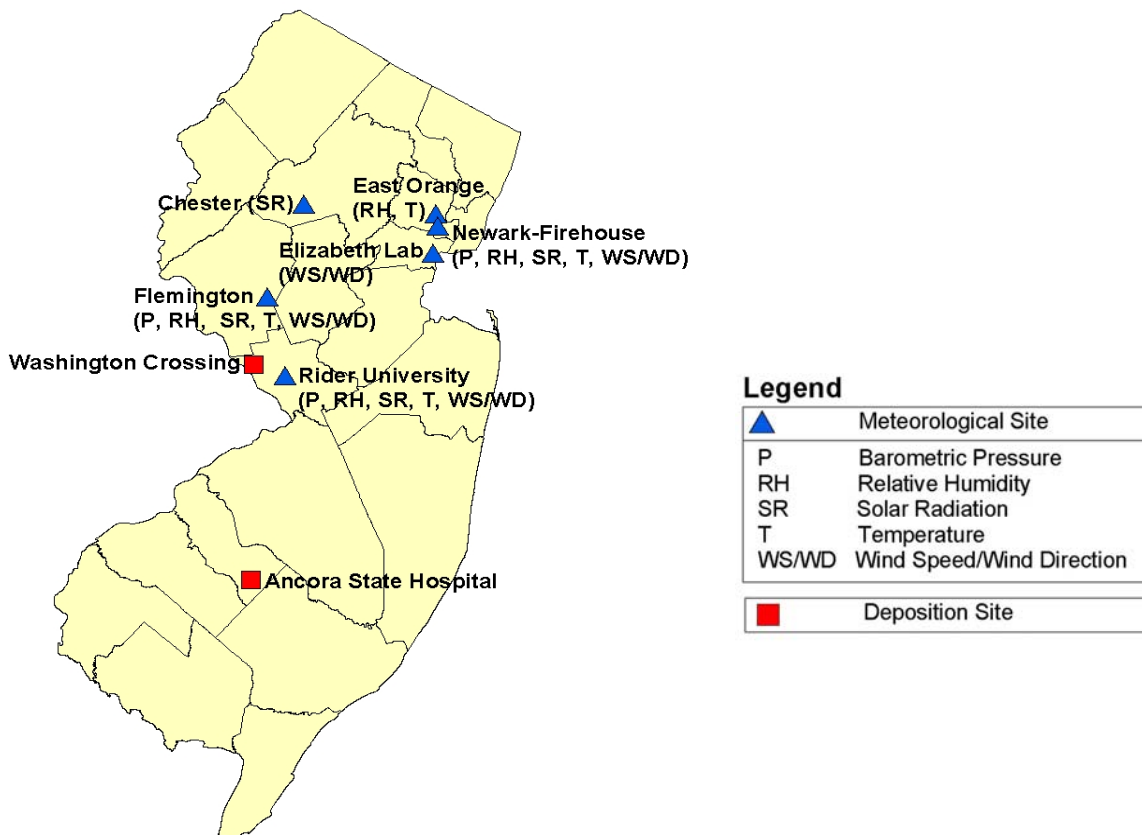


TABLE 1

SUMMARY OF METEOROLOGICAL MONITORING DATA - 2010
NORTHERN NEW JERSEYMONITORING
SITES

| East Orange and Chester | | <u>JAN</u> | <u>FEB</u> | <u>MAR</u> | <u>APR</u> | <u>MAY</u> | <u>JUNE</u> | <u>JULY</u> | <u>AUG</u> | <u>SEPT</u> | <u>OCT</u> | <u>NOV</u> | <u>DEC</u> | <u>YEAR</u> |
|--------------------------------------|-------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-------------|
| Temperature: (°F) | Mean ¹ | 31/31 | 33/34 | 48/42 | 55/52 | 65/63 | 74/72 | 80/77 | 76/75 | 70/68 | 56/56 | 46/46 | 31/36 | 55/54 |
| | Min | 12 | 16 | 28 | 29 | 32 | 54 | 59 | 58 | 51 | 40 | 31 | 18 | 12 |
| | Max | 74 | 56 | 73 | 90 | 92 | 91 | 102 | 95 | 95 | 76 | 65 | 65 | 102 |
| Relative Humidity: (%) | Mean | 65.8 | 70.0 | 66.8 | 61.3 | 71.8 | 73.4 | 70.6 | 75.9 | 74.8 | 73.0 | 70.8 | 67.2 | 64.5 |
| | Min | 30.9 | 28.6 | 20.9 | 22.6 | 26.8 | 36.4 | 34.5 | 36.5 | 35.2 | 32.3 | 17.5 | 32.1 | 17.5 |
| | Max | 98.4 | 98.0 | 98.2 | 98.2 | 99.7 | 98.8 | 98.6 | 98.7 | 99.0 | 99.1 | 98.9 | 99.1 | 99.7 |
| Solar Radiation: (Langleys) | Mean | 0.097 | 0.151 | 0.223 | 0.333 | 0.348 | 0.388 | 0.388 | 0.299 | 0.250 | 0.165 | 0.108 | 0.080 | 0.229 |
| | Max | 0.866 | 1.073 | 1.314 | 1.497 | 1.554 | 1.550 | 1.522 | 1.534 | 1.361 | 1.147 | 0.921 | 0.625 | 1.554 |
| Precipitation (inches) | Historical ² | 3.98 | 2.96 | 4.21 | 3.92 | 4.46 | 3.40 | 4.68 | 4.02 | 4.01 | 3.16 | 3.88 | 3.57 | 46.25 |
| | Observed ³ | 2.67 | 3.24 | 8.47 | 1.99 | 4.04 | 0.84 | 3.03 | 1.04 | 1.16 | 6.06 | 1.93 | 2.67 | 37.14 |
| Newark Firehouse ⁴ | | | | | | | | | | | | | | |
| Temperature: (°F) | Mean ¹ | /31 | /34 | /42 | /52 | /63 | /72 | /77 | /75 | /68 | /56 | 47/46 | 32/36 | /54 |
| | Min | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | 32 | 19 |
| | Max | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | 64 | 60 |
| Relative Humidity: (%) | Mean | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | 57.6 |
| | Min | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | 34.3 |
| | Max | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | 90.5 |
| Solar Radiation: (Langleys) | Mean | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | 0.112 | 0.092 |
| | Max | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | 0.741 | 0.641 |
| Barometric Pressure (in of Hg) | Mean | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | 30.00 | 29.74 |
| | Min | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | 29.39 | 29.02 |
| | Max | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | No Data ⁴ | 30.45 | 30.30 |

1) Newark Airport 30-year mean shown to the right of the slash.

2) Historical monthly precipitation data for Newark Airport

3) Observed monthly precipitation collected by NJDEP at Washington's Crossing state park.

4) Newark Firehouse site commenced operation in November 2010.

