2007

AIR QUALITY SUMMARY

STATE OF RHODE ISLAND

Department of Environmental Management
Office of Air Resources

Rhode Island Department of Health
Air Pollution Laboratory

INTRODUCTION

Ambient air quality has been monitored at a network of stations in the State of Rhode Island since 1968. The monitoring network is operated and maintained by the Rhode Island Department of Environmental Management (RI DEM) Office of Air Resources (OAR) and by the Rhode Island Department of Health (RI HEALTH) Air Pollution Laboratory via an interagency contract agreement. The ambient air quality data collected are entered quarterly in the U.S. Environmental Protection Agency's (USEPA's) Aerometric Information Retrieval System (AIRS).

PURPOSE

Monitoring data collected are used for the following purposes:

1. Determining whether the State is in attainment of national and State ambient air quality standards;
2. Tracking progress toward meeting national and State ambient air quality standards for which the State is in nonattainment;
3. Documenting maintenance of air quality standards for which the State is in attainment;
4. Providing a daily report of air quality and a forecast for the next day's air quality with appropriate health warnings, when required;
5. Providing real-time data for regional air quality maps;
6. Identifying pollution patterns and trends;
7. Assessing health and welfare effects and land use and transportation plans and evaluating the effectiveness of abatement strategies and enforcement of control regulations; and,
8. Activating emergency control procedures intended to prevent air pollution episodes.

This summary of 2007 ambient air quality data is intended to be used to provide general information about air quality in Rhode Island and as a source of statistics necessary to support modeling studies and other air quality analyses.

AMBIENT AIR QUALITY STANDARDS AND ATTAINMENT

The USEPA has set National Ambient Air Quality Standards (NAAQS) for six air pollutants: lead (Pb), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide

(CO), ozone (O_3) and particulate matter (PM). Pollutants with adopted NAAQS are referred to as "criteria pollutants."

There are two types of NAAQS; primary NAAQS are designed to protect human health and secondary NAAQS are designed to protect the environment, property and aesthetics. The derivations of the NAAQS, as well as background information about the sources, chemistry and deleterious effects of the criteria pollutants, are documented in the USEPA's air quality criteria documents.

The NAAQS currently in effect are listed in Table 1. In July 1997, the USEPA promulgated a NAAQS for particulate matter with diameters less than or equal to 2.5 micrometers (PM-2.5); an updated NAAQS for that pollutant was adopted in October 2006. The USEPA revised its NAAQS for ozone in July 1997 and again in March 2008. The State of Rhode Island has not as yet adopted those standards, but has adopted all NAAQS promulgated prior to 1997.

Areas that do not meet air quality standards are called nonattainment areas. The Clean Air Act (CAA) requires each state with a nonattainment area to submit and implement a State Implementation Plan (SIP) which documents the measures that the State will take to come into attainment with the standard. The entire State of Rhode Island is a nonattainment area for ozone. The State is in attainment of the NAAQS for the other criteria pollutants.

Since the State of Rhode Island is a nonattainment area for ozone, it, was required by the Clean Air Act Amendments of 1990 to implement a variety of measures to limit emissions of two classes of ozone precursors, volatile organic compounds and nitrogen oxides, from industrial and commercial sources such as surface coating facilities, power plants and gasoline stations, as well as from mobile sources (motor vehicles). Although these measures have reduced ozone levels, the State has still not attained the NAAQS for that pollutant. Since Rhode Island's air quality is substantially affected by transport of pollutants into the State, further reductions in emissions in upwind states will be necessary for Rhode Island to become an attainment area for ozone.

TABLE 1: NATIONAL AMBIENT AIR QUALITY STANDARDS in 2007

POLLUTANT	AVERAGING TIME	PRIMARY STANDARD	SECONADARY STANDARD
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	0.03 ppm 80 µg/m³	None
	24-Hour[A]	0.14 ppm 365 µg/m³	None
	3-Hour[A]	None	0.50 ppm 1300 µg/m³
Carbon Monoxide (CO)	8-Hour[A]	9 ppm 10 mg/m³	None
	1-Hour[A]	35 ppm 40 mg/m³	None
Ozone (O_3)	8-Hour[B]	0.08 ppm[B] 157 µg/m³	Same as Primary Standard
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.053 ppm 100 µg/m³	Same as Primary Standard
Particulate Matter $\leq$10 micrometers (PM-10)	24-Hour[C]	150 µg/m³	Same as Primary Standard
Particulate Matter $\leq$ 2.5 micrometers (PM-2.5)	Annual Arithmetic Mean[D]	15 µg/m³	Same as Primary Standard
	24-Hour[E]	35 µg/m³	Same as Primary Standard
Lead (Pb)	Calendar Quarter Arithmetic Mean[F]	1.5 µg/m³[F]	Same as Primary Standard

Primary standards protect against adverse health effects. **Secondary standards** protect against welfare effects such as damage to crops, vegetation, and buildings.

[A]Not be exceeded more than once a year.

[B] To attain the O_3 standard, the 3-year average of the fourth-highest daily maximum 8-hour average each year at a site must not exceed 0.08 ppm (changed to 0.075 ppm as of May 2008)

[C] To attain the PM-10 standard, 24-hour concentration at a site must not exceed 150 µg/m³ more than once per year, averaged over 3 years.

[D] To attain the PM-2.5 annual standard, the annual arithmetic average of the 24-hour concentrations, averaged over 3 consecutive years, must not exceed 15 µg/m³.

[E] To attain the PM-2.5 24-hour standard, the 3-year average of the 98th percentile of 24-hour concentrations at a site must not exceed 35 µg/m³.

[F]On October 16, 2008, the Pb NAAQS was changed to 0.15 µg/m³ as a rolling 3-month average, not to be exceeded in a 3-year period.

µg/m³ = micrograms per cubic meter; **ppm** = parts per million; **mg/m³** = milligrams per cubic meter

RHODE ISLAND AMBIENT AIR QUALITY MONITORING NETWORK

During 2007, RI DEM and RI HEALTH monitored the ambient air levels of all of the criteria pollutants except for lead. The State discontinued lead monitoring in 1992 because airborne lead concentrations in the State had been substantially lower than the NAAQS for that pollutant since 1986, when lead was removed from gasoline. Due to the promulgation of a considerably more stringent NAAQS for lead in 2008, Rhode Island may be required to resume lead monitoring in future years.

Monitoring was also conducted for nitrogen oxides (NOx), volatile organic compounds (VOCs) and carbonyls in 2007. Those pollutants are ozone precursors which react in the atmosphere to form ground-level ozone, a criteria pollutant. In addition, some of the VOCs and carbonyls monitored are air toxics; exposure to those substances is associated with cancer and other serious health effects. Monitoring is also conducted for toxic metals and for black carbon, an indicator of diesel exhaust.

The locations of the criteria pollutant and air toxics monitoring sites are shown in Figures I - IV. Table 2 lists the parameters measured and the sampling methods employed at each of those sites.

TABLE 2: MONITORING SITES

Site Location	AIRS Code	UTM East	UTM North	Parameter Measured	Method Of Sampling	EPA Method Designation
Vernon Trailer Vernon Street Pawtucket	440070026	302.5	4638.4	PM-2.5	Lo Vol	Reference
				PM-10	Hi Vol	Reference
				VOCs	Canisters, GC/MS	Reference
Johnson & Wales 111 Dorrance Street Providence	440070027	299.2	4633.8	PM-10	Hi Vol	Reference
Hallmark Building 695 Eddy Street Providence	440070028	299.2	4633.8	PM-2.5	Lo Vol	Reference
Brown University 10 Prospect Street Providence	440070012	300.2	4633.0	Oxides of Nitrogen	Chemiluminescence	Reference
				Nitrogen Dioxide	Chemiluminescence	Reference
				Sulfur Dioxide	Simulated Fluorescence	Equivalent
Case Mead Building[1] 76 Dorrance Street Providence	440071009	299.7	4632.8	Carbon Monoxide	Gas Filter Correlation	Equivalent
				Sulfur Dioxide	Simulated Fluorescence	Equivalent
USEPA Laboratory 27 Tarzwell Drive Narragansett	440090007	273.4	4610.4	Ozone	U.V. Photometric	Reference
				PM-2.5	Beta Attenuation/Cont	N/A
				Wind Speed	Anemometer	N/A
				Wind Direction	Wind Vane	N/A
				Temperature	Spot Reading	N/A
Francis School 64 Bourne Avenue E. Providence	440071010	303.9	4634.5	Oxides of Nitrogen	Chemiluminescence	Reference
				Nitrogen Dioxide	Chemiluminescence	Reference
				VOCs	Canisters, GC/MS	Reference
				Carbon Monoxide	Gas Filter Correlation	Equivalent
				Ozone	U.V. Photometric	Reference
				PM-2.5	Lo Vol	Reference
				PM-2.5	TEOM/Continuous	N/A
				Carbonyls	HPLC Cartridges	N/A
				Black Carbon	Aethalometer	N/A
				Wind Speed	Anemometer	N/A
				Wind Direction	Wind Vane	N/A
				Barometric Pressure	Barometer	N/A
				Temperature	Spot Reading	N/A
				Relative Humidity	Plastic Film	N/A
				Solar Radiation	Pyranometric	N/A
				UV Radiation	UV Photometric	N/A
				Precipitation	Bucket/Continuous	N/A

[1] Site discontinued July 2007.

