# Commonwealth of Massachusetts
# 2006 Air Quality Report

Executive Office of Energy and Environmental Affairs
Department of Environmental Protection
Bureau of Waste Prevention
Division of Planning and Evaluation

Air Assessment Branch
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This 2006 Air Quality Report was prepared by the Massachusetts Department of Environmental Protection (MassDEP), Air Assessment Branch (AAB), which collects representative samples of ambient air for a number of pollutants at monitoring stations located throughout the Commonwealth. All samples are collected in a precise and scientifically sound manner in order to properly characterize the quality of the air in the State and to accurately assess the exposure of its citizens to airborne pollutants.

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This report is available on MassDEP's web site at www.mass.gov/dep/air/perfor01.htm#annual.

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# List of Abbreviations

AAB ..... Air Assessment Branch
AQS..... Air Quality System
AQI…… . Air Quality Index
BAM ..... Beta Attenuation Monitor
BP..... Barometric Pressure
CAA ..... Clean Air Act
CFR..... Code of Federal Regulations
CO..... Carbon Monoxide
$CO_2$..... Carbon Dioxide
DVMT..... Daily Vehicle Miles Traveled
EOEEA ..... Executive Office of Energy and Environmental Affairs
FRM ..... Federal Reference Method
IMPROVE ... Interagency Monitoring of Protected Visual Environments
MassDEP..... Massachusetts Department of Environmental Protection
$mg/m^3$ ..... milligrams per cubic meter
NAAQS..... National Ambient Air Quality Standards (for criteria pollutants)
NADP..... National Atmospheric Deposition Program
NAMS ..... National Air Monitoring Stations
NATTS..... National Air Toxics Trends Station
NESCAUM .. Northeast States for Coordinated Air Use Management
NOAA ..... National Oceanic and Atmospheric Administration
NO..... Nitric Oxide
$NO_x$ ..... Nitrogen Oxides
$NO_y$ ..... Total Reactive Oxidized Nitrogen
$NO_2$ ..... Nitrogen Dioxide
$NO_3$ ..... Nitrate
NPN..... NOAA Profiler Network
$O_3$ ..... Ozone
PAMS..... Photochemical Assessment Monitoring Stations
Pb ..... Lead
PEI..... Periodic Emissions Inventory
pH..... Concentration of hydrogen cations ($H^+$) in solution (an indicator of acidity)
ppb..... parts per billion by volume
ppm ..... parts per million by volume
$PM_{2.5}$ ..... Particulate matter ≤ 2.5 microns aerodynamic diameter
$PM_{10}$ ..... Particulate matter ≤ 10 microns aerodynamic diameter
PSI..... Pollutant Standards Index
QA/QC ..... Quality Assurance and Quality Control
RH..... Relative Humidity
SIP..... State Implementation Plan
SLAMS ..... State and Local Air Monitoring Stations
$SO_2$ ..... Sulfur Dioxide
$SO_4$ ..... Sulfate
Solar Rad….. Solar Radiation
TSP..... Total Suspended Particulates
$ug/m^3$ ..... micrograms per cubic meter
USEPA..... United States Environmental Protection Agency
VOCs..... Volatile Organic Compounds
WS/WD..... Wind Speed/Wind Direction

# Section I
# Ambient Air Monitoring Program

## Program Overview

### Introduction

The Massachusetts Department of Environmental Protection (MassDEP) monitors outdoor air quality and requires emission controls, as necessary, for pollutants that adversely affect public health, welfare, and the environment.

MassDEP's Air Assessment Branch (AAB) collects ambient air quality data from monitoring sites located throughout Massachusetts. During 2006, MassDEP operated a network of 28 monitoring stations located in 20 cities and towns, and oversaw a separate privately-funded industrial network of four monitoring stations located at industrial facilities in the Boston area. MassDEP also received data from the Wampanoag Tribe of Gay Head (Aquinnah), which began operating an ozone monitor in 2003 on Martha's Vineyard. The tribal air quality data is listed at www.epa.gov/ne/aqi/.

MassDEP submits all ambient air quality data to the national Air Quality System (AQS) database that is administered by the U.S. Environmental Protection Agency (USEPA).

### Why is Air Quality Data Collected?

Ambient air quality data is used for a number of purposes, including:

- to verify compliance with National Ambient Air Quality Standards;
- to support development of policies and regulations designed to reduce ambient air pollution;
- to assess the effectiveness of existing air pollution control strategies;
- to provide information about air quality to the public;
- to support long-term trend analysis and special research; and
- to fulfill USEPA reporting requirements for ambient air quality data.

### What is Monitored?

MassDEP monitors parameters in the following categories:

**Criteria pollutants** are subject to National Ambient Air Quality Standards (NAAQS). The criteria pollutants monitored are:

- sulfur dioxide ($SO_2$)
- ozone ($O_3$)
- carbon monoxide (CO)
- nitrogen dioxide ($NO_2$)
- lead (Pb)
- particulate matter ≤10 microns ($PM_{10}$)
- particulate matter ≤ 2.5 microns ($PM_{2.5}$)

**Non-criteria pollutants** have no established National Ambient Air Quality Standards; however, some of these pollutants are subject to emissions limits in facility permits issued by MassDEP. The non-criteria pollutants monitored are:

- nitric oxide (NO)
- total nitrogen oxides ($NO_x$)
- total reactive oxidized nitrogen ($NO_y$)
- total suspended particulates (TSP)
- volatile organic compounds (VOCs) – ozone precursors and reaction product chemicals
- black carbon
- acid deposition – measured as pH and conductivity of precipitation
- toxics – health-relevant VOCs, aldehydes and metals