Figure 3
2010 Maximum, Mean and Minimum Temperatures, East Orange

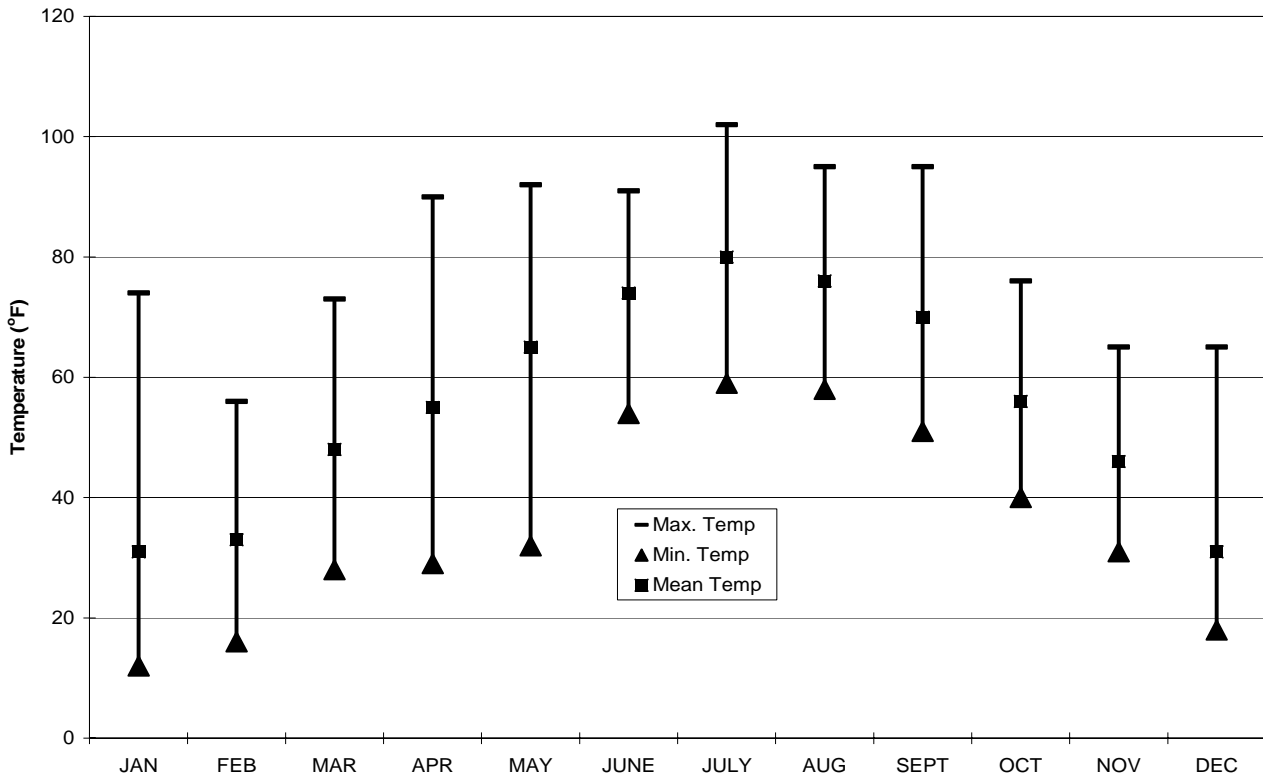


Figure 4
2010 Observed vs. 30-Year Mean Temperatures, East Orange

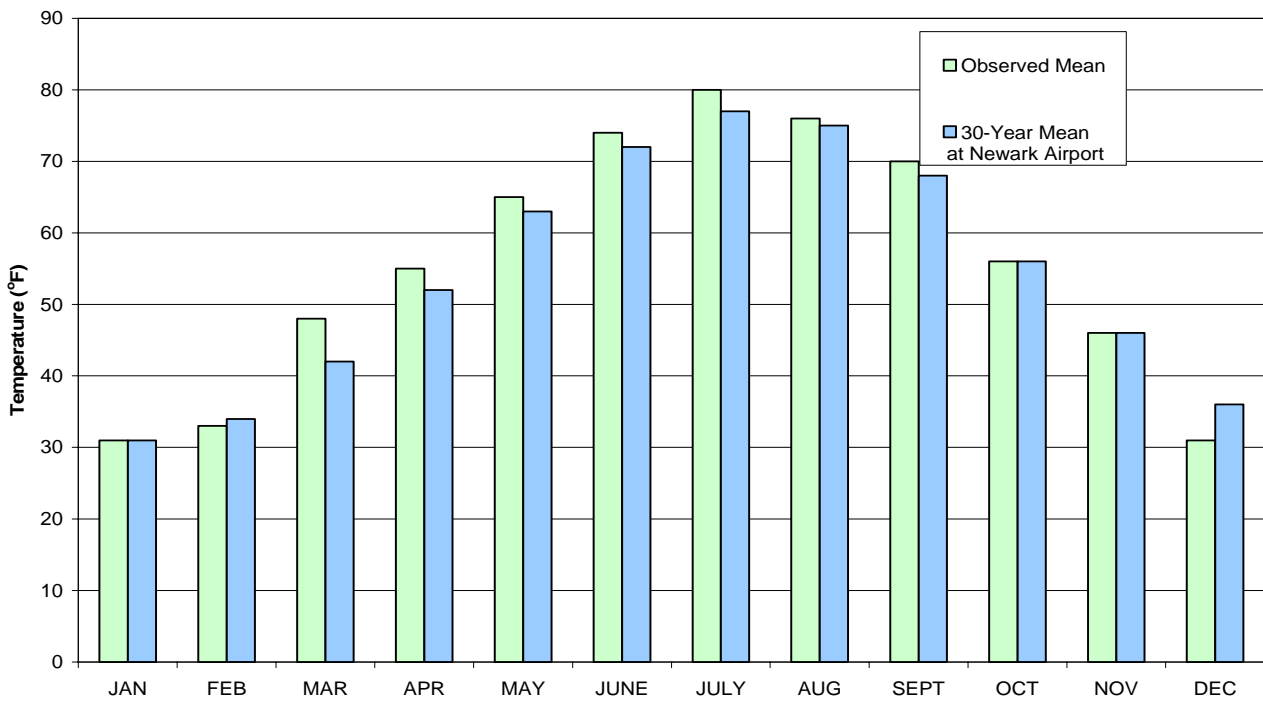


TABLE 2

SUMMARY OF METEOROLOGICAL MONITORING DATA - 2010
CENTRAL NEW JERSEYMONITORING
SITES

| Rider University | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC | YEAR |
|--------------------------------------|-------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Temperature: (°F) | Mean ¹ | 29/32 | 30/35 | 45/43 | 54/53 | 62/64 | 72/72 | 76/78 | 73/76 | 68/69 | 53/57 | 43/47 | 29/37 | 53/55 |
| | Min | 11 | 12 | 26 | 34 | 32 | 48 | 52 | 52 | 44 | 35 | 23 | 13 | 11 |
| | Max | 59 | 44 | 74 | 88 | 89 | 92 | 99 | 93 | 95 | 76 | 63 | 61 | 99 |
| Relative Humidity: (%) | Mean | 63.3 | 66.9 | 64.2 | 58.7 | 67.4 | 66.9 | 65.0 | 67.5 | 66.5 | 71.8 | 68.1 | 63.0 | 65.8 |
| | Min | 25.8 | 27.7 | 13.8 | 17.5 | 19.2 | 22.6 | 17.3 | 19.4 | 15.1 | 21.5 | 10.6 | 33.5 | 10.6 |
| | Max | 100.0 | 99.8 | 98.6 | 99.5 | 98.8 | 98.9 | 98.0 | 98.3 | 98.4 | 99.5 | 99.9 | 98.3 | 100.0 |
| Solar Radiation: (Langleys) | Mean | 0.098 | 0.130 | 0.178 | 0.296 | 0.309 | 0.346 | 0.341 | 0.270 | 0.239 | 0.159 | 0.112 | 0.082 | 0.214 |
| | Max | 0.704 | 0.936 | 1.104 | 1.283 | 1.318 | 1.366 | 1.322 | 1.238 | 1.152 | 1.001 | 0.776 | 0.584 | 1.366 |
| Barometric Pressure (in of Hg) | Mean | 30.16 | 29.97 | 30.05 | 30.11 | 30.19 | 30.08 | 30.14 | 30.17 | 30.15 | 30.09 | 30.28 | 30.06 | 30.12 |
| | Min | 29.34 | 29.17 | 29.56 | 29.41 | 29.66 | 29.58 | 29.96 | 29.82 | 29.70 | 29.69 | 29.56 | 29.31 | 29.17 |
| | Max | 30.55 | 30.60 | 30.62 | 30.79 | 30.65 | 30.38 | 30.47 | 30.46 | 30.45 | 30.40 | 30.77 | 30.62 | 30.79 |
| Precipitation (inches) | Historical ² | 3.52 | 2.74 | 3.81 | 3.49 | 3.89 | 3.29 | 4.39 | 3.82 | 3.88 | 2.75 | 3.16 | 3.31 | 42.05 |
| | Observed ³ | 2.87 | 4.03 | 8.83 | 2.28 | 3.57 | 2.51 | 2.50 | 2.83 | 2.96 | 5.71 | 3.04 | 2.36 | 43.49 |
| Flemington | | | | | | | | | | | | | | |
| Temperature: (°F) | Mean ⁴ | 29/27 | 30/30 | 45/39 | 55/49 | 64/60 | 74/69 | 78/73 | 74/71 | 68/63 | 54/52 | 42/42 | 29/32 | 54/51 |
| | Min | 11 | 12 | 24 | 31 | 31 | 45 | 50 | 50 | 40 | 32 | 19 | 10 | 10 |
| | Max | 60 | 47 | 78 | 89 | 98 | 95 | 107 | 100 | 100 | 81 | 68 | 62 | 107 |
| Relative Humidity: (%) | Mean | 75.0 | 77.0 | 76.3 | 71.6 | 80.7 | 82.1 | 81.4 | 83.6 | 80.7 | 81.7 | 79.6 | 74.4 | 78.7 |
| | Min | 36.6 | 38.7 | 28.6 | 33.4 | 35.3 | 43.5 | 44.8 | 44.8 | 38.7 | 37.9 | 23.9 | 44.2 | 23.9 |
| | Max | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.0 | 99.0 | 99.0 | 99.0 | 99.1 | 99.1 | 100.0 |
| Solar Radiation: (Langleys) | Mean | 0.126 | 0.160 | 0.209 | 0.326 | 0.334 | 0.372 | 0.360 | 0.293 | 0.260 | 0.179 | 0.136 | 0.107 | 0.239 |
| | Max | 0.841 | 1.157 | 1.304 | 1.370 | 1.406 | 1.505 | 1.437 | 1.327 | 1.221 | 1.080 | 0.880 | 0.722 | 1.505 |
| Barometric Pressure (in of Hg) | Mean | 30.05 | 29.86 | 29.95 | 30.01 | 30.09 | 29.99 | 30.05 | 30.08 | 30.06 | 29.99 | 30.18 | 29.97 | 30.02 |
| | Min | 29.28 | 29.07 | 29.47 | 29.31 | 29.57 | 29.50 | 29.87 | 29.73 | 29.63 | 29.60 | 29.48 | 29.23 | 29.07 |
| | Max | 30.42 | 30.46 | 30.48 | 30.66 | 30.53 | 30.28 | 30.36 | 30.35 | 30.33 | 30.28 | 30.66 | 30.51 | 30.66 |