Site Location	AIRS Code	UTM East	UTM North	Parameter Measured	Method Of Sampling	EPA Method Designation
Urban League 212 Prairie Avenue Providence	440070022	299.4	4631.1	PM-2.5	Lo Vol	Reference
				PM-10	Lo Vol	Reference
				Black Carbon	Aethalometer	N/A
				PM-2.5	Beta Attenuation/Cont	N/A
				Speciated PM-2.5	Speciation Monitor	N/A
				PM-10/Metals	Hi Vol	Reference
				Chromium VI	Xontech, Ion chrom	N/A
				VOCs	Canisters, GC/MS	Reference
				Carbonyls	HPLC Cartridges	N/A
				Wind Speed	Anemometer	N/A
				Wind Direction	Wind Vane	N/A
				Temperature	Spot Reading	N/A
				Relative Humidity	Plastic Film	N/A
	440030002	273.4	4610.4	Ozone	U.V. Photometric	Reference
				Nitrogen Dioxide	Chemiluminescence	Reference
				Oxides Of Nitrogen	Chemiluminescence	Reference
				VOCs	Canisters, GC/MS	Reference
				PM-10	Hi Vol	Reference
				PM-2.5	Lo Vol	Reference
				PM-2.5	Beta Attenuation/Cont	N/A
				Wind Speed	Anemometer	N/A
				Wind Direction	Wind Vane	N/A
				Barometric Pressure	Barometer	N/A
				Temperature	Spot Reading	N/A
				Relative Humidity	Plastic Film	N/A
				Solar Radiation	Pyranometric	N/A

Figure 1
Air Quality Monitoring Network (2007)
Continous Monitors
Site Locations

Figure 2
PM-10 Air Pollution Monitoring Network
(2007)
Site Locations

Figure 3
PM-2.5 Air Pollution Monitoring Network
(2007)
Site Locations

Figure 4
Air Toxics Monitoring Network (2007)
Site Locations

AIR QUALITY INDEX

In 1976, the USEPA developed the Pollutant Standards Index (PSI), a readily understandable way of communicating monitored air pollutant concentrations and associated health implications to the public. In June 2000, the USEPA updated the index and renamed it the Air Quality Index (AQI). The AQI converts monitored ambient concentrations of criteria pollutants to a scale of 0 to 500. An AQI level of 100 means that the monitored concentration is at the level of the short-term standard for that pollutant. Monitored levels just above the standard (AQI of 101 –150) are characterized as “unhealthy for sensitive groups” and higher levels (AQI of 151-200) are characterized as “unhealthy” by the USEPA. To avoid any confusion that might result from the interpretation of the term “sensitive group,” Rhode Island describes all AQI levels between 100 and 200 as “unhealthy” in its health advisories.

AQI subindices are calculated every day for the highest 8-hour average concentrations of ozone and CO and for the 24-hour average concentration of SO_2 and PM-2.5 recorded during the 24-hour period ending at 8:00 AM on that day. The highest of the subindices is then reported as the AQI for that date. During the summer, the AQI is based on the ozone and PM-2.5 sub indices, while during the cooler months the AQI is based on CO, SO_2 and PM-2.5. .

Rhode Island DEM reports the AQI to the local news media, accompanied by an easily understood descriptor word. A forecast for the next day’s pollutant levels, consisting only of a descriptor word, is also reported.

The Rhode Island AQI descriptors are as follows:

AQI	**Descriptor**
0 to 50	Good
51 to 100	Moderate
101 to 200	Unhealthy
201-300	Very Unhealthy

Pollutant levels measured at six monitoring sites were used for AQI reporting in 2007. The AQI pollutants measured at those sites are as follows:

Site Location	AQI Pollutants Monitored
Case Mead Building, 76 Dorrance Street, Providence (discontinued July 2007)	Carbon Monoxide Sulfur Dioxide
Brown University, 10 Prospect Street, Providence	Sulfur Dioxide
Myron Francis School, 64 Bourne Avenue, E. Providence	Ozone Carbon Monoxide
Alton Jones Campus of URI, Victory Highway. Greenwich	Ozone PM-2.5
USEPA Research Laboratory 72 Tarzwell Drive, Narragansett	Ozone PM-2.5
Urban League 212 Prairie Avenue, Providence	PM-2.5

Note that nitrogen dioxide concentrations are not used to calculate the AQI because there is no short-term air quality standard for that pollutant. PM-10 levels are also not used, because the monitoring results for those pollutants are not available the day after the samples are taken. Similarly, PM-2.5 concentrations measured using the filter-based Federal Reference Method are not used for calculating the AQI because those values are not immediately available; only PM-2.5 concentrations measured by continuous instruments are used for the AQI.

In 2007, the AQI in Rhode Island was good on 77% of the reporting days, moderate on 21% and unhealthful on 3%. (see Figure V). The daily AQI and forecast are printed in the weather section of the Providence Journal. A daily air quality report is also available on the OAR hotline at 401-222-2808 and at DEM's web site at http://www.dem.ri.gov/programs/benviron/air/pm.htm. Additional information on the AQI and the health effects associated with various index levels is available from the OAR.

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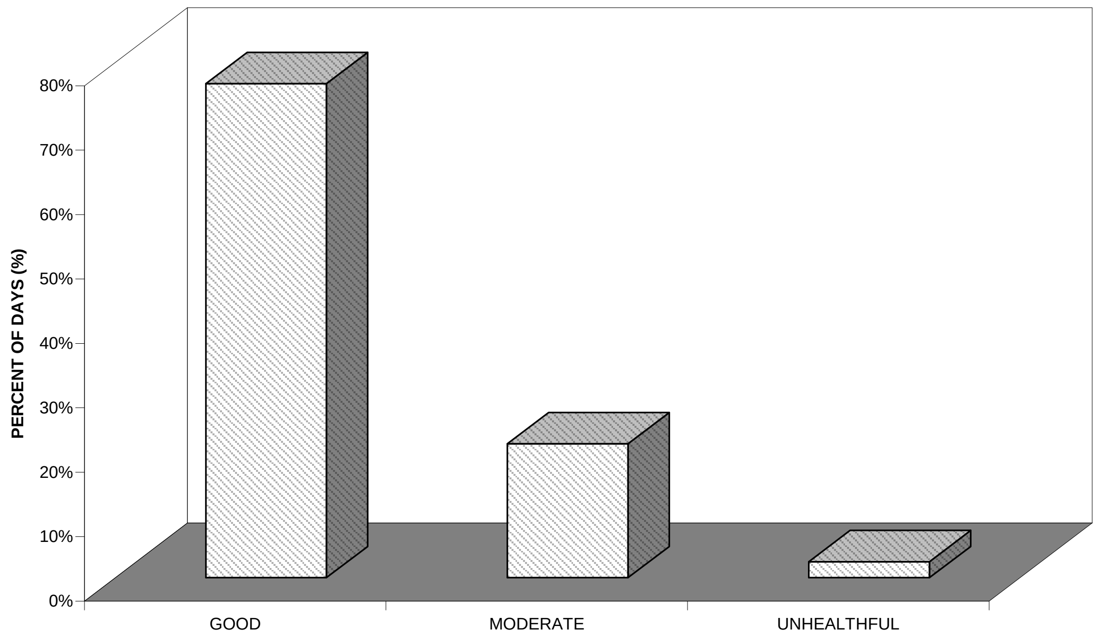
The weather in the summer of 2007 was warm and humid and, as a result, the ozone concentrations were higher than those that occurred during the cooler summer of 2006. The 8-hour ozone standard was exceeded on eight days in 2007, as compared to six days in 2006. Ambient concentrations of the other criteria pollutants continued to stay below the National Ambient Air Quality Standards (NAAQS).

A more detailed discussion of the properties of the criteria pollutants, the concentrations of pollutants measured in 2007 and ambient air quality trends follows.

Figure V
Air Quality Index (AQI)
2007 Air Quality Levels



CARBON MONOXIDE (CO)

Carbon monoxide (CO) is a colorless, odorless, poisonous gas formed by the incomplete combustion of fuels by motor vehicles, aircraft, boilers, power plants, incinerators, industrial processes and other fuel-burning sources. Elevated CO levels are often found in downtown areas with heavy traffic and poor dispersion characteristics.

By binding to the hemoglobin in blood, CO reduces the amount of oxygen that is delivered to the body's organs and tissues. CO exposure is most dangerous to those who suffer from cardiovascular disease. Healthy individuals are also affected at higher levels of exposure. Exposure to elevated CO levels can cause shortness of breath, chest pain, headaches, confusion, visual impairment, reduced work capacity, reduced coordination, poor learning ability, and difficulty in performing complex tasks.

The primary and secondary NAAQS for CO are the same, 9 ppm as an 8-hour average and 35 ppm as a 1-hour average. Those standards have not been exceeded in Rhode Island since 1984. In 2007, CO was measured at two sites in the State, Dorrance Street in downtown Providence and the Francis School in East Providence.

On October 17, 2006, the USEPA revised its ambient air monitoring requirements; those changes eliminated the specification of a minimum number of CO monitors that must be operated in a state. In response to those changes, RI DEM evaluated Rhode Island CO monitoring data to determine whether those data provide useful information and whether continuing operation of those monitors is warranted. RI DEM concluded that the usefulness of the CO data are limited, due to the following factors:

- No exceedances of the CO NAAQS have been observed in the State for more than 20 years;
- Current CO levels are significantly below the NAAQS;
- All CO readings in the past five years have been in the "good" air quality category, and thus measurements have not provided useful health related information for the AQI; and
- Due to the trend toward lower emissions from motor vehicles, it is very unlikely that CO levels will increase significantly in the coming years.

After considering those factors, along with resource limitations, RI DEM decided to discontinue operation of the CO monitor at the Dorrance Street, Providence site at the end of June 2007. The CO monitor at the East Providence site continues to operate; that site is part of the national Photochemical Assessment Monitoring Sites (PAMS) network and will, in the future, be part of the USEPA's Network of Core Multipollutant Monitoring sites (NCore). Since the Dorrance Street site has been used to track maintenance of the CO NAAQS in Providence, the USEPA required the RI DEM to develop alternative methods to track CO levels when that monitor ceased to operate. A revision to the Rhode Island State Implementation Plan was submitted to the USEPA in September 2008 that delineates the methods that will be used to track CO levels in the Providence area to ensure that those levels do not exceed the NAAQS in the future.

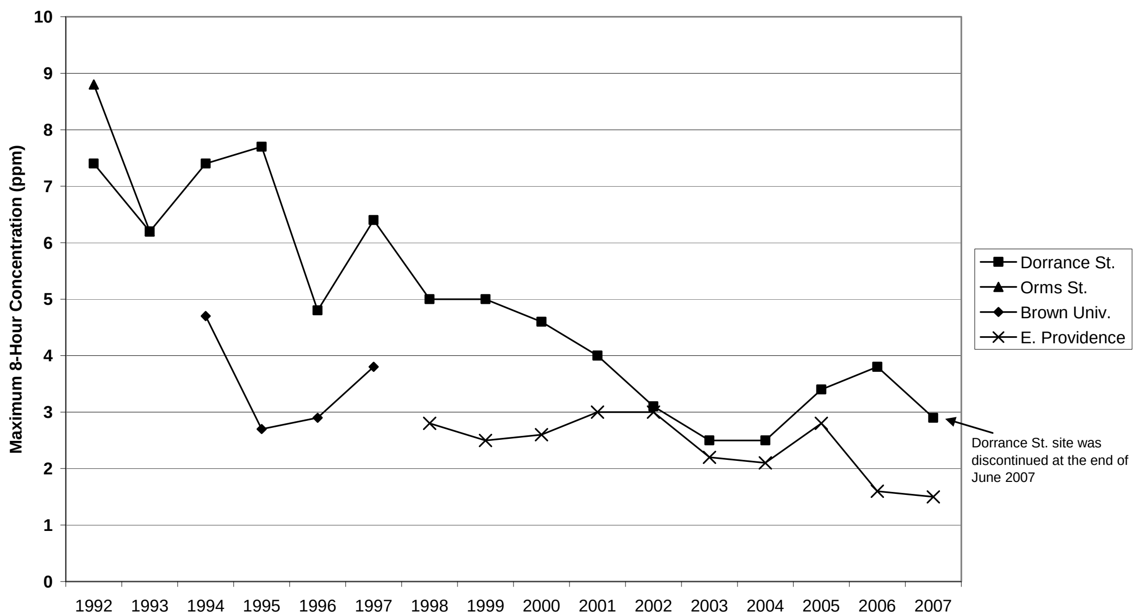
In 2007, the highest CO concentrations recorded were 32% and 13% of the 8-hour and 1-hour NAAQS respectively, (See Table 3). Those measurements were recorded at the Dorrance Street site. As discussed above, CO monitoring at that site was discontinued at the end of June 2007.