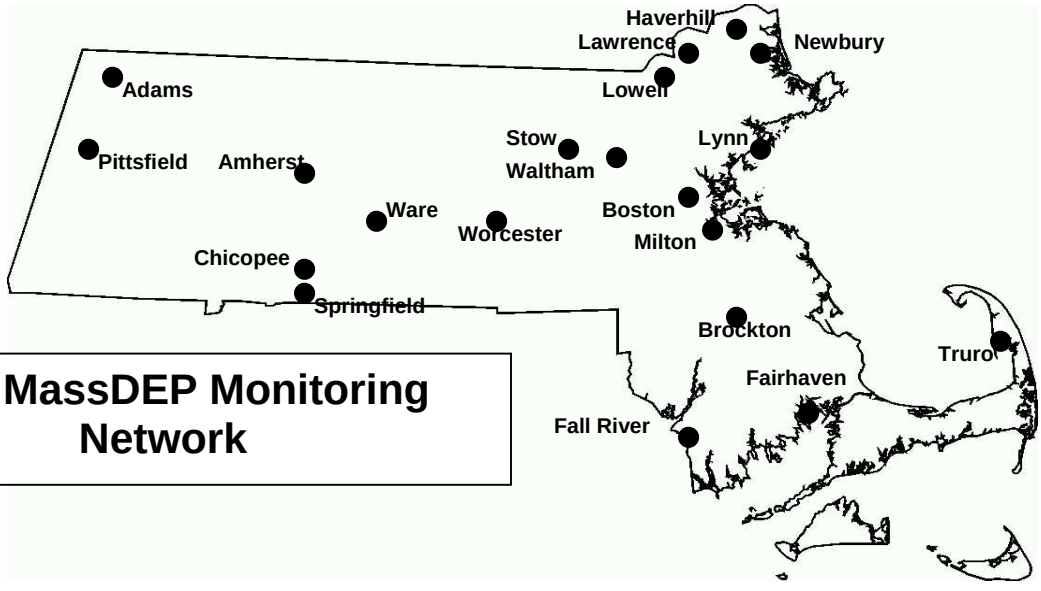
**Meteorological parameters** monitored are:

- wind speed/wind direction (WS/WD)
- relative humidity (RH)
- temperature (TEMP)
- barometric pressure (BP)
- solar radiation (Solar Rad)
- upper air wind and temperature (Profiler)
- total B band ultraviolet radiation (UVB)
- precipitation (PRECIP)

## Monitoring Station Locations

Monitoring stations are sited to provide data for various purposes. Some are located in "hot spots" where maximum pollutant concentrations are expected, while others are located in areas that will provide data that is representative of larger geographic areas. Local topography and the location of pollutant sources are factors that determine how well a particular monitor location will represent an area.

Networks of monitors are located throughout the state. These networks are designed to reflect pollutant concentrations for all of Massachusetts. Section III contains data summaries for each pollutant measured and maps showing the monitor locations for each network. Appendix A contains a list of the monitor locations. The map below shows Massachusetts cities and towns where air monitors were located during 2006.




**2006 MassDEP Monitoring Network**

## For Further Information

For further information about this report, please contact MassDEP's Air Assessment Branch. For information about general air quality topics, please contact MassDEP's Bureau of Waste Prevention or visit MassDEP's website at www.mass.gov/dep/air. You can also contact one of MassDEP's Regional Offices. To find out what region you are in, go to www.mass.gov/dep/about/regional.htm. To view online air quality data for Massachusetts and other states, go to USEPA's website at www.epa.gov/air/data.

| | |
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## National Ambient Air Quality Standards

**Primary Standards** – designed to protect public health against adverse health effects with a margin of safety.

**Secondary Standards** – designed to protect against damage to crops, vegetation, and buildings.

| POLLUTANT | AVERAGING TIME* | PRIMARY | SECONDARY |
|---|---|---|---|
| $SO_2$ | Annual Arithmetic Mean | 0.03 ppm (80 ug/m³) | None |
| | 24-Hour | 0.14 ppm (365 ug/m³) | None |
| | 3-Hour | None | 0.50 ppm (1300 ug/m³) |
| CO | 8-Hour | 9 ppm (10 mg/m³) | Same as Primary Standard |
| | 1-Hour | 35 ppm (40 mg/m³) | Same as Primary Standard |
| $O_3$ ** | 8-Hour | 0.08 ppm (157 ug/m³) | Same as Primary Standard |
| • The 8-hour standard is met when the 3-year average of the 4th-highest daily maximum 8-hour average does not exceed 0.08 ppm at any one monitor. | | | |
| Pb | Calendar Quarter Arithmetic Mean | 1.5 ug/m³ | Same as Primary Standard |
| $NO_2$ | Annual Arithmetic Mean | 0.053 ppm (100 g/m³) | Same as Primary Standard |
| $PM_{2.5}$ *** Particulates up to 2.5 microns in size | Annual Arithmetic Mean | 15.0 ug/m³ | Same as Primary Standard |
| | 24-Hour | 35 ug/m³ | Same as Primary Standard |
| • The annual standard is met when the annual average of the quarterly mean $PM_{2.5}$ concentrations is less than or equal to 15 ug/m³ (3-year average). If spatial averaging is used, the annual average from all monitors within the area may be averaged in the calculation of the 3-year mean.<br>• The 24-hour standard is met when the 98th percentile value is less than or equal to 35 ug/m³ (3-year average). | | | |
| $PM_{10}$*** Particulates up to 10 microns in size | Annual Arithmetic Mean | 50 ug/m³ | Same as Primary Standard |
| | 24-Hour | 150 ug/m³ | Same as Primary Standard |
| • The $PM_{10}$ standard is based upon estimated exceedance calculations described in 40 CFR Part 50, Appendix K.<br>• The annual standard is met if the estimated annual arithmetic mean does not exceed 50 ug/m³. Please note that USEPA revoked the annual standard effective December 18, 2006.<br>• The 24-hour standard is attained if the estimated number of days per calendar year above 150 ug/m³ does not exceed one per year on average over 3 years. | | | |

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

***** Standards based on averaging times other than the annual arithmetic mean must not be exceeded more than once per year.