1) Philadelphia International Airport 30 year mean shown to the right of the slash.

2) Historical monthly precipitation data for Philadelphia International Airport

3) Observed monthly precipitation collected by NJDEP at Ancora State Hospital

4) Lehigh Valley International Airport (Allentown, PA) 30-year mean shown to the right of the slash.

Figure 5
2010 Maximum, Mean and Minimum Temperatures, Flemington

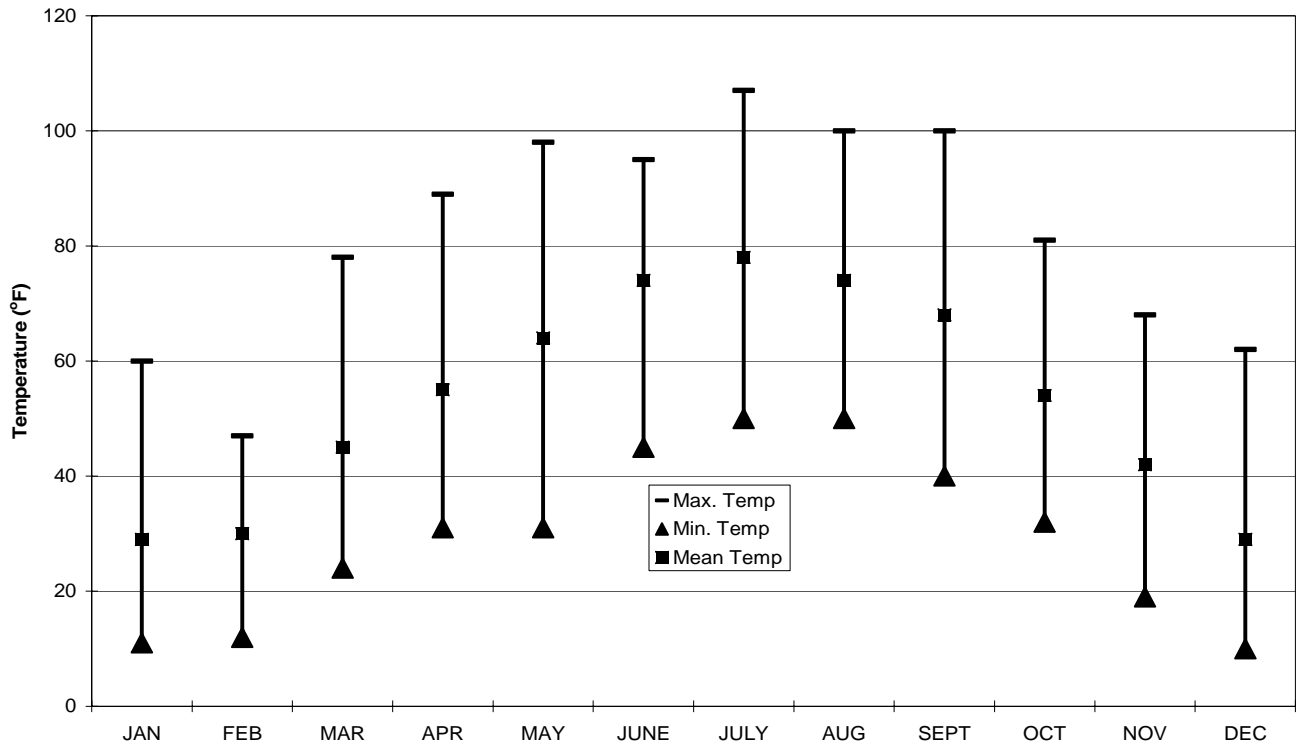