Figure VI shows CO trends in Rhode Island between 1992 and 2007. Yearly maximum 8-hour average CO concentrations at the Dorrance Street site generally decreased in that period. The maximum 8-hour average CO concentrations at the East Providence site was slightly lower in 2007 than in 2006.

Table 3 Carbon Monoxide (CO) Levels Measured in Rhode Island in 2007 (ppm)

	1-Hour Values (NAAQS is 35 ppm)				**8-Hour Values (NAAQS is 9 ppm)**		
Stations	**# of Observations**	**1st Maximum**	**2nd Maximum**	**# of Exceedances**	**1st Maximum**	**2hd Maximum**	**# of Exceedances**
Francis School 64 Bourne Ave. E. Providence	8,393	2.0	1.8	0	1.5	1.1	0
76 Dorrance St. Providence	4,080 (1/07 – 6/07)	4.7	4.5	0	2.9	2.5	0
Totals				0			0

Figure VI
CARBON MONOXIDE (CO)
Maximum 8-Hour Concentrations
Standard = 9 ppm



LEAD (Pb)

Lead is no longer monitored as a criteria pollutant in the State because, since the removal of lead from gasoline, airborne lead concentrations in the State have been substantially lower than the NAAQS. There are no major stationary sources of lead in the State. Note, however, that lead monitoring may be required in the future to determine compliance with a more a more stringent lead NAAQS which was adopted by the USEPA in October 2008.

Lead can enter the body through inhalation of lead dust or fumes and by ingestion of lead paint chips and lead-contaminated dust, water, soil, or food. Lead accumulates in blood, bone, and soft tissue. Fetuses and small children are particularly susceptible to the toxic effects of lead, which include brain damage, behavioral alterations, decreased intelligence and slowed growth. At higher levels, exposure to lead can damage the kidneys, liver, and nervous system, and cause reproductive disorders and anemia. The USEPA's health-based NAAQS for lead in 2007 was 1.5 $\mu g/m^3$ as a three-month calendar year average. In October 2008, the USEPA adopted a new lead standard that is ten times more stringent than the one it replaced, 0.15 $\mu g/m^3$ as a rolling three-month average.

Lead is one of the metals monitored in respirable particulate matter (PM-10) at the Urban League site in Providence as part of the National Air Toxics Trends Sites (NATTS) network. In addition, lead in fine particulate matter (PM-2.5) was measured at Urban League site in 2007 on a one-in three day schedule as part of the national PM-2.5 Speciation program. A summary of Rhode Island PM-10 and PM-2.5 metals data is included in the Air Toxics section of this document.

NITROGEN DIOXIDE (NO_2) and OXIDES of NITROGEN (NOx)

Nitrogen dioxide (NO_2) belongs to a family of highly reactive gases called oxides of nitrogen (NOx). NOx forms when fuel is burned at high temperatures, and is found in the exhuast emitted by motor vehicles and stationary sources such as power plants and industrial boilers. A suffocating, brownish gas, NO_2 is a strong oxidizing agent that reacts in the air to form corrosive nitric acid, as well as toxic organic nitrates.

Breathing air with elevated NO_2 levels irritates the lungs and lowers the body's resistance to respiratory infections such as influenza. Continued or frequent exposure to high concentrations of NO_2 may cause an increased incidence of acute respiratory illness in children. Emissions of NO_2, as well as other oxides of nitrogen (NOx), contribute to the formation of ground level ozone and to other adverse environmental effects, such as acid rain and the eutrophication of coastal waters.

In 2007, Rhode Island monitored NO_2 and NOx at three sites. The East Providence and West Greenwich NO_2/ NOx monitors are located at Photochemical Assessment Monitoring Sites (PAMS). The PAMS network is designed to track the movement of ozone and its precursors (like NOx) through the region, so NOx monitoring at those locations is required only during June, July and August, when ozone levels tend to be highest. In keeping with that requirement, the NO_2/ NOx monitors in West Greenwich and East Providence were operated from June through August in 2007. The third site, which is located at Brown University in Providence, operated throughout the year.

The NAAQS for NO_2 is 0.053 ppm as an annual arithmetic mean. The NAAQS has not been exceeded in Rhode Island since monitoring for NO_2 began in 1980. In 2007, the annual arithmetic mean NO_2 concentration at the Brown University site was 0.0138 ppm, 26% of the NAAQS. There is no NAAQS for NOx. 2007 NO_2 and NOx levels are summarized in Tables 4 and 5, respectively.

As can be seen in Figure VII, NO_2 and NOx levels in the State have declined over the past ten years. NO_2 and NOx levels were both lower in 2007 than they were in 2006 and in previous years.

Table 4 Nitrogen Dioxide (NO_2) Levels Measured in Rhode Island in 2007 (ppm)

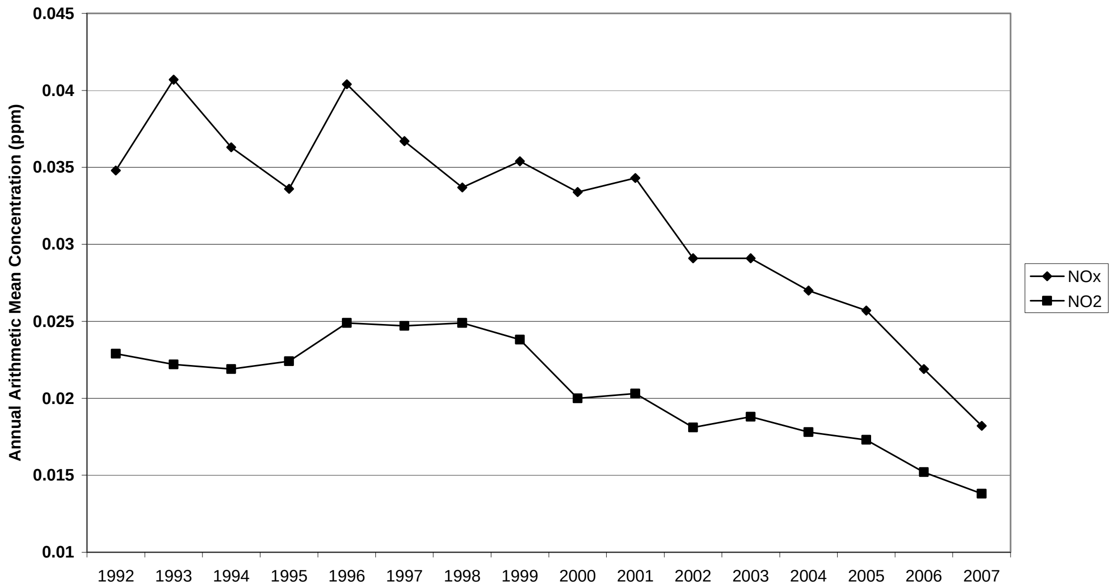
Stations	1-hour Values			Annual Mean (NAAQS = 0.053 ppm)	
	# of Observations	1st Maximum	2nd Maximum	Observed Mean	# of Exceedances
Alton Jones W. Greenwich	1,886	0.010	0.008	N/A*	N/A
Brown University 10 Prospect St. Providence	8,042	0.071	0.070	0.0138	0
Francis School 64 Bourne Ave. E. Providence	2,079	0.028	0.027	N/A*	N/A
Total					0

Table 5 Levels of Oxides of Nitrogen (NOx) Measured in Rhode Island in 2007 (ppm)

Stations	1-hour Values			Annual Mean
	# of Observations	1st Maximum	2nd Maximum	
Alton Jones W. Greenwich	1,886	0.011	0.010	N/A*
Brown University 10 Prospect St. Providence	7,363	0.346	0.335	0.182
Francis School 65 Bourne Ave. E. Providence	2,079	0.070	0.067	N/A*

* N/A = Not applicable. The W. Greenwich and E. Providence NO_2/NOx monitors are operated only in June, July and August. Since those monitors do not operate for the whole year, annual means can not be calculated for those sites.

Figure VII
NITROGEN DIOXIDE (NO_2) and OXIDES OF NITROGEN (NOx)
Annual Average Concentrations at Brown University, Providence Site
NO_2 Standard = 0.053 ppm



OZONE (O_3)

Ozone (O_3) is a photochemical oxidant which is the major component of smog. Elevated concentrations of ground level ozone are a major health and environmental concern. Ozone is formed in the atmosphere when hydrocarbons and oxides of nitrogen (NOx) emitted by mobile and stationary sources react in the presence of elevated temperatures and sunlight.

Because airborne hydrocarbons and NOx, as well as ozone itself, can be transported over long distances, sources emitting ozone precursors in states upwind of Rhode Island contribute to the State's ozone problem. Ozone levels in Rhode Island generally are highest on hot sunny summer days when the winds are from the west or southwest. Rhode Island was previously classified as a serious nonattainment area for the one-hour average NAAQS for ozone and is a moderate nonattainment area for the 1997 8-hour average ozone standard.

People exposed to elevated ozone levels experience eye, nose and throat irritation; coughing; chest pain; shortness of breath; decreased lung function; headache; and fatigue. Repeated exposures can increase susceptibility to respiratory infection and lung inflammation, and can aggravate preexisting respiratory diseases, such as asthma. Long-term exposures can cause irreversible changes in the lungs, leading to chronic respiratory illnesses such as emphysema and chronic bronchitis and to premature aging of the lungs.

Children, who are frequently active outside during the summertime when ozone levels are at their highest, are at a high risk for ozone-related effects. Adults who work or exercise outside and people with respiratory and heart diseases are also at an increased risk. Elevated ozone levels also reduce agricultural and commercial forest yields; reduce the growth and survivability rates of tree seedlings; increase tree and plant susceptibility to disease, pests and other environmental stresses; and have long-term effects on forests and ecosystems.