** On June 20, 2007 USEPA proposed revisions to set the primary ozone standard within the range of 0.070-0.075 ppm and proposed two options for revisions to the secondary standard: one option would establish a cumulative standard designed to protect sensitive plants from damage caused by repeated ozone exposure throughout the growing season; the other option would make the secondary standard identical to the primary standard. USEPA must issue final standards by March 12, 2008.

*** In 2006 USEPA revised the PM standards. USEPA lowered the 24-hour $PM_{2.5}$ standard to 35 ug/m³ (from 65 ug/m³), retained the annual $PM_{2.5}$ standard as is (at 15 ug/m³), retained the 24-hour $PM_{10}$ standard as is (at 150 ug/m³), and revoked the annual $PM_{10}$ standard.

## Pollutant Health Effects and Sources

### Ozone ($O_3$)

- Ground-level $O_3$ and stratospheric $O_3$ are the same chemical compound but are often confused. Stratospheric $O_3$ at greater than 30,000 feet above the surface of the earth is beneficial because it filters out the sun's harmful ultraviolet radiation. However, ground-level $O_3$ is a health and environmental problem. This report pertains to ground-level $O_3$.
- $O_3$ is a respiratory irritant and can reduce lung function and cause asthma attacks, nasal congestion, and throat irritation, and reduce resistance to infection. It can inflame and damage (possibly permanently) cells that line the lungs, and aggravate chronic lung diseases. In addition, a number of studies have found a strong link between increases in ground-level $O_3$ and increased risk of premature death.
- $O_3$ is toxic to vegetation, inhibiting growth and causing leaf damage.
- $O_3$ deteriorates materials such as rubber and fabrics.
- Ground-level $O_3$ is unique in that it is formed by the reactions that occur between certain pollutants in the presence of intense, high-energy sunlight during the hot summer months. The complexity of the reactions and the amount of time needed to complete these reactions results in the buildup of ground-level ozone concentrations far downwind from the original source of the precursors.
- Sources of ground-level $O_3$ precursors, i.e., nitrogen oxides and hydrocarbons, include motor vehicles, power plants and other industrial sources.

### Carbon Monoxide (CO)

- CO binds with hemoglobin in the blood, reducing the amount of oxygen carried to organs and tissues.
- Symptoms of high CO exposure include shortness of breath, chest pain, headaches, confusion, and loss of coordination. The health threat is most severe for those with cardiovascular disease.
- Motor vehicle emissions are the largest source of CO, which is produced from incomplete combustion of carbon in fuels.
- Industrial processes and non-transportation fuel combustion are also sources of CO.

### Sulfur Dioxide ($SO_2$)

- $SO_2$ combines with water vapor to form acidic aerosols harmful to the respiratory tract, aggravating symptoms associated with lung diseases such as asthma and bronchitis.
- $SO_2$ is a primary contributor to acid deposition. Impacts of acid deposition include: acidification of lakes and streams, damage to vegetation, damage to materials, and diminution of visibility.
- $SO_2$ is a product of fuel combustion (e.g., burning coal and oil). Sources include heat and power generation facilities, and petroleum refineries.

## Nitrogen Dioxide ($NO_2$)

- $NO_2$ lowers resistance to respiratory infections and aggravates symptoms associated with asthma and bronchitis.
- $NO_2$ contributes to acid deposition (see $SO_2$ listing above for acid deposition effects).
- $NO_2$ and NO contribute to the formation of ozone.
- $NO_2$ is formed from the oxidation of nitric oxide (NO). Major sources of NO are fuel combustion, heating, power plants and motor vehicles.

## Particulate Matter ($PM_{10}$ and $PM_{2.5}$)

- Particulate matter is tiny airborne particles or aerosols, which include dust, dirt, soot, smoke, and liquid droplets. Fine particulate matter (mostly below 2.5 microns in size) are not only the result of direct emissions, but can be formed in the atmosphere by chemical reactions involving gaseous pollutants.
- The numbers 2.5 and 10 refer to the particle size, measured in microns, collected by the monitors. Several thousand $PM_{2.5}$ particles could fit on the period at the end of this sentence.
- The small size of the particles allows entry into the human respiratory system. Long-term exposure allows the particles to accumulate in the lungs and affects breathing and produces respiratory symptoms. The small particles can migrate through the lungs and into the circulatory system and potentially produce cardio-vascular symptoms, as well as impacts from toxic components contained in the particles.
- Particulate matter causes soiling and corrosion of materials.
- Particulate matter contributes to atmospheric haze that degrades visibility.
- Sources include industrial process emissions, motor vehicles, incinerators, and power plants.

## Lead (Pb)

- Lead is an elemental metal that is found in nature.
- Lead enters the atmosphere from the incineration of lead containing materials and from the manufacture and processing of lead containing products or materials like storage batteries, smelting and paint removal.
- Exposure to lead may occur by inhalation or ingestion with food, water, soil or dust particles.
- Children, infants, and fetuses are more susceptible to the effects of lead exposure.
- Lead causes mental retardation, brain damage, and liver disease. It may be a factor in high blood pressure and damages the nervous system.

## Public and Industrial Network Descriptions

### 2006 Public Monitoring Network

MassDEP operates a public ambient air monitoring network.

**Network Size**

- 28 monitoring stations
- 20 cities and towns with monitoring stations

**Number of Continuous Monitors**

Continuous monitors measure air quality 24 hours per day. The data are reported as hourly means.