Figure 6
2010 Observed vs. 30-Year Mean Temperatures, Flemington

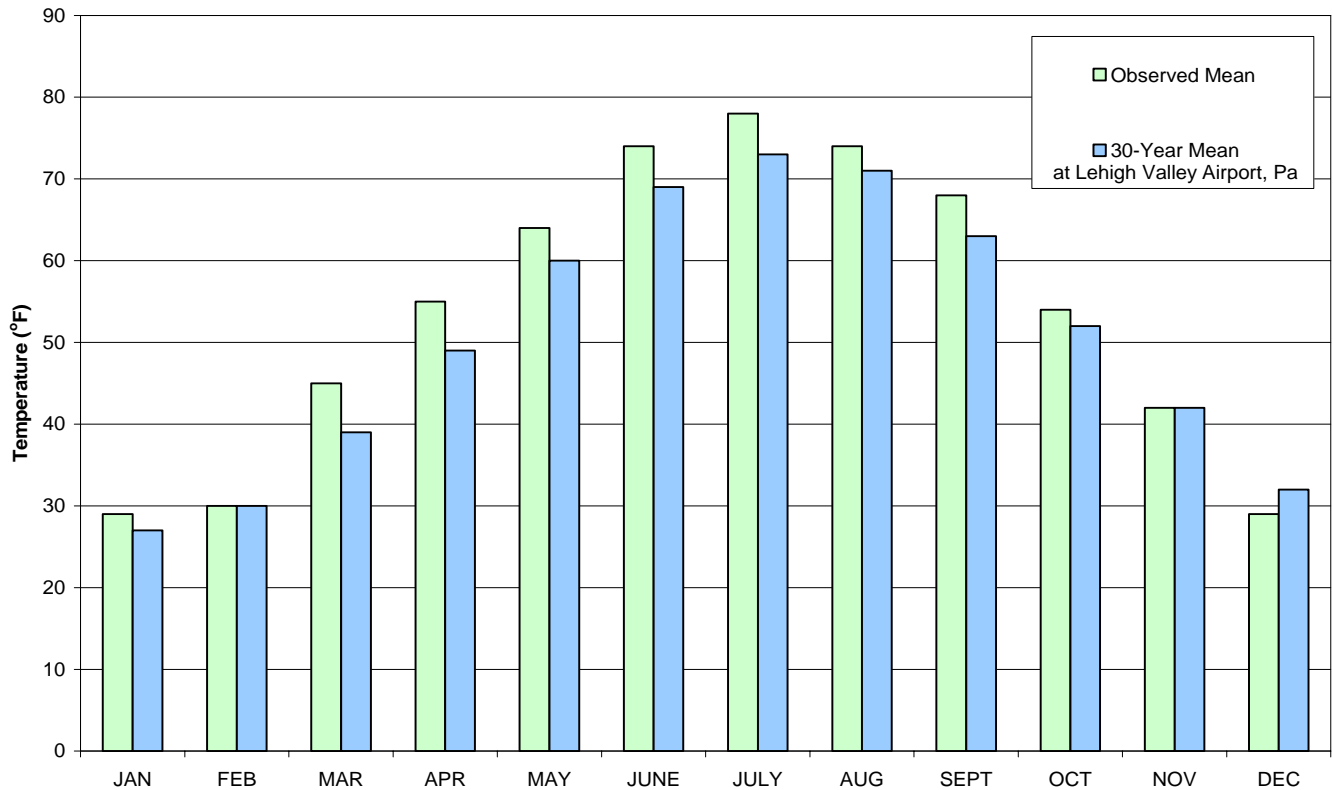


Figure 7
2010 Maximum, Mean and Minimum Temperatures, Rider University

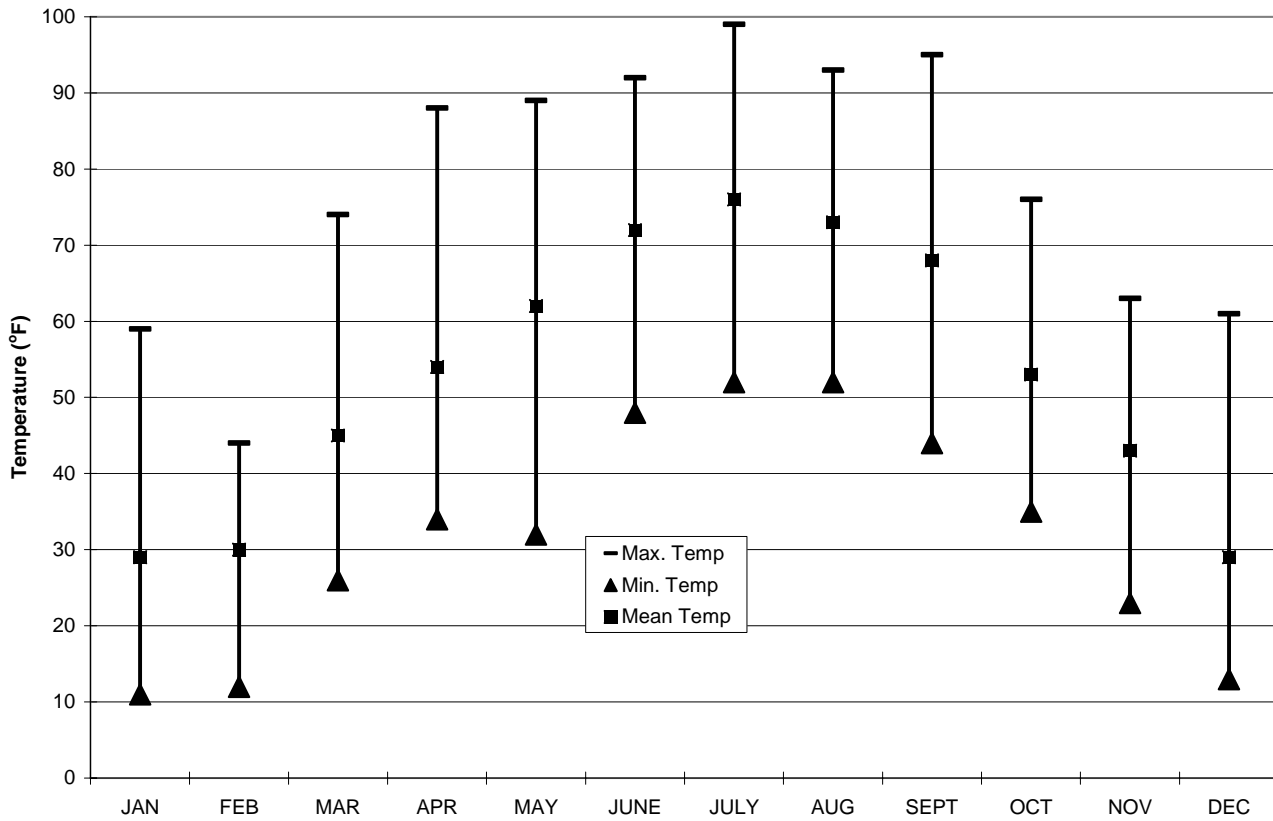
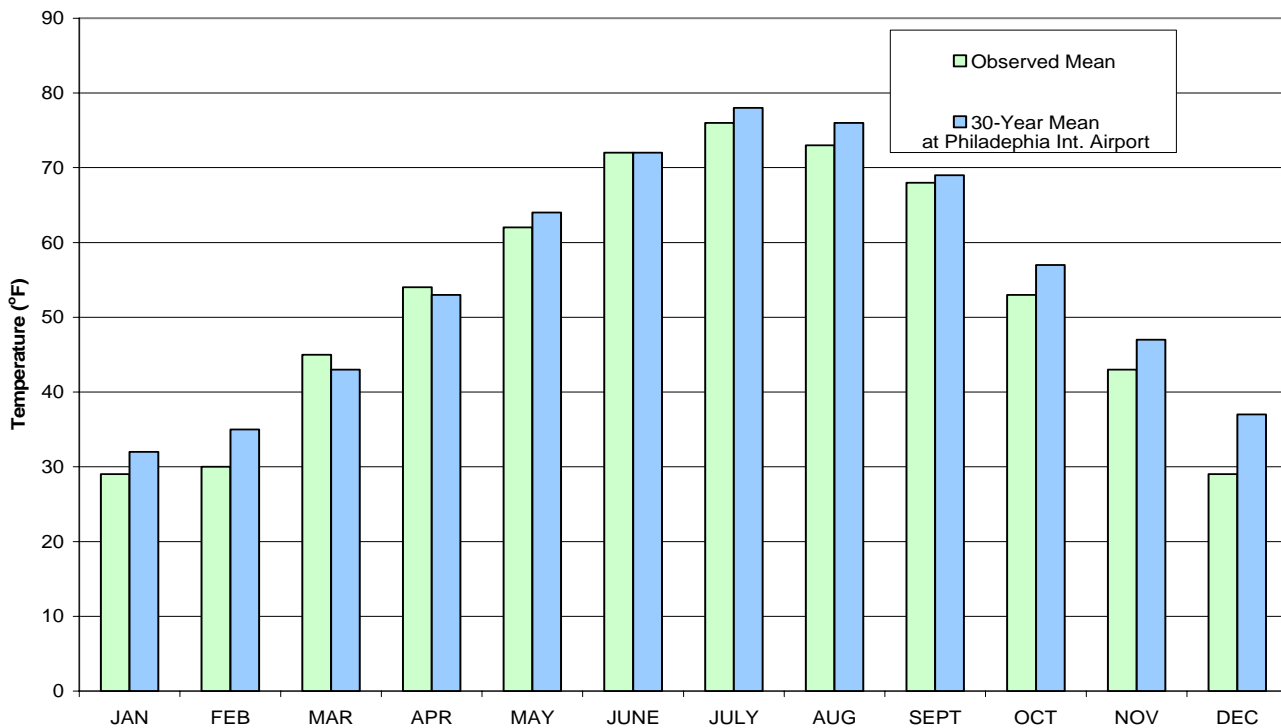


Figure 8
2010 Observed vs. 30-Year Mean Temperatures, Rider University



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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