In 1997, after a lengthy scientific review, the USEPA determined that the one-hour average ozone NAAQS, 0.12 ppm, was not sufficiently stringent to protect public health and the environment and promulgated a new ozone standard of 0.08 ppm as an 8-hour average. The 8-hour standard was further strengthened to 0.075 ppm in May 2008. Although the 1-hour standard was revoked by the USEPA effective June 1, 2005, one-hour average ozone concentrations are shown in Table 6a for information purposes.

Ozone monitors were operated at three Rhode Island sites, Alton Jones in West Greenwich, the Francis School in East Providence and the USEPA Laboratory in Narragansett, during the 2007 ozone season (April - September). Since the NAAQS that was in place in 2007, 0.08 ppm, has only one significant digit, levels at or above 0.085 ppm are considered exceedances of that standard. In 2007, exceedances occurred at one or more of the Rhode Island sites on eight days: May 25th; June 1st, 2nd, 26th, 27th, and 28th; July 8th and August 3rd. Exceedances were recorded on six days at the West

Greenwich , on four days at the East Providence site and on three days at the Narragansett site. The highest 8-hour concentration recorded, at the Narragansett site, was 0.100 ppm, 118% of the 0.085 ppm exceedance level. 2007 8-hour average ozone levels are summarized in Table 6b.

A monitor is in violation of the 8-hour ozone NAAQS if the average of the fourth highest daily maximum 8-hour concentrations for each year in a three-year period, the design value, is greater than or equal to 0.085 ppm. Rhode Island design values for the 2005 – 2007 period were 0.086 ppm for the West Greenwich site, 0.084 for the East Providence site and 0.084 ppm for Narragansett. Therefore, only the West Greenwich monitor violated the 8-hour NAAQS for ozone during that time period. Note, however, that all of these design values exceed the revised 8-hour ozone NAAQS that was promulgated in 2008, 0.075 ppm.

Since a decline in the early 1990's, there has been no clear trend in the number of days per year that the 8-hour ozone standard is exceeded in the State, as can be seen in Figure VIII. Ozone concentrations in any given year are significantly influenced by the weather patterns that occur during the summer of that year. Since the summer of 2007 was warm and humid, the numbers of 8-hour exceedances at the West Greenwich and East Providence sites in 2007 were higher than during the cooler summer of 2006.

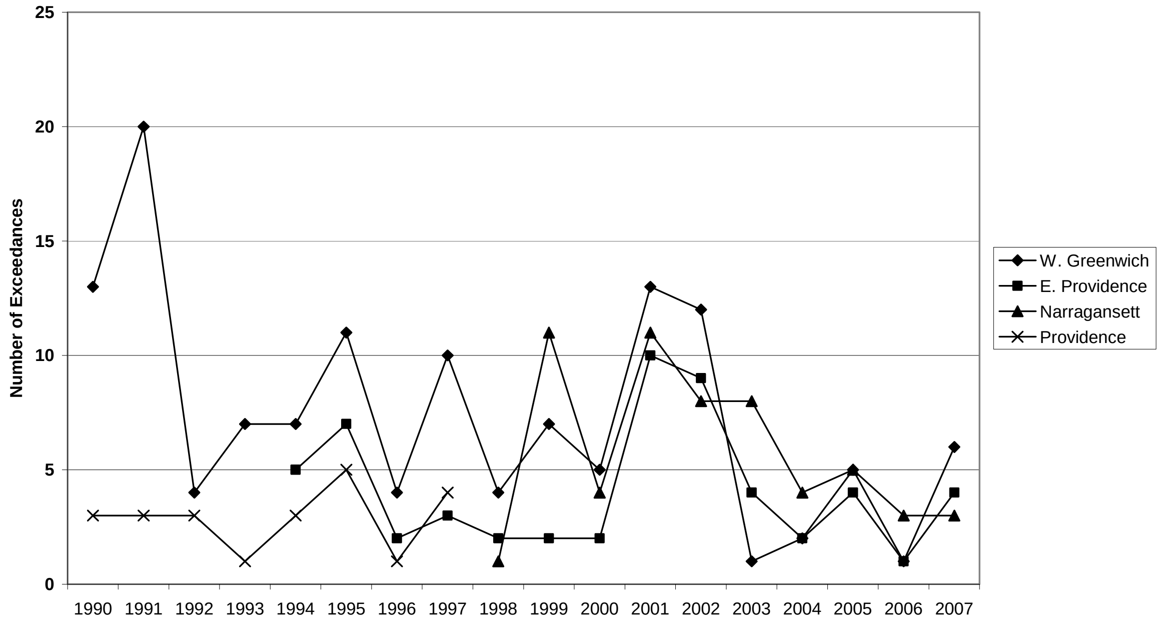
Table 6a One-Hour Average Ozone Levels Measured in Rhode Island in 2007(ppm) (No NAAQS)

Stations	# of Observations	1st Maximum	2nd Maximum	3rd Maximum	4th Maximum
Alton Jones W. Greenwich	180	0.111	0.101	0.100	0.098
Francis School 10 Prospect St. E. Providence	179	0.104	0.102	0.102	0.101
EPA Laboratory 27 Tarzwell Dr. Narragansett	182	0.104	0.104	0.103	0.099
Total					

Table 6b Eight-Hour Average Ozone Levels Measured in Rhode Island in 2007 (ppm) (NAAQS = 0.08 ppm in 2007)

Stations	# of Observations	1st Maximum	2nd Maximum	3rd Maximum	4th Maximum	# of Exceedances
Alton Jones W. Greenwich	180	0.092	0.092	0.091	0.089	6
Francis School 10 Prospect St. E. Providence	176	0.096	0.090	0.089	0.088	4
EPA Laboratory 27 Tarzwell Dr. Narragansett	181	0.100	0.089	0.085	0.083	3
Total						13

Figure VIII
OZONE (O3)
Exceedances of the 8-Hour Standard
8-Hour Standard = 0.08 ppm



PARTICULATE MATTER

Airborne particulate matter (PM) is generated by the operation of mobile and stationary sources, including diesel trucks, wood stoves, power plants, and industrial processes, as well as by natural and human activities. PM is both emitted directly from sources and formed in the atmosphere by chemical reactions of gaseous pollutants. The chemical and physical compositions of airborne particles vary widely.

The NAAQS for PM focus on small particles, because inhaled small particles can travel to the lower regions of the respiratory tract and are therefore associated with significant health effects. The PM-10 standard regulates particles with diameters of 10 micrometers (one-seventh the width of a human hair) or less and the PM-2.5 or fine particulate standard regulates particles with diameters equal to or smaller than 2.5 micrometers.

Exposure to PM is linked to a variety of health effects, including coughing, difficult or painful breathing, chronic bronchitis, aggravated asthma, increased respiratory-related hospital admissions and emergency room visits, and premature death. The elderly, children, and people with heart or lung diseases like emphysema, bronchitis and asthma are at particular risk for those effects. Airborne PM also impairs visibility and can soil and damage materials.

Rhode Island has monitored PM-10 since 1985 and PM-2.5 since 1999.

PM-10

In 2007, Rhode Island operated a network of four PM-10 monitoring sites: the Johnson and Wales library on Dorrance Street in downtown Providence; Vernon Street, Pawtucket, adjacent to Route I-95*;* the Urban League building in urban South Providence and the Alton Jones campus of the University of Rhode Island in West Greenwich, a background rural site. PM-10 samples collected at the Urban League, which is the State's NATTS site, are also analyzed for metals; metals results are discussed in the air toxics section of this document.

The NAAQS for PM-10 is 150 $\mu g/m^3$ as a 24-hour average. The annual NAAQS for PM-10, which was in effect in previous years, was revoked effective December 2006. The PM-10 standard has not been exceeded in Rhode Island since PM-10 monitoring began in 1985. As is shown in Table 7a, the maximum 24-hour PM-10 concentration in 2007, which was measured at the Vernon Street, Pawtucket site, was 54 $\mu g/m^3$, 36% of the NAAQS.

Figure IX shows the annual average PM-10 levels measured in the past ten years. Until 2002, the Allens Avenue monitor, which was located immediately adjacent to Route I-95 in Providence, routinely recorded the highest PM-10 levels in the State. That site reflected worst-case PM-10 levels and was not representative of neighborhood exposures.

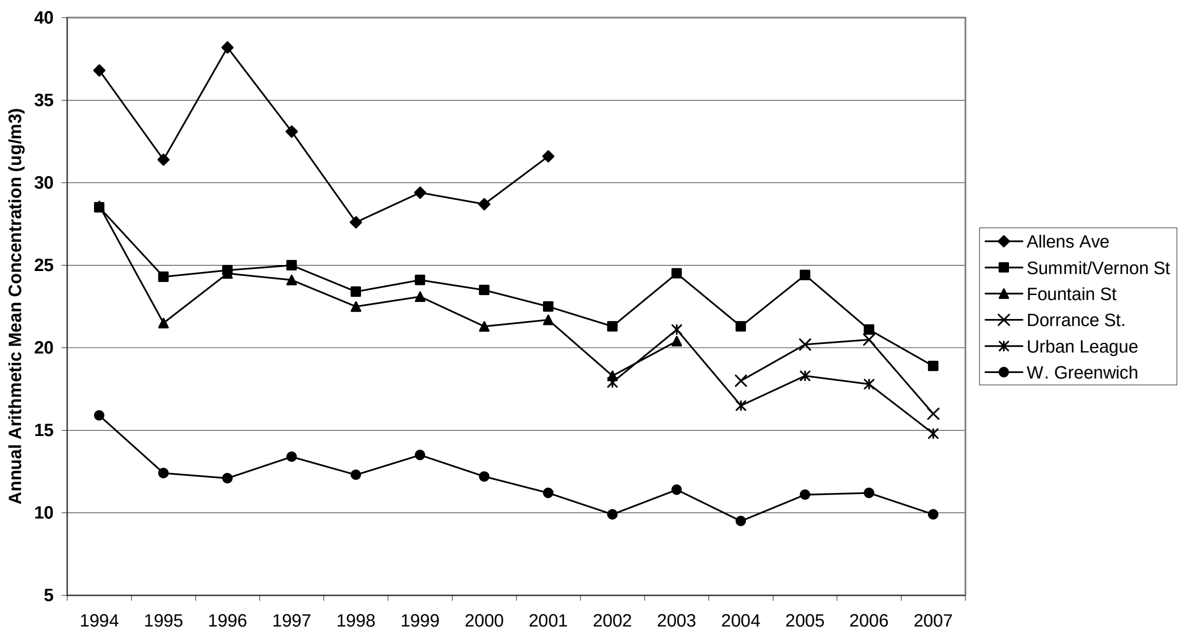
Monitoring at the Allens Avenue site was discontinued in 2002 due to extensive construction and demolition activity in the area around the monitor associated with a highway relocation project. Since the discontinuation of monitoring at the Allens Avenue site, the highest annual mean PM-10 concentrations in the State have been recorded at the Vernon Street site, which is located near Rte. I-95 in Pawtucket, The annual mean PM-10 concentration, as well as the maximum 24-hour concentration at the Vernon Street site in 2007 were nearly double the concentrations at the rural W. Greenwich site.