- Criteria pollutant monitors measure pollutants for which National Ambient Air Quality Standards (NAAQS) have been set.
  - 5 – CO (carbon monoxide)
  - 12 – $NO_2$ (nitrogen dioxide). NO (nitric oxide) and $NO_x$ (total nitrogen oxides) also are measured by these monitors.
  - 14 – $O_3$ (ozone)
  - 6 – $SO_2$ (sulfur dioxide)

- Meteorological monitors track weather conditions.
  - 12 – BP (barometric pressure)
  - 12 – RH (relative humidity)
  - 12 – Solar Rad (solar radiation)
  - 13 – TEMP (temperature)
  - 12– WS/WD (wind speed/wind direction)
  - 1 – Profiler (this monitor measures WS/WD and TEMP at various altitudes, which aids in the analysis of pollutant transport)
  - 2 – UVB (B Band Ultra-violet Radiation)
  - 2 – Precipitation

- Other Monitors
  - 4 – $NO_y$ (Total Reactive Oxidized Nitrogen)
  - 6 – PAMS (Photochemical Assessment Monitoring Station). These monitors measure VOCs (volatile organic compounds).
  - 10 – $PM_{2.5}$ BAM (particulate matter – 2.5 microns)
  - 2 – Black Carbon
  - 1 – Acid Deposition. Precipitation is collected and analyzed for conductivity and acidic compounds that are harmful to the environment. This monitor, located in Waltham, is part of the National Atmospheric Deposition Program (NADP). Two other monitors in Massachusetts are also part of the NADP. They are located in Truro and Ware and are not operated by MassDEP.

**Number of Intermittent Monitors**

Intermittent monitors take discrete samples for a specific time period. The samples are taken every day, every third day, or every sixth day. The data is averaged in 3-hour or 24-hour intervals.

- Criteria pollutant monitors measure pollutants that have National Ambient Air Quality Standards (NAAQS).
  - 1 – Pb (Lead)
  - 6 – $PM_{10}$ (particulate matter – 10 microns)
  - 15 – $PM_{2.5}$ FRM (particulate matter – 2.5 microns)
- Non-criteria pollutant monitors measure pollutants that do not have NAAQS.
  - 6 – PAMS (photochemical assessment monitoring station). These monitors measure VOCs (volatile organic compounds).
  - 1 – TSP (total suspended particulates) used for lead analysis
  - 2 – Toxics. These monitors measure health-relevant VOCs.
  - 2 – Speciation. These monitors measure for $PM_{2.5}$, nitrates, and organics.
  - 1 – $PM_{10}$ (particles for toxic metals)

## 2006 Industrial Monitoring Network

Industries monitor air quality and submit data under agreement with MassDEP. The data must be collected using quality assurance requirements established by MassDEP and USEPA.

**Network Size**

- 4 monitoring stations
- All are located in the Boston area

**Number of Continuous Monitors**

Continuous monitors measure the air quality 24 hours per day. The data is averaged to provide 1-hour averages.

- Criteria pollutant monitors measure pollutants that have National Ambient Air Quality Standards (NAAQS).
  - 1 – $NO_2$ (nitrogen dioxide). NO (nitrogen oxide) and $NO_x$ (total nitrogen oxides) also are measured by this monitor.
  - 4 – $SO_2$ (sulfur dioxide)

- Meteorological monitors
  - 4– WS/WD (wind speed/wind direction)

**Number of Intermittent Monitors**

Intermittent monitors take discrete samples for a specific time period. These monitors sample every sixth day, and the data is averaged for a 24-hour interval.

- Other Monitors
  - 4 – TSP (total suspended particulates)
  - 4 – $SO_4$ (sulfate)

# Section II
# Attainment and Exceedances of Air Quality Standards

## Attainment Status Summary

The Clean Air Act (CAA) established timeframes and milestones for states to meet and maintain National Ambient Air Quality Standards (NAAQS) for criteria pollutants. USEPA sets the NAAQS levels to protect public health and the environment. USEPA must review the NAAQS every five years and may update the standards based on new scientific information. Each state is required to monitor the ambient air to determine whether it meets each standard. If the air quality does not meet a standard, the state must develop and implement pollution control strategies to attain that standard. Once air quality meets a standard, a state must develop a plan to maintain that standard while accounting for future economic and emissions growth. Taken together, these plans and control strategies constitute the State Implementation Plan (SIP).

Ozone is the only pollutant for which Massachusetts monitors indicate violations of a NAAQS. Massachusetts is in attainment for the other criteria pollutants, including carbon monoxide, lead, nitrogen dioxide, sulfur dioxide, and particulate matter (including $PM_{10}$ and $PM_{2.5}$).

It should be noted that a new national strategy currently under development calls for the continued measurement of gaseous pollutants that already attain the standards, including sulfur dioxide, nitrogen dioxide and carbon monoxide. Under the new strategy, these gases will be measured in lower concentration ranges than in the past. This strategy will enable scientists to resolve trends more easily and obtain more meaningful data from monitors at rural locations.

### Sulfur Dioxide, Nitrogen Dioxide, and Lead

Massachusetts has been in attainment for sulfur dioxide, nitrogen dioxide, and lead for a number of years based on decades of monitoring.

### Carbon Monoxide

Prior to the mid-1980s, Massachusetts was in violation of the carbon monoxide (CO) standard. However, with the adoption of numerous control programs, CO emissions have significantly decreased. The last violation in the state of the CO NAAQS occurred in 1986. In 2000, MassDEP formally requested that the USEPA re-designate the cities of Lowell, Springfield, Waltham, and Worcester as attainment for CO since the CO monitoring data for those cities had been below the standard for many years. With the re-designation of these cities to CO attainment in April 2002, the entire state is now in attainment of the CO standard.