2010 Air Monitoring Sites

New Jersey Department of Environmental Protection

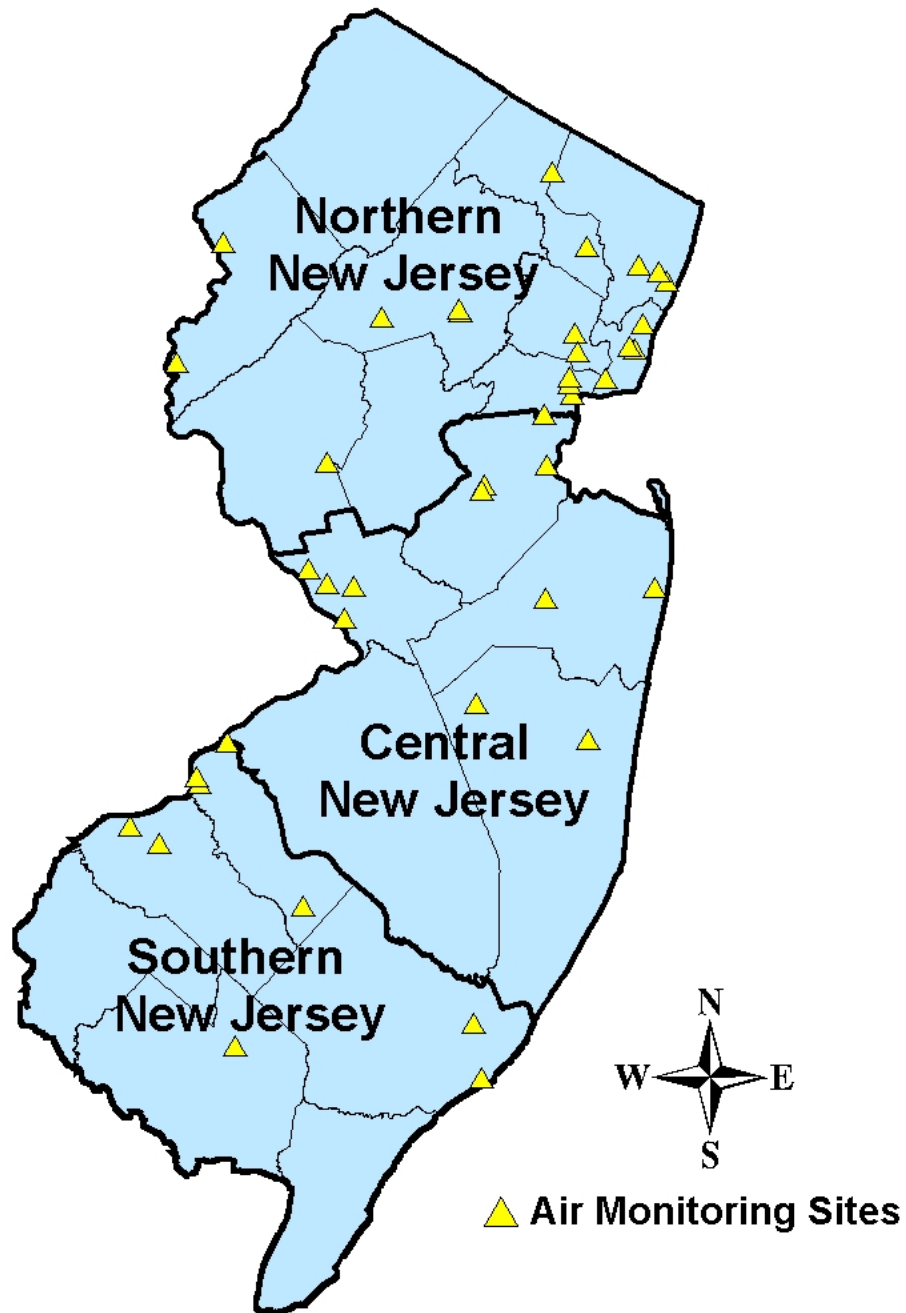
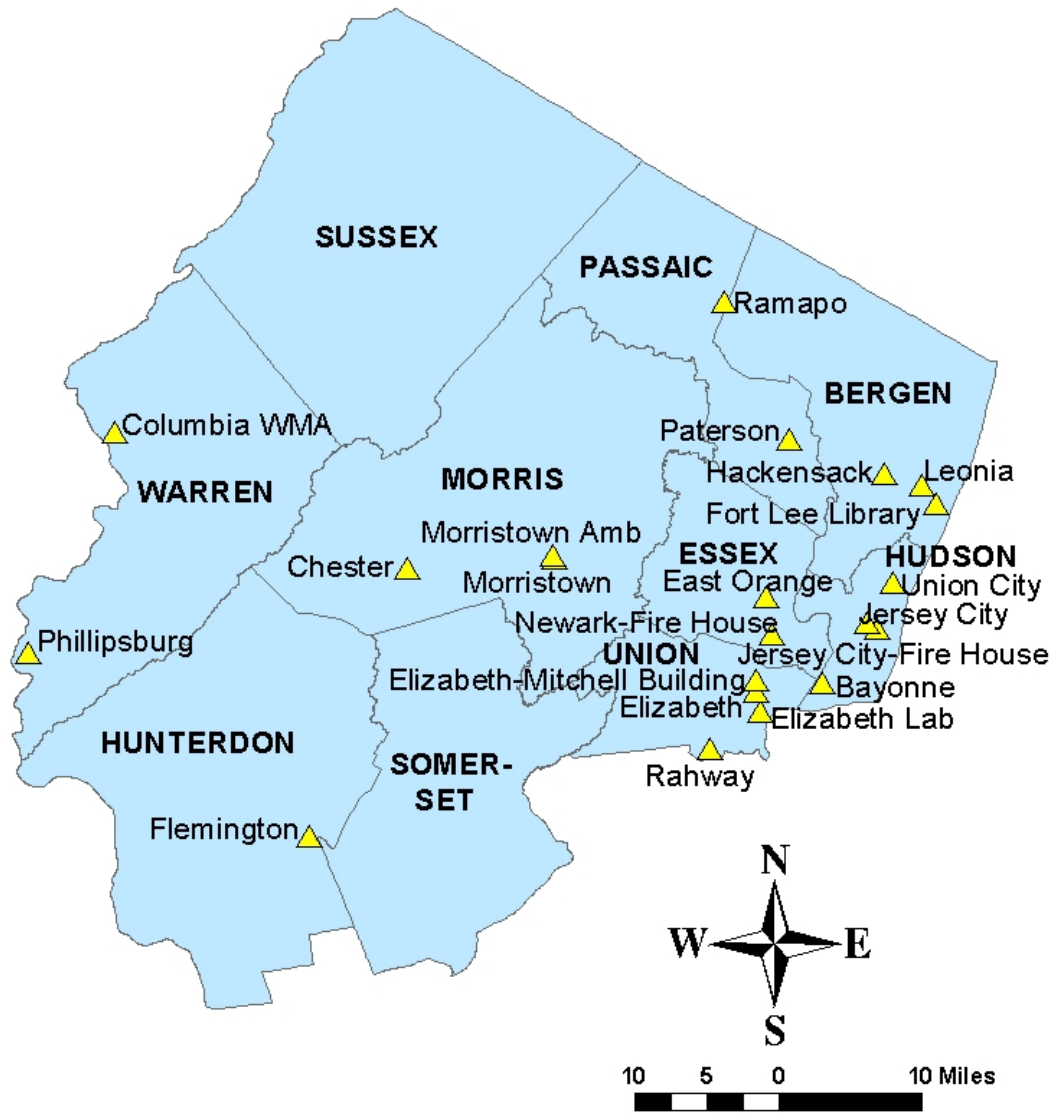