As can be seen in Figure IX, the average PM-10 concentrations at the Rhode Island sites show a slight downward trend over the past ten years; the annual average levels at all four of the sites were slightly lower in 2007 than in the previous year.

Table 7a PM–10 Concentrations in Rhode Island in 2007(ug/m3)
NAAQS = 150 ug/m3 (24-hour average)

Stations	24-hour Values						Annual Mean
	# Of Observations.	1st Maximum	2nd Maximum	3rd Maximum	4th Maximum	# of Exceedances	
Vernon St. Pawtucket	55	54	52	35	32	0	18.9
Alton Jones W. Greenwich	57	26	24	21	21	0	9.9
212 Prairie Ave. Providence	60	30	27	27	26	0	14.8
111 Dorrance St. Providence	58	31	29	27	27	0	16.0
Totals						0	

Figure IX
PARTICULATE MATTER (PM-10)
Annual Average Concentrations
Standard = 50 ug/m³



FINE PARTICULATE MATTER (PM-2.5)

As discussed above, an NAAQS for PM-2.5 was promulgated in July 1997. In 1999, RI DEM began operating a network of PM-2.5 monitors to determine whether Rhode Island was in compliance with those standards. The 24-hour PM-2.5 NAAQS was updated in December 2006. Rhode Island is in attainment of the original and updated standards.

PM-2.5 was measured at five sites in the State in 2007. Urban core sites, which reflect population exposure in urban areas, are located at the Urban League building on Prairie Avenue in Providence; at the Vernon Street monitoring trailer in Pawtucket, adjacent to Route I-95; on the roof of a building on Eddy Street in Providence and at a trailer adjacent to the Francis School in East Providence, which is frequently downwind of the Providence metropolitan area. A background/transport rural site is located at the Alton Jones campus of the University of Rhode Island in West Greenwich. PM-2.5 samples are collected daily at the Urban League and East Providence sites and every 3rd day at the other sites. The West Greenwich, Pawtucket, and Urban League sites are also PM-10 sites.

Rhode Island also operates continuous PM-2.5 Beta Attenuation Monitors (BAMs) at three sites - the Urban League site, the West Greenwich site and the USEPA laboratory in Narragansett, a coastal site where ozone is also measured. The BAMs operated in 2007 do not produce data that are identical to those produced by the filter-based Federal

Reference Method (FRM), and, thus, those data cannot be used for determining compliance with the NAAQS. However, the continuous monitors provided real-time data which are vital for forecasting PM-2.5 levels, for issuing health alerts, for calculating the AQI and for tracking hourly PM-2.5 levels.

Rhode Island has measured speciated PM-2.5 levels in the State since June 2002. Speciated PM-2.5 samples were collected at the East Providence site every 6th day from June 2002 until May 2004. Speciation sampling at the Urban League site began in June 2002 on the one in six day schedule, but the frequency was increased to one in three days in May 2004, when the East Providence speciation measurements were discontinued. Speciation monitors provide data on the composition of PM-2.5 which are useful for identifying sources and for characterizing the toxicity of this pollutant.

In 2006, the 24-hour average NAAQS for PM-2.5 was reduced from 65 $\mu g/m^3$ to 35 $\mu g/m^3$. A monitor is in attainment of that NAAQS if the 98th percentile value of the 24 hour average concentrations measured at that site does not exceed that level. The annual average NAAQS for PM-2.5, 15 $\mu g/m^3$, remained unchanged. In 2007, the 98th percentile 24-hour concentrations at all of the Rhode Island sites were below the new 24-hour PM-2.5 standard. The annual average concentrations were also below the corresponding NAAQS. As can be seen in Table 7b, in 2007 the highest 98th percentile 24-hour concentration, recorded at both the Eddy Street and the Vernon Street sites, was 31.0 $\mu g/ m^3$, 89% of the new NAAQS, and the highest annual average, which was measured at the Vernon Street site, was 11.68 $\mu g/m^3$, 78% of the annual NAAQS.

Although the amended PM-2.5 24-hour NAAQS, 35 $\mu g/m^3$, is considerably more stringent than the previous value, a number of experts recommended that the USEPA adopt an even more stringent standard, e.g. 30 $\mu g/m^3$, to protect sensitive members of the public. As discussed above, Rhode Island is in attainment of the NAAQS; however, on some days elevated levels of PM-2.5 occur that may pose health threats to sensitive individuals. In 2007, PM-2.5 levels at or above 35 $\mu g/m^3$ were recorded at one or more Rhode Island monitoring site on two days and levels at or above 30 $\mu g/m^3$ were recorded on six days. Unlike ozone, elevated PM-2.5 levels can occur in the cooler months as well as during the summer.

As can been seen in Figure X, annual average PM-2.5 concentrations at the Rhode Island sites have been consistently lower than the annual average NAAQS since measurement of that pollutant began. The 24-hour concentrations measured at all of the currently operating sites, except for that measured at the Vernon Street site in 2003, have been below the new short-term PM-2.5 standard, as shown in Figure XI.

Table 7b PM-2.5 Concentrations in Rhode Island in 2007 (ug/m3)
2007 NAAQS = 35 ug/m3 (24-hour average), 15ug/m3 (annual mean)
FRM (Federal Reference Method) DATA SUMMARY

Stations	24-hour Values							Annual Mean
	# of Observations .	1st Maximum	2nd Maximum	3rd Maximum	4th Maximum	98th Percentile	# of Days that Exceeded 24-hr NAAQS	
Francis School E. Providence	347*	43.7	40.7	32.6	29.6	27.5	2	9.21
Vernon St Pawtucket	114**	34.8	32.1	31.0	29.5	31.0	0	11.68
Alton Jones W. Greenwich	113**	38.1	26.1	25.7	25.3	25.7	1	8.47
Prairie Avenue Providence	347*	43.2	31.2	29.8	29.7	27.1	1	9.52
695 Eddy St Providence	117**	30.4	30.1	28.3	28.0	28.3	0	10.47

*Samples collected daily at this site.
**Samples collected every 3rd day at this site.
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Figure X
FINE PARTICULATE MATTER (PM-2.5)
Annual Average Concentrations
Stamdard = 15 ug/m^3

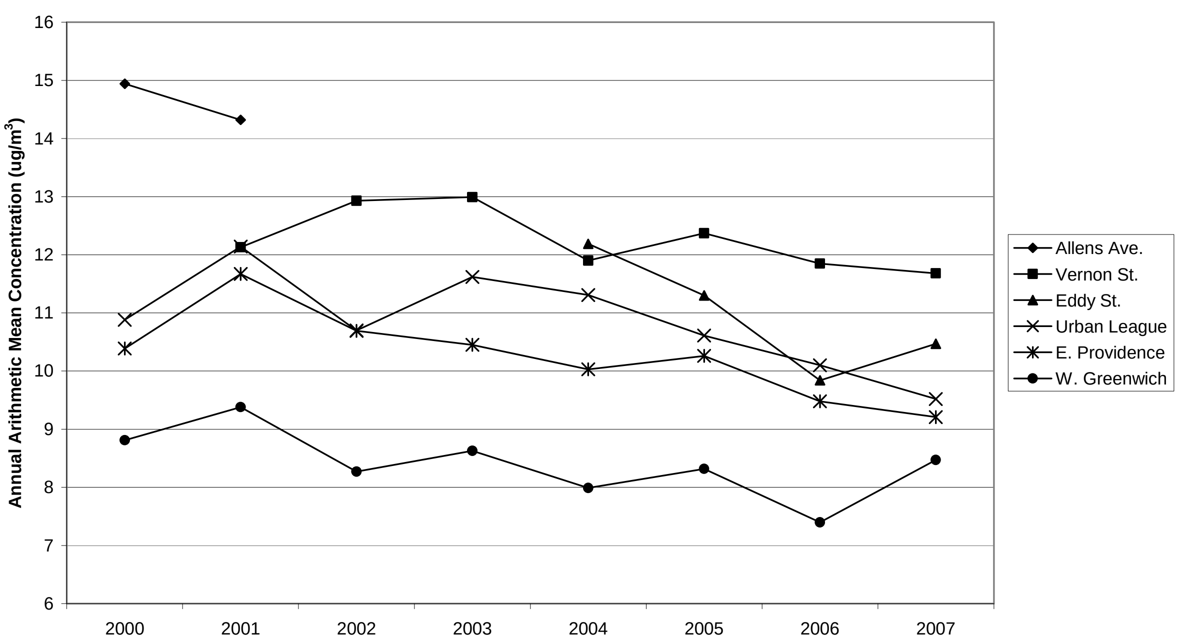
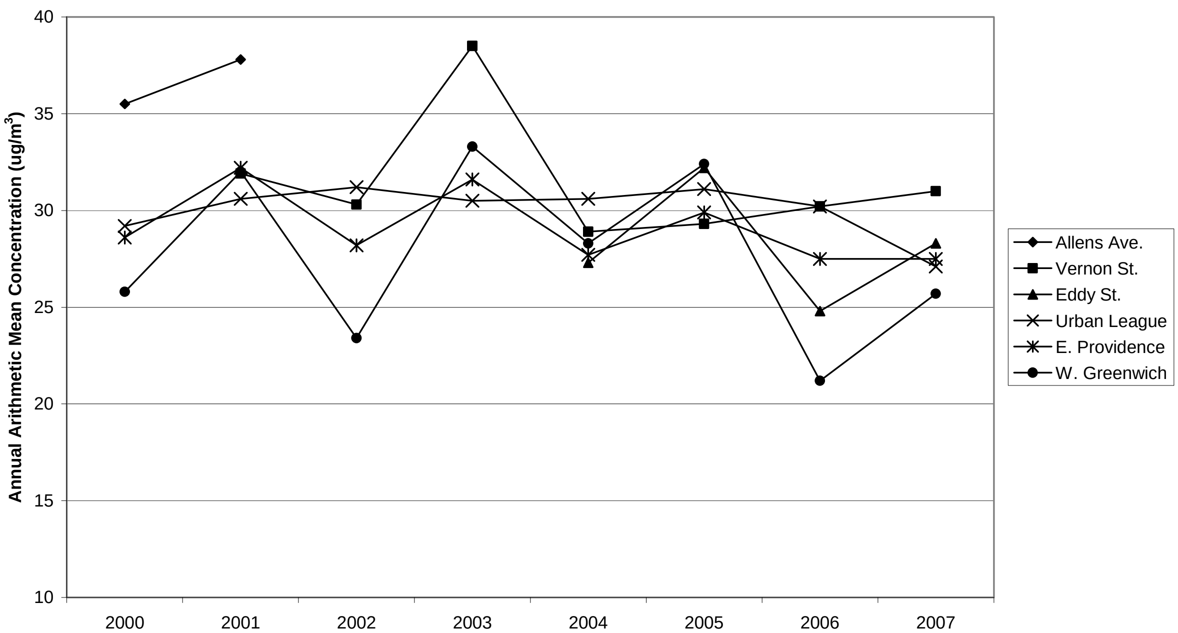