## Particulate Matter

There are currently two sets of NAAQS particulate matter standards: $PM_{10}$ and $PM_{2.5}$. Massachusetts has been in attainment of the $PM_{10}$ standard for several years. $PM_{2.5}$ standards were first established in 1997. In December 2004, USEPA designated Massachusetts "Attainment/Unclassifiable" for $PM_{2.5}$ statewide based on monitoring data. In December 2006, USEPA revised the $PM_{10}$ and $PM_{2.5}$ standards. USEPA retained the 24-hour $PM_{10}$ standard as is (at 150 ug/m³), and revoked the annual $PM_{10}$ standard. In addition, USEPA retained the annual $PM_{2.5}$ standard as is (at 15 ug/m³) and lowered the 24-hour $PM_{2.5}$ standard to 35 ug/m³ (from 65 ug/m³). Based on 2004-2006 monitoring data, by December 18, 2007 Massachusetts must submit a recommendation to USEPA on whether it is in attainment or nonattainment with the new 24-hour $PM_{2.5}$ standard. USEPA will issue final designations by December 18, 2008.

## Ozone

In 1997, USEPA set a new stricter ozone standard of 0.08 ppm averaged over an eight-hour period, but implementation was delayed due to legal challenges to the standard. USEPA designated Massachusetts as "moderate nonattainment" for the 8-hour standard effective June 15, 2004. The 1-hour standard was revoked on June 15, 2005. The 1-hour ozone standard (0.12 ppm averaged over one hour) had been in place for almost two decades. Massachusetts had been classified as "serious nonattainment" for the 1-hour ozone standard since the early 1990s. However, with the adoption of numerous control programs, Massachusetts has made significant progress in reducing the number and severity of 1-hour ozone exceedances. Mitigation programs that were put in place to attain the 1-hour standard will continue as part of MassDEP's strategy to attain the new 8-hour standard. MassDEP is developing an 8-hour Ozone SIP including strategies for attaining the 8-hour ozone standard by 2010.

On June 20, 2007, USEPA proposed further revisions to the ozone NAAQS. USEPA proposed to set the primary ozone standard within the range of 0.070-0.075 ppm. USEPA also proposed two options for revisions to the secondary standard: one option would establish a cumulative standard designed to protect sensitive plants from damage caused by repeated ozone exposure throughout the growing season; the other option would make the secondary standard identical to the primary standard. USEPA must issue final standards by March 12, 2008

## Ozone Exceedances

### What Determines an Exceedance?

An ozone exceedance occurs when monitored ozone concentrations exceed the National Ambient Air Quality Standards (NAAQS). Ozone is collected as an hourly average of continuous data and is then used to determine the 8-hour average value for the day. An exceedance of the 8-hour standard is an 8-hour averaged value that is equal to or greater than 0.085 ppm.

### The Difference Between an Exceedance and a Violation

An ozone exceedance occurs when a monitor records ambient levels of ozone above a standard. A violation of an ozone standard (as opposed to an exceedance) is based on 3-year averages of data, so monitoring an exceedance does not necessarily mean that a violation of the standard has occurred.

Violations of the 8-hour standard are determined using the annual $4^{th}$-highest daily maximum 8-hour ozone value at each monitor. A violation requires a 3-year average of the annual $4^{th}$-highest daily maximum 8-hour value that is equal to or greater than 0.085 ppm. In other words, the 8-hour values for each day during a year for a specific monitor are ranked from highest to lowest. Then, the $4^{th}$-highest value for 3 consecutive years is averaged. If the 3-year average is 0.085 ppm or greater, a violation of the 8-hour standard has occurred at that specific monitoring site.

### Ozone Exceedances and Violations During 2006

*Exceedances*

The Table below shows the 2006 ozone exceedances. During 2006, there were four days when the former 1-hour ozone standard was exceeded. There were 10 days when the 8-hour ozone standard was exceeded. There were 24 exceedances during those 10 days.

*Violations*

Violations of the ozone standard are based on 3-year averages. Using data from 2004–2006, two sites out of 14 violated the 8-hour standard. These sites were located in Chicopee and Ware. Both sites had a 3-year average of 0.086 ppm (just over the 0.085 ppm standard).

# 2006 Ozone Exceedances (ppm)

| DATE | SITE | 8-HOUR high value (ppm) | START HOUR | 1-HOUR high value (ppm) |
|---|---|---|---|---|
| June 18, 2006 | Chicopee | .102 | 16 | .126 |
| June 18, 2006 | Milton | .086 | 11 | .099 |
| June 18, 2006 | Ware | .103 | 16 | .135 |
| June 19, 2006 | Amherst | .102 | 10 | .136 |
| June 19, 2006 | Chicopee | .119 | 10 | .143 |
| June 19, 2006 | Lynn | .086 | 9 | .099 |
| June 19, 2006 | Newbury | .086 | 10 | .092 |
| June 19, 2006 | Worcester | .087 | 13 | .101 |
| June 19, 2006 | Haverhill | .089 | 7 | .098 |
| June 19, 2006 | Ware | .110 | 11 | .130 |
| June 22, 2006 | Chicopee | .091 | 14 | .105 |
| June 22, 2006 | Worcester | .091 | 14 | .099 |
| June 22, 2006 | Ware | .098 | 15 | .113 |
| July 10, 2006 | Chicopee | .085 | 11 | .092 |
| July 17, 2006 | Fairhaven | .085 | 15 | .092 |
| July 18, 2006 | Fairhaven | .107 | 14 | .129 |
| July 18, 2006 | Truro | .104 | 16 | .117 |
| July 18, 2006 | Milton | .087 | 9 | .092 |
| July 27, 2006 | Chicopee | .090 | 11 | .104 |
| August 1, 2006 | Fairhaven | .104 | 16 | .126 |
| August 1, 2006 | Truro | .106 | 16 | .126 |
| August 2, 2006 | Fairhaven | .093 | 10 | .102 |
| August 2, 2006 | Truro | .098 | 11 | .105 |
| August 7, 2006 | Ware | .086 | 13 | .096 |

## Exceedance Days and Total Exceedance Trends

Figures 1 and 2 show the trends in number of 1-hour and 8-hour exceedance days and the total number of exceedances.