Figure 1 Northern New Jersey Air Monitoring Sites

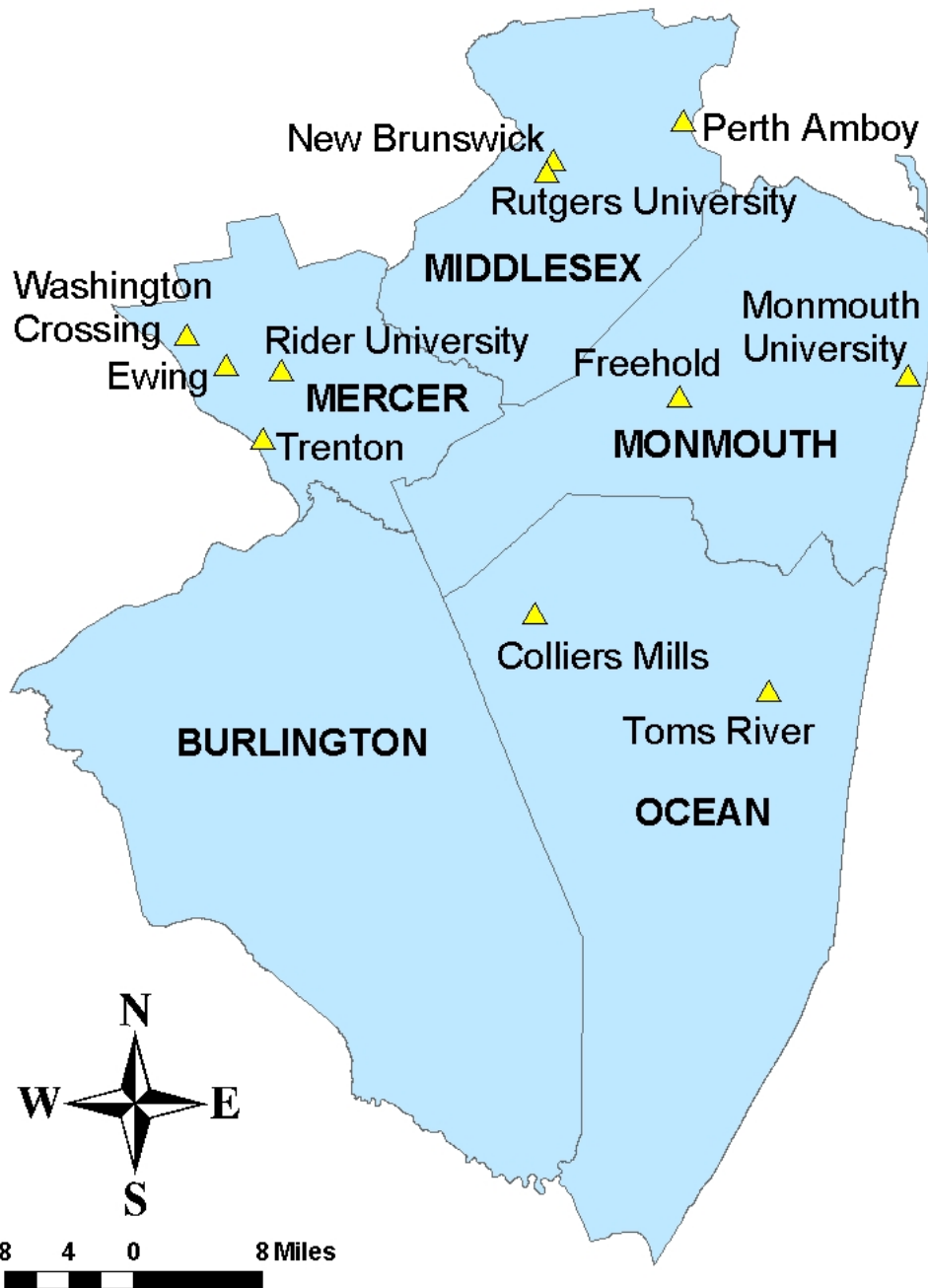


**Table 1
Northern New Jersey Air Monitoring Sites**

| 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. |
| | Hackensack | 34 003 5001 | CO, SO ₂ , SS | 40.882373 | - 74.042172 | 133 River St. near Moore & Mercer Streets. |
| | Leonia | 34 003 0006 | NO _x , O ₃ | 40.870422 | -73.992053 | Overpeck Park, 40 Fort Lee Road. |
| ESSEX | East Orange | 34 013 1003 | CO, NO _x , MET | 40.757501 | - 74.200500 | Engine No. 2, Dr. Martin Luther King Blvd & Greenwood Avenue. |
| | Newark-Fire House | 34 013 0003 | CO, O ₃ , SO ₂ , TEOM, PM _{2.5} , PM _{2.5} Spec, MET, NO _y | 40.721019 | -74.192808 | Newark Firehouse, 360 Clinton Avenue. |
| HUDSON | Bayonne | 34 017 0006 | NO _x , O ₃ , SO ₂ | 40.670250 | - 74.126081 | Veterans Park, 25 th Street near Park Road. |
| | Jersey City | 34 017 1002 | CO, SO ₂ , SS | 40.731690 | - 74.066566 | 2828 Kennedy Blvd. |
| | 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 31 st Street. |
| HUNTERDON | Flemington | 34 019 0001 | O ₃ , MET, TEOM | 40.515253 | -74.806753 | Raritan Twp (Municipal Utilities Authority), 365 Old York Road. |
| MORRIS | Chester | 34 027 3001 | NO _x , O ₃ , SO ₂ , MET, PM _{2.5} , TOXICS, Hg, PM _{2.5} Spec | 40.787628 | - 74.676301 | Bldg. #1, Department of Public Works, (DPW), Route 513. |
| | Morristown | 34 027 0003 | CO, SS | 40.797342 | -74.482494 | 11 Washington Street. |
| | Morristown-Ambulance Squad | 34 027 0004 | PM _{2.5} | 40.801211 | - 74.483433 | Ambulance Squad, 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 | 41.058572 | - 74.255419 | Access Road, off Skyline Drive, Wanaque Borough. |
| UNION | Elizabeth | 34 039 0003 | CO, SO ₂ , SS | 40.662451 | - 74.214745 | 7 Broad Street. |
| | Elizabeth Lab | 34 039 0004 | CO, NO _x , SO ₂ , SS, TEOM, MET, PM _{2.5} , TOXICS, Hg, PM _{2.5} Spec | 40.641440 | - 74.208365 | Interchange 13, NJ TURNPIKE. |
| | Elizabeth-Mitchell Building | 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 | SO ₂ , PM _{2.5} , TEOM | 40.924600 | -75.067800 | Colombia WMA, Delaware Rd, Knowlton Twp. |
| | Phillipsburg | 34 041 0006 | PM _{2.5} | 40.699207 | - 75.180525 | Municipal Bldg., 675 Corliss Avenue |

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

Figure 2
Central New Jersey
Air Monitoring Sites



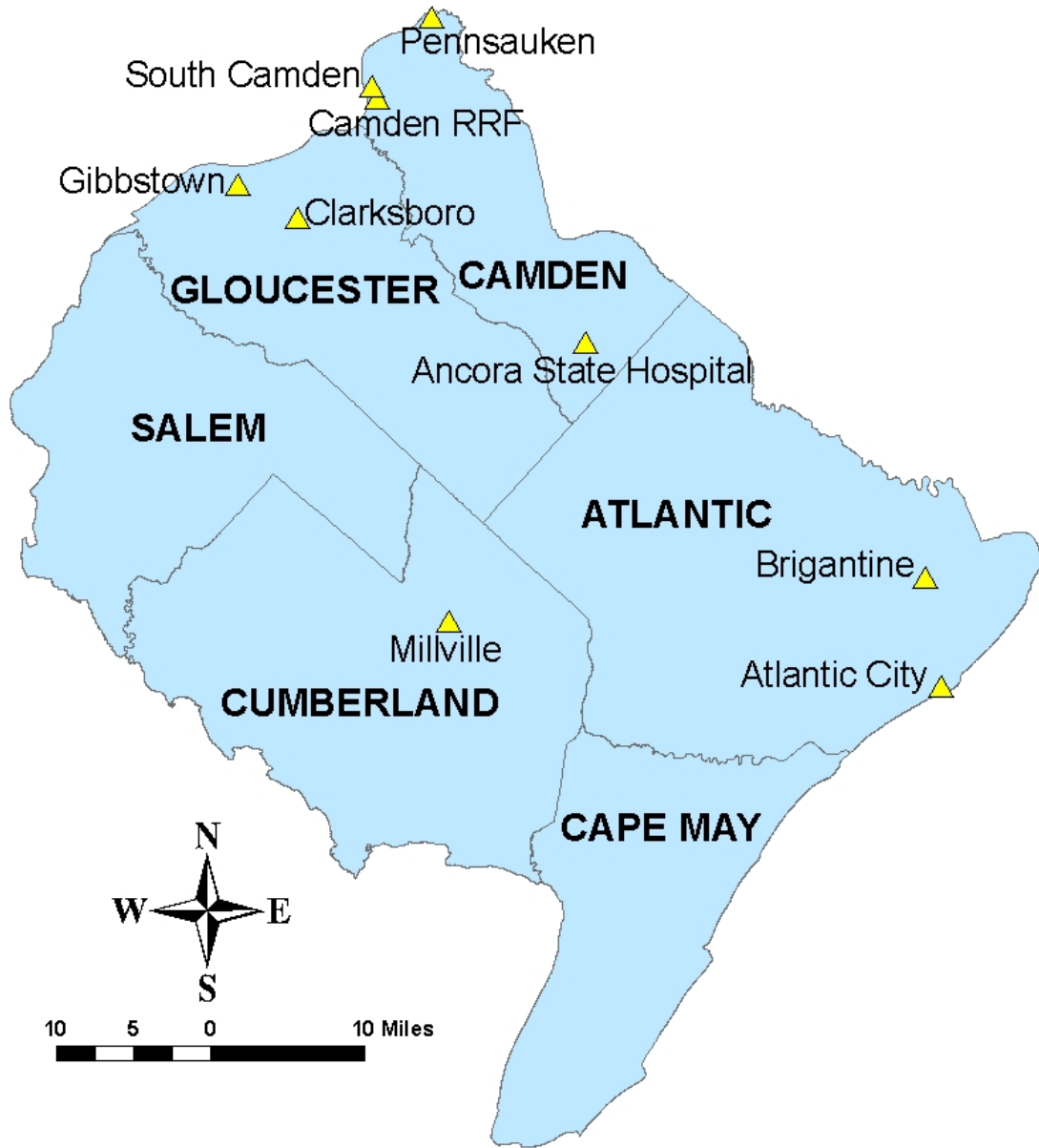
**Table 2
Central New Jersey Air Monitoring Sites**