Figure XI
FINE PARTICULATE MATTER (PM-2.5)
24-Hour Concentrations (98th percentile)
2006 Standard = 35 ug/m^3



PM-coarse

In 2007, Rhode Island began operation of a low-volume PM-10 monitor at the Urban League site. This monitor uses the same technology as do the PM-2.5 Federal Reference Method monitors operated in the State. The low-volume PM-10 measurements, along with the Urban League PM-2.5 measurements, allow Rhode Island to calculate the concentration of PM-coarse, which is particulate matter with diameters above 2.5 microns and below 10 microns. Currently, there is no NAAQS for PM-coarse, but, since health effects have been linked exposure to PM in that size category, a standard may be promulgated in the future.

In the first year of operation, the PM-10 concentrations measured by the low-volume monitor correlated well with and were, on average, approximately 2 µg/m^3 higher than, the concentrations measured by the high volume PM-10 sampler at that site. The average PM-2.5 concentration at the Urban League site was approximately 55% of the low-volume PM-10 concentration, so the PM-coarse fraction accounted for, on average, approximately 45% of the low-volume PM-10 levels.

SULFUR DIOXIDE (SO_2)

Sulfur dioxide (SO_2) is emitted primarily by sources burning fossil fuels to produce heat or electricity. Exposures to high concentrations of SO_2 cause respiratory illness, alterations in pulmonary defenses, and aggravation of existing cardiovascular disease. Children, the elderly, and people with asthma, cardiovascular disease or chronic lung disease such as bronchitis or emphysema are most susceptible to the adverse health effects of SO_2.

SO_2 combines with water in the atmosphere to form sulfates, which can cause acidification of lakes and streams, accelerated corrosion of buildings and monuments, reduced visibility, and adverse health effects.

The primary (health-based) NAAQS for SO_2 are 0.03 ppm as an annual arithmetic mean and 0.14 ppm as a 24-hour average. The USEPA has also set a secondary NAAQS for SO_2, 0.50 ppm as a three- hour average, to protect the environment, property, and aesthetics. The State of Rhode Island has been in compliance with these standards since 1975.

In 2007, SO2 was monitored at two sites, Brown University and Dorrrance Street, both in Providence. As with CO, RI DEM determined that the usefulness of the data currently collected by the SO_2 monitors in Rhode Island is limited, because concentrations have been consistently below the NAAQS since measurements began, current levels are significantly below the NAAQS, and, since all SO_2 readings in the past five years have been in the "good" air quality range, these measurements have not been provided useful health related information for the AQI.
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The 2006 revisions to USEPA's monitoring regulations discussed above eliminated minimum requirements for SO_2 monitoring networks, except that SO_2 monitoring will be required at NCore sites when they are established. Since the current SO_2 monitors are not generating data that are useful for determining compliance with the NAAQS or for the AQI, operation of the SO_2 monitor at the Dorrance St. site was discontinued at the end of June 2007. Operation of the SO_2 monitor at the Brown University site will be continued at least until monitoring for that pollutant at the NCore site begins.

In 2007, the highest annual average SO_2 concentration measured in Rhode Island was 0.0050 ppm, 17% of the NAAQS; the highest 24-hour concentration was 0.026 ppm, 34% of the NAAQS; and the highest 3-hour concentration was 0.042 ppm, 14% of the secondary NAAQS. All of these measurements were at Brown University. (See Table 8).

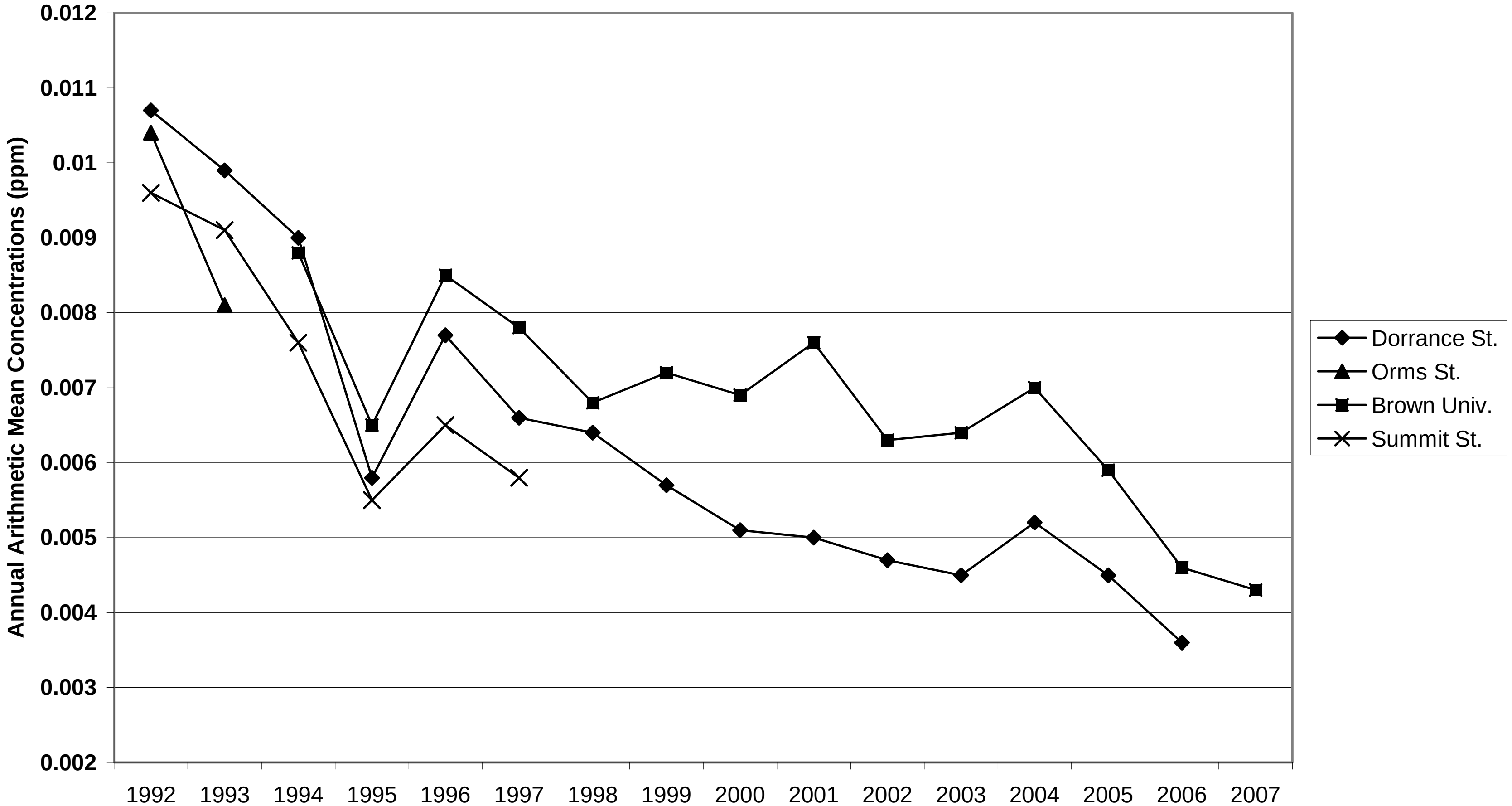
Figure XII shows annual arithmetic mean concentrations of SO_2 at Rhode Island monitoring sites between 1992 and 2007. Annual mean SO_2 concentrations show a downward trend during that time period.

Table 8 Rhode Island 2007 Sulfur Dioxide (SO_2) Levels

Stations	1-Hour Values			3-Hour Values (NAAQS = 0.50 ppm)			24-hour Values (NAAQS = 0.14 ppm)			Annual Mean (NAAQS = 0.03 ppm)
	# of Obser-vations	1st Maximum	2nd Maximum	1st Maximum	2nd Maximum	# o f Exceed -ances	1st Maximum	2nd Maximum	# of Exceed -ances	
Brown Univer. 10 Prospect St. Providence	8,171	0.047	0.046	0.042	0.039	0	0.026	0.018	0	0.0043
76 Dorrance St. Providence (1/07 – 6/07)*	4,091	0.029	0.028	0.026	0.026	0	0.014	0.013	0	
Totals						0			0	

*Operation of the Dorrance St. monitor was discontinued at the end of June 2007.

Figure XII
SULFUR DIOXIDE (SO_2)
Annual Average Concentrations
Standard = 0.03 ppm



PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS)

Although ground-level ozone concentrations in Rhode Island have decreased over the past ten years, the State, as well as much of the rest of the Northeast, continues to violate the ozone NAAQS.

Ground level ozone is a regional problem; ozone precursors (NOx and VOCs) emitted in one state can contribute to elevated ozone levels in states that are many miles downwind. The photochemical reactions involved in ozone formation are influenced by a number of factors, including the relative concentrations of various precursor chemicals in the atmosphere and a variety of meteorological parameters. Therefore, identifying emissions control strategies that effectively reduce ozone levels in nonattainment areas is a complex task.

In order to obtain ambient air quality data useful for evaluating such strategies, the Clean Air Act Amendments of 1990 (CAAA) required serious, severe and extreme ozone nonattainment areas to establish enhanced monitoring networks for ozone and ozone precursors. In response to that mandate, the USEPA promulgated rules in 1993 that required the establishment of a network of Photochemical Assessment Monitoring Stations (PAMS) to measure ozone, NOx, VOCs (including carbonyls), and meteorological parameters in nonattainment areas.

Rhode Island's PAMS network in 2007 consisted of three sites: one Type 1 site, one Type 2 site and one Type 3 site. Type 1 sites are located upwind of nonattainment areas and are used to measure concentrations of pollutants entering the area. Type 2 sites are located immediately downwind of the area of maximum precursor emissions, which in Rhode Island is the Providence metropolitan area. Type 3 sites are located 10-30 miles downwind of the urban area, and are used to track the movement of precursor pollutants and the resulting formation of ozone..