The trend for the 1-hour data in Figure 1 shows a decline in the number of exceedances and exceedance days over the period covered. Although the 1-hour standard was revoked June 15, 2005, Figure 1 reflects the total number of 1-hour exceedances for 2006. The trend in Figure 2 shows that, under the new more stringent 8-hour standard, there were a greater number of exceedances and exceedance days compared to the former1-hour standard.

**Figure 1**
**1-hr Ozone Exceedance Days and Total Exceedances 1987-2006**
1-hour standard = 0.125 ppm (revoked June 15, 2005)

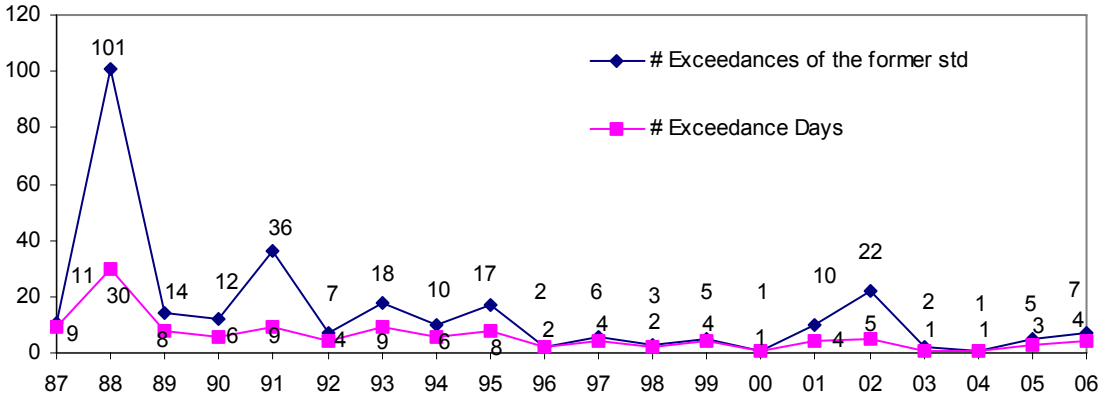
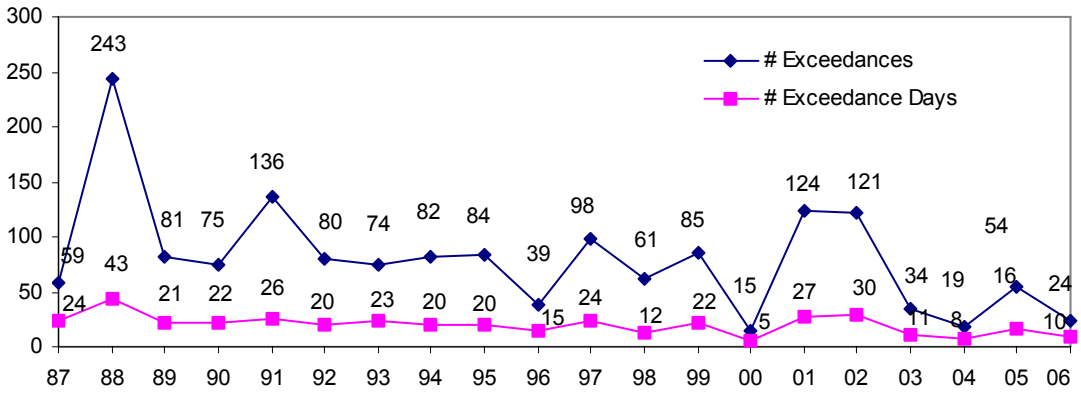



**Figure 2**
**8-hr Ozone Exceedance Days and Total Exceedances 1987-2006**
**8-hour standard = 0.085 ppm**



## Daily Ozone and PM Forecasts

MassDEP provides to the public daily air quality forecasts for ozone from May through September and for fine particles all year round using weather maps and meteorological conditions to predict whether or not conditions will result in elevated pollution levels. The daily air quality forecasts are available from www.mass.gov/air or by calling the Air Quality Hotline (1-800-882-1497). USEPA web sites that contain regional and national pollution forecasts using data that is provided by participating states are at www.epa.gov/region01/airquality/forecast.html and http://airnow.gov/. The table below describes the ratings used in the daily air quality forecasts.

**Air Quality Index (AQI): Ozone**

| Index Values | Levels of Health Concern | Cautionary Statements |
|---|---|---|
| 0-50 | Good | None |
| 51-100* | Moderate | Unusually sensitive people should consider reducing prolonged or heavy exertion outdoors. |
| 101-150 | Unhealthy for Sensitive Groups | Active children and adults, and people with lung disease, such as asthma, should reduce prolonged or heavy exertion outdoors. |
| 151-200 | Unhealthy | Active children and adults, and people with lung disease, such as asthma, should avoid prolonged or heavy exertion outdoors. Everyone else, especially children, should reduce prolonged or heavy exertion outdoors. |
| 201-300 | Very Unhealthy | Active children and adults, and people with lung disease, such as asthma, should avoid all outdoor exertion. Everyone else, especially children, should avoid prolonged or heavy exertion outdoors. |

* Generally, an AQI of 100 for ozone corresponds to an ozone level of 0.08 parts per million (averaged over 8 hours).

**Air Quality Index (AQI): Particle Pollution**

| Index Values | Levels of Health Concern | Cautionary Statements |
|---|---|---|
| 0-50 | Good | None |
| 51-100* | Moderate | Unusually sensitive people should consider reducing prolonged or heavy exertion. |
| 101-150 | Unhealthy for Sensitive Groups | People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion. |
| 151-200 | Unhealthy | People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion. |
| 201-300 | Very Unhealthy | People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion. |

*An AQI of 100 for particles up to 2.5 micrometers in diameter corresponds to a level of 40 micrograms per cubic meter (averaged over 24 hours). An AQI of 100 for particles up to 10 micrometers in diameter corresponds to a level of 150 micrograms per cubic meter (averaged over 24 hours).