| 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, West Trenton. |
| | Rider University | 34 021 0005 | NO _x , O ₃ , PAMS, MET | 40.283092 | -74.742644 | Athletic Fields, Route 206 South, Lawrenceville. |
| | Trenton | 34 021 0008 | PM _{2.5} , PM ₁₀ | 40.222411 | -74.763167 | Trenton Library, 120 Academy Street. |
| | Washington Crossing | 34 021 8001 | PM _{2.5} , ACID | 40.315350 | -74.853617 | Washington Crossing State Park, off Church Road, Titusville. |
| MIDDLESEX | New Brunswick | 34 023 0006 | TEOM, PM _{2.5} , Hg, PM _{2.5} Spec, TOXICS | 40.472786 | - 74.422515 | Cook College, Log Cabin Road. |
| | Perth Amboy | 34 023 2003 | CO, SO ₂ , SS | 40.508764 | -74.268083 | 130 Smith Street, Perth Amboy |
| | Rutgers University | 34 023 0011 | NO _x , O ₃ , MET ² , PAMS | 40.462182 | - 74.429439 | Horticultural Farm #3, off Ryder's Lane, New Brunswick. |
| MONMOUTH | Freehold | 34 025 2001 | CO, SS | 40.259895 | - 74.274689 | 5 West Main Street. |
| | Monmouth University | 34 025 0005 | O ₃ | 40.278461 | - 74.005343 | Edison Science Bldg., 400 Cedar Ave., West Long Branch. |
| OCEAN | Colliers Mills | 34 029 0006 | O ₃ | 40.064847 | -74.444058 | Colliers Mills Wildlife Management Area. |
| | Toms River | 34 029 2002 | PM _{2.5} | 39.994908 | -74.170447 | 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} , PM ₁₀ | 39.363528 | -74.431219 | 1535 Bacharach Blvd., Atlantic City. |
| | Brigantine | 34 001 0006 | O ₃ , SO ₂ , TEOM, PM _{2.5} , Hg, ACID, PM _{2.5} Spec ² | 39.464872 | -74.448736 | Edwin Forsythe National Wildlife Refuge Visitor Center, Great Creek Road. |
| CAMDEN | Ancora State Hospital | 34 007 1001 | CO, O ₃ , SO ₂ , ACID | 39.684250 | - 74.861491 | Ancora State Hospital, 202 Spring Garden Road, Hammonton. |
| | South Camden | 34 007 0010 | TEOM | 39.923969 | -75.122317 | Camden County Sewage Treatment Plant, 1645 Ferry Avenue. |
| | Camden-RRF | 34 007 0009 | PM ₁₀ | 39.912431 | - 75.116864 | Camden RRF, Morgan Blvd. & I-676. |
| | 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 , SO ₂ , TEOM | 39.422273 | - 75.025204 | Lincoln Avenue & Route 55. |
| GLOUCESTER | Clarksboro | 34 015 0002 | O ₃ , SO ₂ | 39.800339 | -75.212119 | Clarksboro Shady Lane Rest Home, County House Road. |
| | Gibbstown | 34 015 0004 | PM _{2.5} | 39.830806 | -75.284723 | Municipal Maintenance Yard, North School Street. |

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

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

**Table 4
Parameter Codes**

| | | | |
|-----------------|---|------------------------|--|
| ACID | Acid Deposition | PM ₁₀ | Coarse particles (10 Microns or less) collected by a Federal Reference Method PM ₁₀ Sampler |
| CO | Carbon Monoxide | PM _{2.5} Spec | Speciated (2.5 Microns or Less) fine particles |
| Hg | Mercury Station | PM _{2.5} | Fine Particles (2.5 Microns or less) collected by a Federal Reference Method PM _{2.5} Sampler |
| MET | Meteorological Parameters | TEOM | Continuous PM _{2.5} Analyzer |
| NO _x | Nitrogen Dioxide and Nitric Oxide | SO ₂ | Sulfur Dioxide |
| NO _y | Total Reactive Oxides of Nitrogen | SS | Smoke Shade |
| O ₃ | Ozone | TOXICS | Air Toxics |
| PAMS | Photochemical Assessment Monitoring Station | | |



Appendix B

Fine Particulate Speciation Summary- 2010

New Jersey Department of Environmental Protection

Table 1
Fine Particulate Speciation Data – 2010
Chester, New Jersey

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

| Pollutant | Annual Average Concentration | Daily Average Maximum Concentration | Daily Average 2nd Highest Concentration |
|------------------|-------------------------------------|--|--|
| Aluminum | 0.0167 | 0.1239 | 0.1219 |
| Ammonium | 0.7546 | 2.8553 | 2.7442 |
| Antimony | 0.0052 | 0.0617 | 0.0431 |
| Arsenic | 0.0003 | 0.0036 | 0.0024 |
| Barium | 0.0005 | 0.0065 | 0.0050 |
| Bromine | 0.0021 | 0.0075 | 0.0061 |
| Cadmium | 0.0027 | 0.0197 | 0.0181 |
| Calcium | 0.0140 | 0.0703 | 0.0683 |
| Cerium | 0.0002 | 0.0045 | 0.0036 |
| Cesium | 0.0006 | 0.0079 | 0.0061 |
| Chlorine | 0.0038 | 0.0453 | 0.0281 |
| Chromium | 0.0020 | 0.0110 | 0.0106 |
| Cobalt | 0.0002 | 0.0018 | 0.0015 |
| Copper | 0.0013 | 0.0102 | 0.0072 |
| Elemental carbon | 0.1665 | 0.4682 | 0.3727 |
| Indium | 0.0027 | 0.0234 | 0.0223 |
| Iron | 0.0313 | 0.1194 | 0.0823 |
| Lead | 0.0012 | 0.0091 | 0.0057 |
| Magnesium | 0.0012 | 0.0165 | 0.0148 |
| Manganese | 0.0007 | 0.0041 | 0.0029 |
| Nickel | 0.0009 | 0.0047 | 0.0044 |
| Nitrate | 0.7608 | 4.1260 | 3.9992 |
| Organic carbon | 1.8039 | 4.8656 | 4.8275 |
| Phosphorus | 0.0000 | 0.0000 | 0.0000 |
| Potassium | 0.0361 | 0.4180 | 0.1031 |
| Rubidium | 0.0003 | 0.0021 | 0.0016 |
| Selenium | 0.0004 | 0.0023 | 0.0022 |
| Silicon | 0.0373 | 0.2492 | 0.2489 |
| Silver | 0.0022 | 0.0338 | 0.0222 |
| Sodium | 0.0383 | 0.1898 | 0.1203 |
| Strontium | 0.0004 | 0.0024 | 0.0023 |
| Sulfate | 2.0118 | 8.4574 | 6.8414 |

Table 1 (Continued)
Fine Particulate Speciation Data – 2010
Chester, New Jersey

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

| Pollutant | Annual Average Concentration | Daily Average Maximum Concentration | Daily Average 2nd Highest Concentration |
|------------------|---|--|--|
| Sulfur | 0.7051 | 3.0954 | 2.7794 |
| Tin | 0.0053 | 0.0361 | 0.0338 |
| Titanium | 0.0009 | 0.0097 | 0.0093 |
| Total mass | 8.5265 | 36.5099 | 26.7286 |
| Vanadium | 0.0006 | 0.0071 | 0.0042 |
| Zinc | 0.0045 | 0.0177 | 0.0177 |
| Zirconium | 0.0010 | 0.0128 | 0.0105 |

Table 2
Fine Particulate Speciation Data – 2010
Elizabeth Lab, New Jersey

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

| Pollutant | Annual Average Concentration | Daily Average Maximum Concentration | Daily Average 2nd Highest Concentration |
|------------------|-------------------------------------|--|--|
| Aluminum | 0.0427 | 0.2736 | 0.2693 |
| Ammonium | 0.9678 | 3.9678 | 3.1512 |
| Antimony | 0.0069 | 0.0837 | 0.0732 |
| Arsenic | 0.0003 | 0.0034 | 0.0024 |
| Barium | 0.0067 | 0.0375 | 0.0338 |
| Bromine | 0.0028 | 0.0135 | 0.0096 |
| Cadmium | 0.0023 | 0.0233 | 0.0221 |
| Calcium | 0.0441 | 0.1954 | 0.1613 |
| Cerium | 0.0002 | 0.0036 | 0.0034 |
| Cesium | 0.0005 | 0.0056 | 0.0051 |
| Chlorine | 0.0207 | 0.3981 | 0.1401 |
| Chromium | 0.0033 | 0.0359 | 0.0330 |
| Cobalt | 0.0007 | 0.0046 | 0.0033 |
| Copper | 0.0067 | 0.0291 | 0.0207 |
| Elemental carbon | 1.0941 | 3.3277 | 3.2695 |
| Indium | 0.0032 | 0.0221 | 0.0198 |
| Iron | 0.1596 | 0.6520 | 0.4775 |
| Lead | 0.0020 | 0.0128 | 0.0108 |
| Magnesium | 0.0070 | 0.0751 | 0.0507 |
| Manganese | 0.0022 | 0.0101 | 0.0072 |
| Nickel | 0.0025 | 0.0125 | 0.0107 |
| Nitrate | 1.3183 | 7.1813 | 5.7393 |
| Organic carbon | 2.6235 | 5.9068 | 5.6497 |
| Phosphorus | 0.0000 | 0.0013 | 0.0007 |
| Potassium | 0.0518 | 0.8045 | 0.1399 |
| Rubidium | 0.0003 | 0.0024 | 0.0022 |
| Selenium | 0.0004 | 0.0023 | 0.0021 |
| Silicon | 0.0980 | 0.5717 | 0.5108 |
| Silver | 0.0014 | 0.0131 | 0.0128 |
| Sodium | 0.1738 | 6.4068 | 0.5244 |
| Strontium | 0.0008 | 0.0133 | 0.0071 |
| Sulfate | 2.2260 | 8.1866 | 6.9421 |