Two of Rhode Island's PAMS sites are located within the State boundaries; the Type 1 site at the Alton Jones campus of the University of Rhode Island in West Greenwich and the Type 2 site at the Francis School in East Providence. Due to the proximity of the Providence metropolitan area to the Massachusetts border, the Type 3 site is located on the Great Blue Hill in Milton, Massachusetts. At the W. Greenwich Type I PAMS site, 24-hour samples VOC are collected every sixth day year round. At the Type 2 site in East Providence, eight three-hour VOC samples are collected daily and eight three-hour carbonyl samples are collected every third day during June, July and August, while 24-hour VOC and carbonyl samples are collected every sixth day year round. The Massachusetts site collects eight three-hour VOC samples every day during June, July and August.

VOC samples are analyzed for approximately 56 substances which are ozone precursors and/or air toxics. The carbonyl samples are analyzed for formaldehyde, acetaldehyde and acetone. The PAMS sites also measure ozone, NOx and surface meteorological conditions during the summer months. PAMS monitoring began at the East Providence site in 1994 and at the West Greenwich site in 1995.

The data from the Rhode Island PAMS sites, combined with results from similar sites in the other states, are being used to identify sources of ozone precursors, to track migration of those pollutants, to determine the concentrations of various toxic air pollutants in the region, to track changes in ambient levels over time, and to verify the inputs and results of regional ozone modeling.

AIR TOXICS

Many of the substances measured at the PAMS sites are air toxics as well as ozone precursors. Since the PAMS sites have been operated for a decade, data from those sites provide useful information about trends in concentrations of air toxics in Rhode Island. RI DEM began operating an air toxics monitoring site in May 2001 that became a National Air Toxics Trends Site (NATTS) in 2002. That site is located at the Urban League building in Providence, in an urban residential area that is not immediately impacted by localized industrial or commercial sources. In addition to VOCs and carbonyls, black carbon, PM-10, PM-10 metals, hexavalent chromium (Cr VI), PM-2.5, PM-coarse and speciated PM-2.5 are monitored at that site. VOCs have also been monitored at the Vernon Street, Pawtucket site, adjacent to I-95, since 2001 on a one in six day schedule.

<u>VOCs</u>

One of the toxics measured in VOC samples is benzene, a gasoline constituent known to cause leukemia in humans. The average benzene concentrations measured at the PAMS and toxics sites for the years 1995 –2007 are displayed in Figure XIII. Benzene levels dropped sharply between 1995 and 1996, probably due to the implementation of rules requiring the sale of reformulated gasoline with a reduced benzene content in late 1995. In the succeeding years, ambient benzene levels have continued to show a downward trend. In 2007, the average benzene levels at the Vernon Street, Pawtucket and Urban League, Providence sites were considerably lower in the previous year. The average benzene concentration at the East Providence site in 2007 was slightly lower than in 2006, while the level at the Alton Jones, West Greenwich site was roughly equivalent to that in the previous year.

Due to the ubiquitous nature of motor vehicle traffic, benzene, as well as other components of motor vehicle exhaust, such as the carcinogen 1,3-butadiene, are present in the ambient air throughout the State. However, the average concentrations of those pollutants are significantly higher in urban and highly trafficked areas than in more rural areas of the State. As can be seen in Figure XIV, the mean concentration of benzene in 2007 at the suburban E. Providence site was one and one-half times that at the rural site in W. Greenwich. The average benzene concentrations at the urban Providence site was twice as high as at the rural site and the level at the Pawtucket site, which is in a residential area next to the highway, was two and one-half times that at the rural site.

Intrastate variations in concentrations were even more substantial for 1,3-butadiene. The 2007 average 1,3-butadiene concentration at the E. Providence site was twice as high as that in W. Greenwich. The average concentration of 1, 3-butadiene at the urban Providence site was three times higher and at the Pawtucket site near the highway was four and one-half times higher than at the rural site in W. Greenwich.

Similarly, as shown in Figures XV and XVI, the concentrations of the industrial/commercial chlorinated cleaning solvents trichloroethylene and perchloroethylene were substantially higher at the urban locations than at the rural site. Trichloroethylene was detected in only 5% of the samples collected at the rural site in W. Greenwich in 2007. In comparison, trichloroethylene was detected in 58% of the suburban E. Providence samples and in 63 and 75% of the urban Providence and Pawtucket samples, respectively. The average concentration at the Providence site was one and one-half times that in E. Providence and the average level at the Pawtucket site was more than twice that at the E. Providence site. As shown in Figure XV, ambient trichloroethylene levels in Rhode Island have declined over the past several years; this is consistent with declines in the of use of that solvent by Rhode Island industry over that period.

The difference between urban and rural levels of perchloroethylene levels was also substantial. As shown in Figure XVI, average perchloroethylene levels at the two urban sites (Pawtucket and Providence) in 2007 were four and one-half times that at the W. Greenwich site, while the average concentration in E. Providence was three times that in W. Greenwich. Unlike trichloroethylene, however, ambient perchloroethylene levels have not shown a significant decline in recent years.