# Section III
# Massachusetts Air Quality Data Summaries

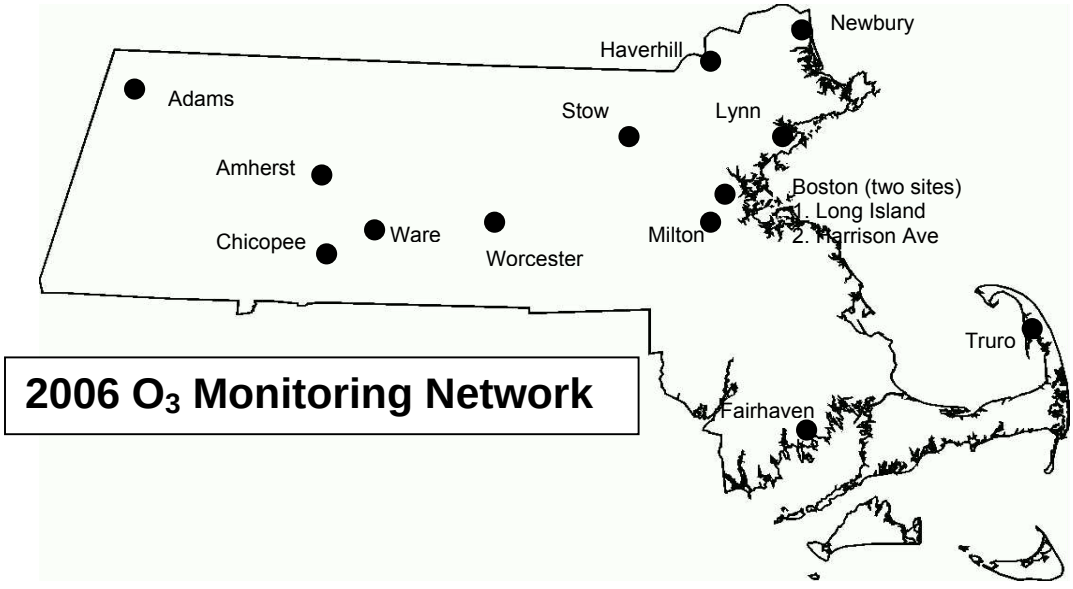
## Ozone Summary

### 2006 Ozone Data Summary

A summary of the 2006 data collected during the ozone season (April 1 – Sept. 30) is shown below. There were 14 ozone sites in operation during 2006 in the state-operated monitoring network. All of the sites achieved the requirement of 75% or greater data capture for the year.

| SITE ID | CITY | COUNTY | ADDRESS | % OBS | 1ST MAX 1-HR | 2ND MAX 1-HR | DAY MAX≥ 0.125 | 1ST MAX 8-HR | 2ND MAX 8-HR | 3RD MAX 8-HR | 4TH MAX 8-HR | DAY MAX≥ 0.085 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25-003-4002 | Adams | Berkshire | MT GREYLOCK SUMMIT | 93 | .090 | .085 | 0 | .082 | .079 | .077 | .076 | 0 |
| 25-015-0103 | Amherst | Hampshire | N PLEASANT ST | 99 | .136 | .103 | 1 | .102 | .078 | .075 | .074 | 1 |
| 25-025-0041 | Boston | Suffolk | LONG ISLAND | 96 | .096 | .092 | 0 | .083 | .083 | .083 | .079 | 0 |
| 25-025-0042 | Boston | Suffolk | HARRISON AVE | 98 | .084 | .082 | 0 | .075 | .070 | .069 | .069 | 0 |
| 25-013-0008 | Chicopee | Hampden | ANDERSON RD AFB | 99 | .143 | .126 | 2 | .119 | .102 | .091 | .090 | 5 |
| 25-005-1002 | Fairhaven | Bristol | LEROY WOOD SCH | 95 | .129 | .126 | 2 | .107 | .104 | .093 | .085 | 4 |
| 25-009-5005 | Haverhill | Essex | CONSENTINO SCHOOL | 98 | .098 | .087 | 0 | .089 | .081 | .075 | .075 | 1 |
| 25-009-2006 | Lynn | Essex | 390 PARKLAND | 97 | .099 | .097 | 0 | .086 | .084 | .079 | .078 | 1 |
| 25-021-3003 | Milton | Norfolk | BLUE HILL OBSERVATORY | 95 | .099 | .093 | 0 | .087 | .086 | .084 | .083 | 2 |
| 25-009-4004 | Newbury | Essex | SUNSET BLVD | 97 | .105 | .092 | 0 | .086 | .082 | .078 | .075 | 1 |
| 25-017-1102 | Stow | Middlesex | US MILITARY RESERVATION | 100 | .100 | .092 | 0 | .084 | .083 | .076 | .075 | 0 |
| 25-001-0002 | Truro | Barnstable | FOX BOTTOM AREA | 98 | .124 | .117 | 0 | .106 | .104 | .098 | .082 | 3 |
| 25-015-4002 | Ware | Hampshire | QUABBIN SUMMIT | 94 | .135 | .130 | 2 | .110 | .103 | .098 | .086 | 4 |
| 25-027-0015 | Worcester | Worcester | WORC AIRPORT | 94 | .101 | .099 | 0 | .091 | .091 | .083 | .077 | 2 |