Table 2 (Continued)
Fine Particulate Speciation Data – 2010
Elizabeth Lab, New Jersey

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

| Pollutant | Annual Average Concentration | Daily Average Maximum Concentration | Daily Average 2nd Highest Concentration |
|------------------|---|--|--|
| Sulfur | 0.7630 | 3.0742 | 2.6173 |
| Tin | 0.0044 | 0.0431 | 0.0337 |
| Titanium | 0.0039 | 0.0250 | 0.0206 |
| Total mass | 12.2777 | 31.9127 | 29.2362 |
| Vanadium | 0.0037 | 0.0290 | 0.0222 |
| Zinc | 0.0114 | 0.0434 | 0.0341 |
| Zirconium | 0.0012 | 0.0175 | 0.0119 |

Table 3
Fine Particulate Speciation Data – 2010
New Brunswick, New Jersey

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

| Pollutant | Annual Average Concentration | Daily Average Maximum Concentration | Daily Average 2nd Highest Concentration |
|------------------|---|--|--|
| Aluminum | 0.0214 | 0.1662 | 0.0948 |
| Ammonium | 0.6474 | 3.4864 | 2.5549 |
| Antimony | 0.0070 | 0.0688 | 0.0606 |
| Arsenic | 0.0003 | 0.0022 | 0.0018 |
| Barium | 0.0010 | 0.0198 | 0.0069 |
| Bromine | 0.0020 | 0.0078 | 0.0072 |
| Cadmium | 0.0031 | 0.0249 | 0.0198 |
| Calcium | 0.0199 | 0.0721 | 0.0613 |
| Cerium | 0.0001 | 0.0015 | 0.0014 |
| Cesium | 0.0005 | 0.0068 | 0.0051 |
| Chlorine | 0.0072 | 0.1034 | 0.0794 |
| Chromium | 0.0023 | 0.0235 | 0.0114 |
| Cobalt | 0.0004 | 0.0026 | 0.0022 |
| Copper | 0.0026 | 0.0184 | 0.0121 |
| Elemental carbon | 0.2935 | 1.1808 | 1.0062 |
| Indium | 0.0028 | 0.0292 | 0.0257 |
| Iron | 0.0548 | 0.1725 | 0.1515 |
| Lead | 0.0012 | 0.0069 | 0.0066 |
| Magnesium | 0.0036 | 0.0444 | 0.0427 |
| Manganese | 0.0010 | 0.0067 | 0.0060 |
| Nickel | 0.0011 | 0.0070 | 0.0060 |
| Nitrate | 0.7701 | 5.4580 | 3.8941 |
| Organic carbon | 1.9458 | 5.2757 | 4.5313 |
| Phosphorus | 0.0000 | 0.0011 | 0.0007 |
| Potassium | 0.0400 | 0.5743 | 0.1163 |
| Rubidium | 0.0003 | 0.0020 | 0.0020 |
| Selenium | 0.0005 | 0.0045 | 0.0026 |
| Silicon | 0.0566 | 0.3482 | 0.2275 |
| Silver | 0.0021 | 0.0199 | 0.0147 |
| Sodium | 0.0464 | 0.1865 | 0.1860 |
| Strontium | 0.0006 | 0.0148 | 0.0098 |
| Sulfate | 1.6946 | 6.1750 | 5.1959 |

Table 3 (Continued)
Fine Particulate Speciation Data – 2010
New Brunswick, New Jersey

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

| Pollutant | Annual Average Concentration | Daily Average Maximum Concentration | Daily Average 2nd Highest Concentration |
|------------------|---|--|--|
| Sulfur | 0.6500 | 2.8815 | 2.5673 |
| Tin | 0.0041 | 0.0332 | 0.0268 |
| Titanium | 0.0014 | 0.0105 | 0.0072 |
| Total mass | 8.9387 | 25.1443 | 22.2979 |
| Vanadium | 0.0010 | 0.0098 | 0.0083 |
| Zinc | 0.0057 | 0.0213 | 0.0200 |
| Zirconium | 0.0015 | 0.0173 | 0.0150 |

Table 4
Fine Particulate Speciation Data – 2010
Newark, New Jersey

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

| Pollutant | Annual Average Concentration | Daily Average Maximum Concentration | Daily Average 2nd Highest Concentration |
|------------------|---|--|--|
| Aluminum | 0.0338 | 0.2906 | 0.2544 |
| Ammonium | 0.8483 | 3.0490 | 2.8267 |
| Antimony | 0.0067 | 0.0572 | 0.0526 |
| Arsenic | 0.0003 | 0.0020 | 0.0020 |
| Barium | 0.0016 | 0.0448 | 0.0086 |
| Bromine | 0.0022 | 0.0079 | 0.0061 |
| Cadmium | 0.0020 | 0.0212 | 0.0203 |
| Calcium | 0.0240 | 0.0930 | 0.0743 |
| Cerium | 0.0001 | 0.0034 | 0.0027 |
| Cesium | 0.0006 | 0.0077 | 0.0052 |
| Chlorine | 0.0106 | 0.2231 | 0.0532 |
| Chromium | 0.0044 | 0.0924 | 0.0482 |
| Cobalt | 0.0004 | 0.0029 | 0.0024 |
| Copper | 0.0049 | 0.0207 | 0.0203 |
| Elemental carbon | 1.0252 | 2.3601 | 2.2675 |
| Indium | 0.0029 | 0.0233 | 0.0205 |
| Iron | 0.0785 | 0.4486 | 0.2822 |
| Lead | 0.0017 | 0.0098 | 0.0091 |
| Magnesium | 0.0043 | 0.0820 | 0.0346 |
| Manganese | 0.0012 | 0.0050 | 0.0045 |
| Nickel | 0.0024 | 0.0272 | 0.0164 |
| Nitrate | 1.0378 | 5.1404 | 4.7123 |
| Organic carbon | 3.8235 | 11.8297 | 8.1849 |
| Phosphorus | 0.0000 | 0.0000 | 0.0000 |
| Potassium | 0.0478 | 1.0392 | 0.2071 |
| Rubidium | 0.0003 | 0.0019 | 0.0015 |
| Selenium | 0.0003 | 0.0043 | 0.0020 |
| Silicon | 0.0526 | 0.2655 | 0.2562 |
| Silver | 0.0017 | 0.0254 | 0.0192 |
| Sodium | 0.0855 | 1.8422 | 0.3513 |
| Strontium | 0.0008 | 0.0215 | 0.0088 |
| Sulfate | 1.9612 | 8.3512 | 7.1085 |

Table 4 (Continued)
Fine Particulate Speciation Data – 2010
Newark, New Jersey

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

| Pollutant | Annual Average Concentration | Daily Average Maximum Concentration | Daily Average 2nd Highest Concentration |
|------------------|---|--|--|
| Sulfur | 0.6760 | 3.1555 | 2.6459 |
| Tin | 0.0038 | 0.0432 | 0.0372 |
| Titanium | 0.0017 | 0.0079 | 0.0078 |
| Total mass | 9.7680 | 28.8283 | 23.6717 |
| Vanadium | 0.0024 | 0.0217 | 0.0153 |
| Zinc | 0.0091 | 0.0352 | 0.0310 |
| Zirconium | 0.0012 | 0.0110 | 0.0087 |