Figure XIII
BENZENE
Annual Average Concentrations

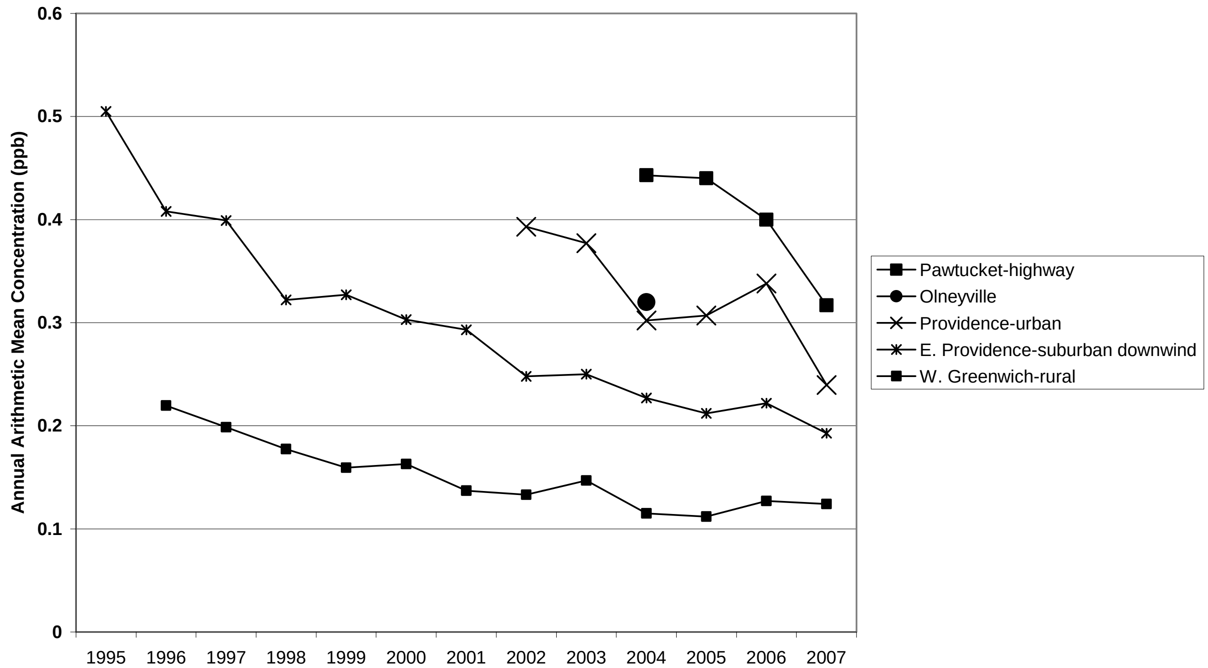


Figure XIV
MOBILE SOURCE TOXIC VOLATILE ORGANICS
2007Annual Mean Concentrations

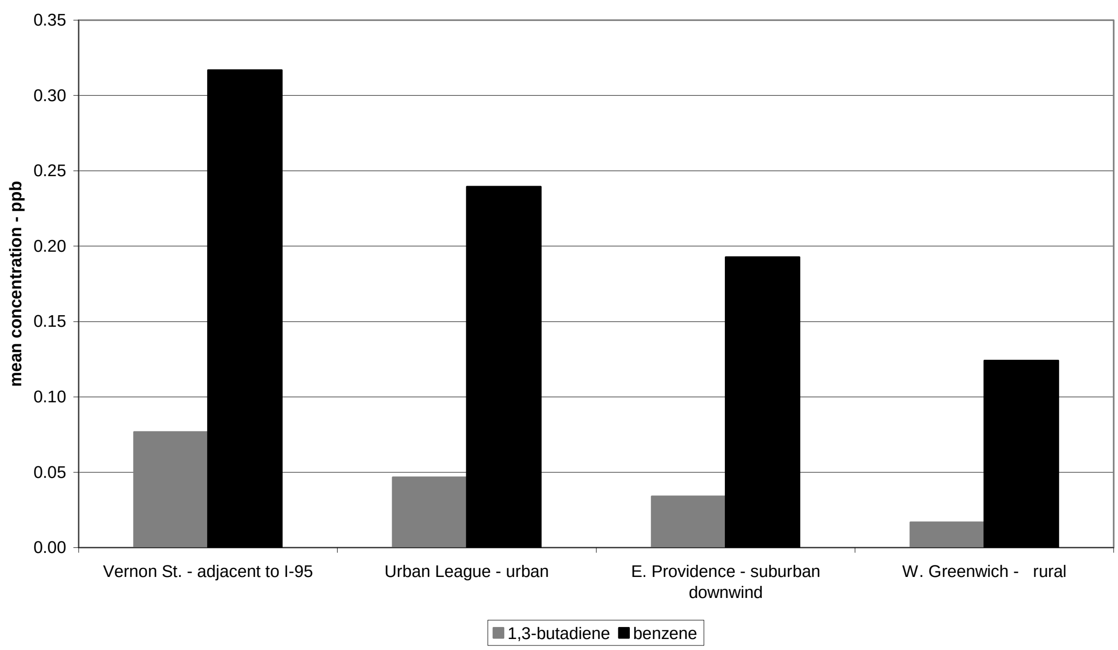


Figure XV Trends in Annual Average Trichloroethylene Levels

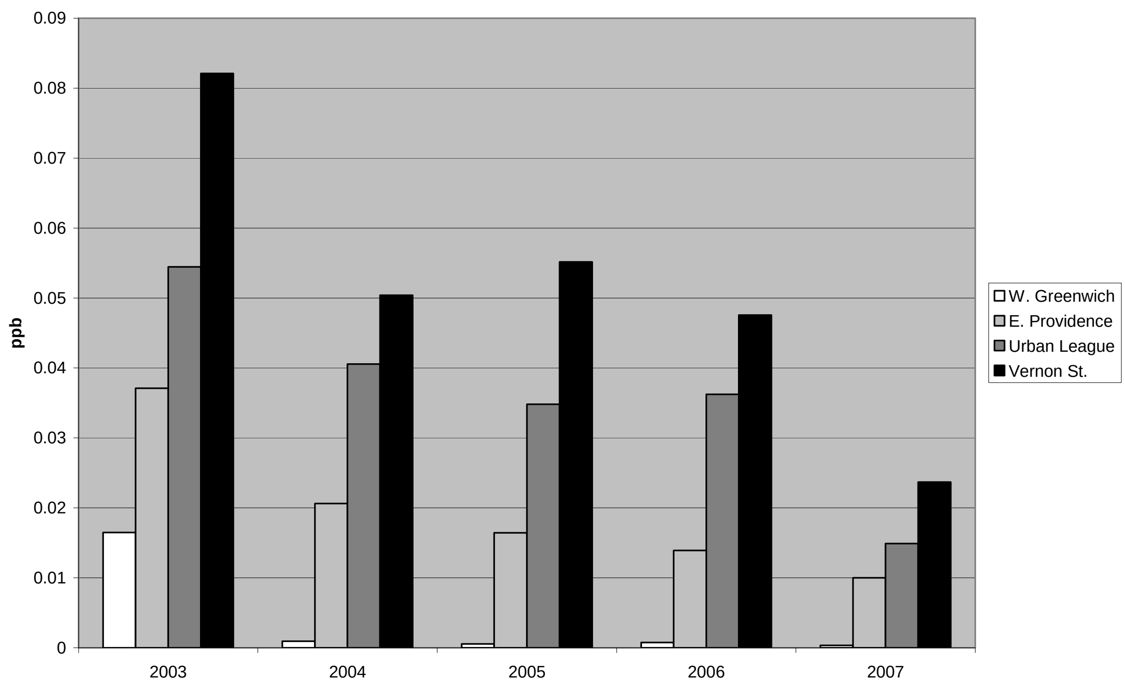
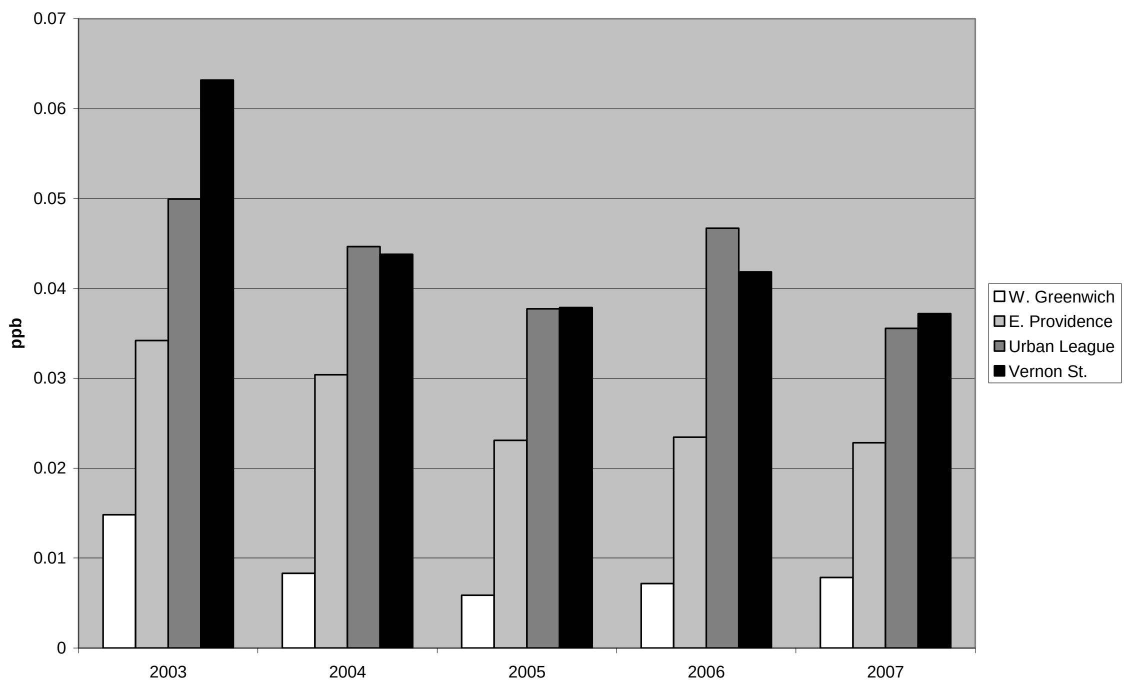


Figure XVI Trends in Annual Average Perchloroethylene Levels

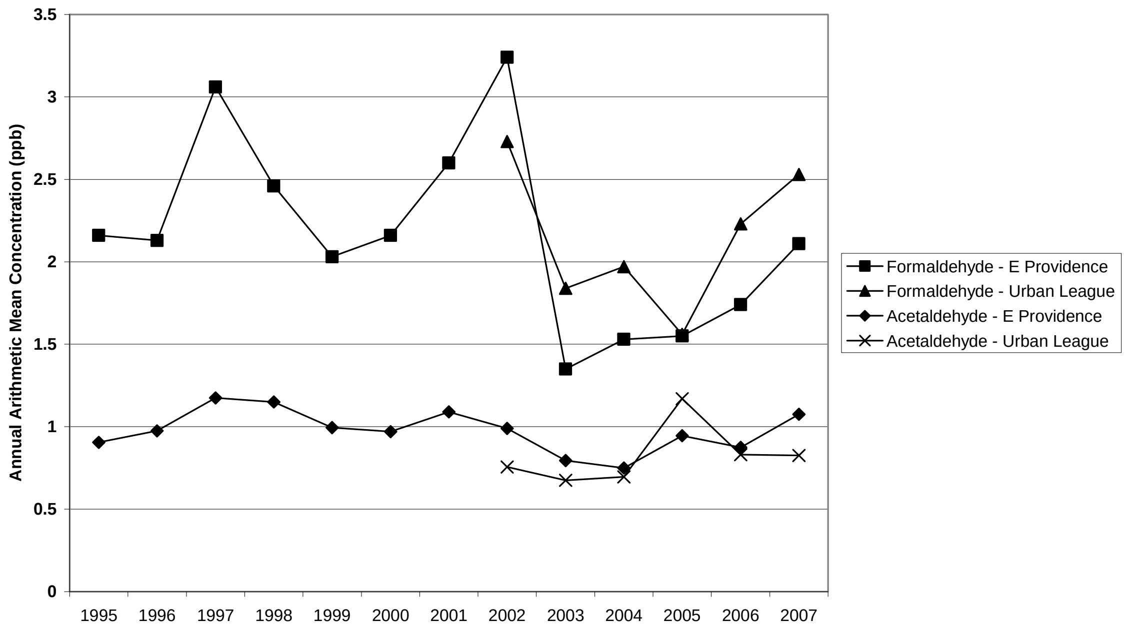


Carbonyls

Average ambient concentrations of the carbonyl compounds formaldehyde and acetaldehyde at the East Providence site for 1995 –2007 and at the Urban League site for

2002- 2007 are displayed in Figure XVII. Carbonyls are emitted by combustion sources but, like ozone, substantial amounts of carbonyls are also formed by photochemical reactions in the atmosphere. Therefore, carbonyl levels tend to be highest in the summer and average carbonyl concentrations in years with hot summers tend to be higher than in cooler years. The carbonyl levels measured to date do not show a clear trend. Average formaldehyde levels in 2007 at both sites were higher than in 2006, while acetaldehyde levels were similar to those in previous years. In four of the six years that the Urban League site has operated, including 2007, the average formaldehyde level at that site has been approximately 0.5 ppb higher than at the East Providence site. Average acetaldehyde levels at the two sites tend to be approximately equal.

Figure XVII
CARBONYLS
Annual Average Concentrations



<u>Metals</u>

At the Urban League NATTS site, RI DEM collects PM-10 samples every sixth day and those samples are analyzed for seven metals. For most of 2007, the analysis of these samples was preformed by the USEPA Region I laboratory but, in December 2007, the Rhode Island Department of Health Laboratories took over those analyses. Four of the metals, arsenic, beryllium, cadmium and chromium, were not detected or only occasionally detected in the 2007 samples. The remaining three metals, lead, manganese and nickel, were detected in most of the samples.

Since 2005, RI DEM has also sampled for hexavalent chromium (chromium VI) in total suspended particulate matter (TSP) samples collected at the Urban League site. Hexavalent chromium, the most toxic form of chromium, is a human carcinogen.

Chromium VI was not detected in the samples collected in 2007 at the detection limit for the method used.

The average concentrations of lead, manganese and nickel in the Urban League PM-10 samples are shown in Table 9. Also listed in that table are health benchmarks for those metals. The health benchmarks for lead and nickel correspond to a lifetime cancer risk of one in one million and the health benchmark listed for manganese was developed by the US Agency for Toxic Substances and Disease Registry to protect for neurological effects.

Table 9 Rhode Island 2007 Metals Levels

	2007 Mean ($\mu g/m^3$)	Health Benchmark ($\mu g/m^3$)	Mean/Benchmark
Lead (PM-10)	0.00427	0.08	0.05
Manganese (PM-10)	0.00790	0.04	0.2
Nickel (PM-10)	0.00274	0.004	0.7

For all of the metals listed in Table 9 the average concentrations measured were lower than the corresponding health benchmark, and thus would not be likely to present a significant health risk. The mean level of nickel measured was closest to the corresponding health benchmark; long-term exposure to the level measured would pose a lifetime cancer risk of slightly less than one in one million. Airborne nickel is generated by the combustion of fossil fuel by stationary and mobile sources, by incineration of metal-containing materials and by certain industrial processes.

As part of the federal PM-2.5 speciation program, lead, manganese and nickel were also measured in PM-2.5 in 2007. On days in 2007 that metals results for both PM-2.5 and PM-10 are available, the lead concentration in PM-2.5 was, on average, 54% of that in PM-10, the PM-2.5 manganese concentration was 26% of that in PM-10 and the PM-2.5 nickel concentration was 81% of that in PM-10. Therefore, lead and nickel were predominantly present in fine particles, while manganese was more highly concentrated on coarser particles (particles with diameters between 2.5 and 10 microns).

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