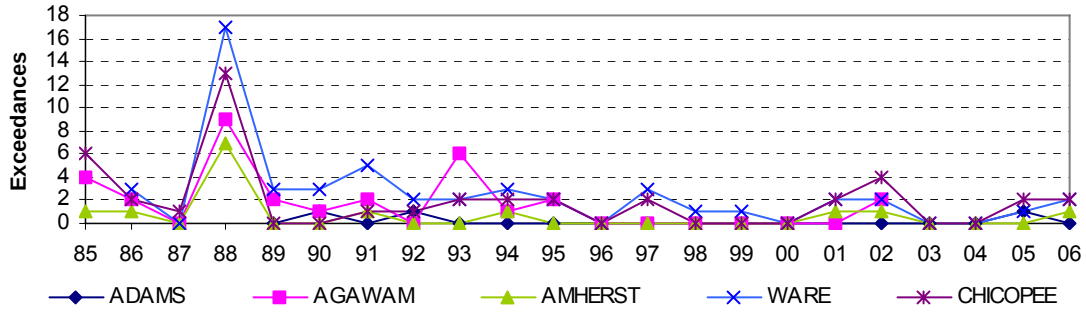
**ABBREVIATIONS AND SYMBOLS USED IN TABLE**
**SITE ID** = AIRS SITE IDENTIFICATION NUMBER **% OBS** = PERCENTAGE OF VALID DAYS MONITORED DURING O3 SEASON **1ST, 2ND MAX 1-HR** = MAXIMUM 1-HR VALUE FOR THE 1ST & 2ND HIGHEST DAY **DAY MAX ≥ 0.125** = NUMBER OF MEASURED DAILY 1-HOUR MAXIMUM VALUES GREATER THAN OR EQUAL TO 0.125 PPM (1-HR STANDARD) **1ST, 2ND, 3RD & 4TH MAX 8-HR** = MAXIMUM 8-HR VALUE FOR THE 1ST, 2ND, 3RD & 4TH HIGHEST DAY **DAY MAX ≥ 0.085** = NUMBER OF MEASURED DAILY 8-HOUR MAXIMUM VALUES GREATER THAN OR EQUAL TO 0.085 PPM (8-HR STANDARD)

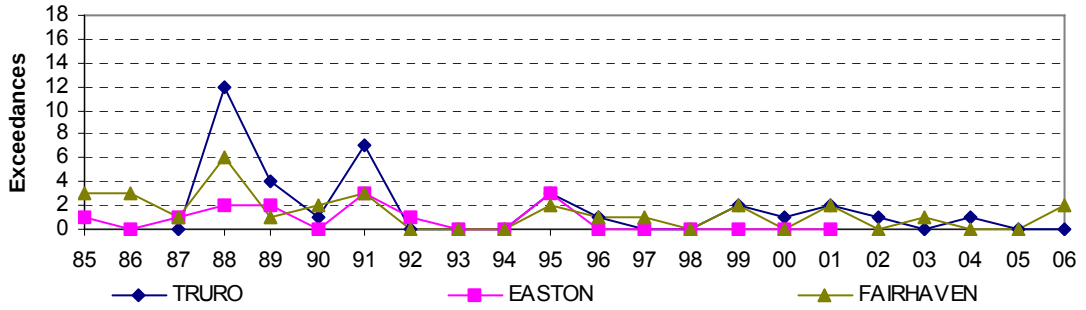


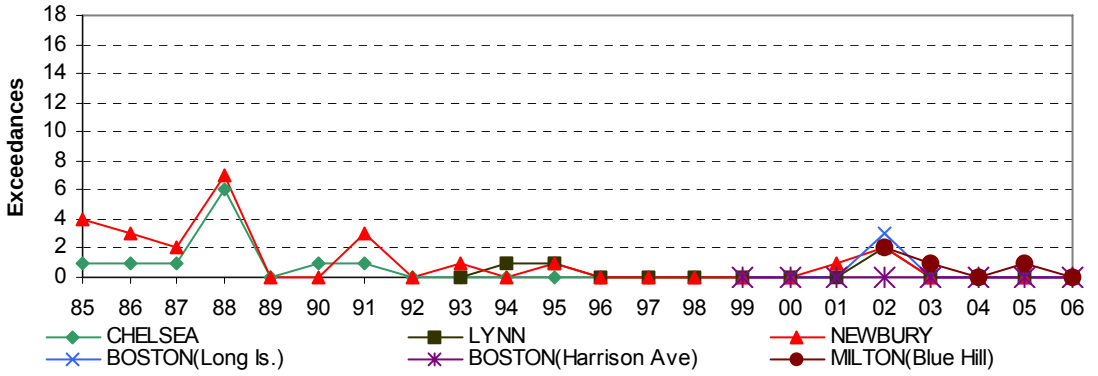
## 1-hour Ozone Exceedance Trends

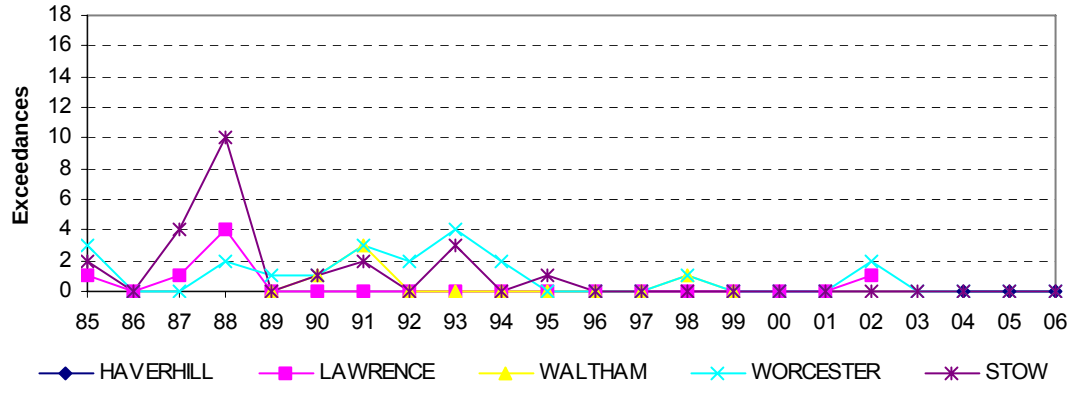
The historical trends of the former 1-hour ozone exceedances for each site are shown below.

**Figure 3**
**1-hour Ozone Exceedance Trends 1985 – 2006**
**Standard = 0.125 ppm (revoked June 15, 2005)**



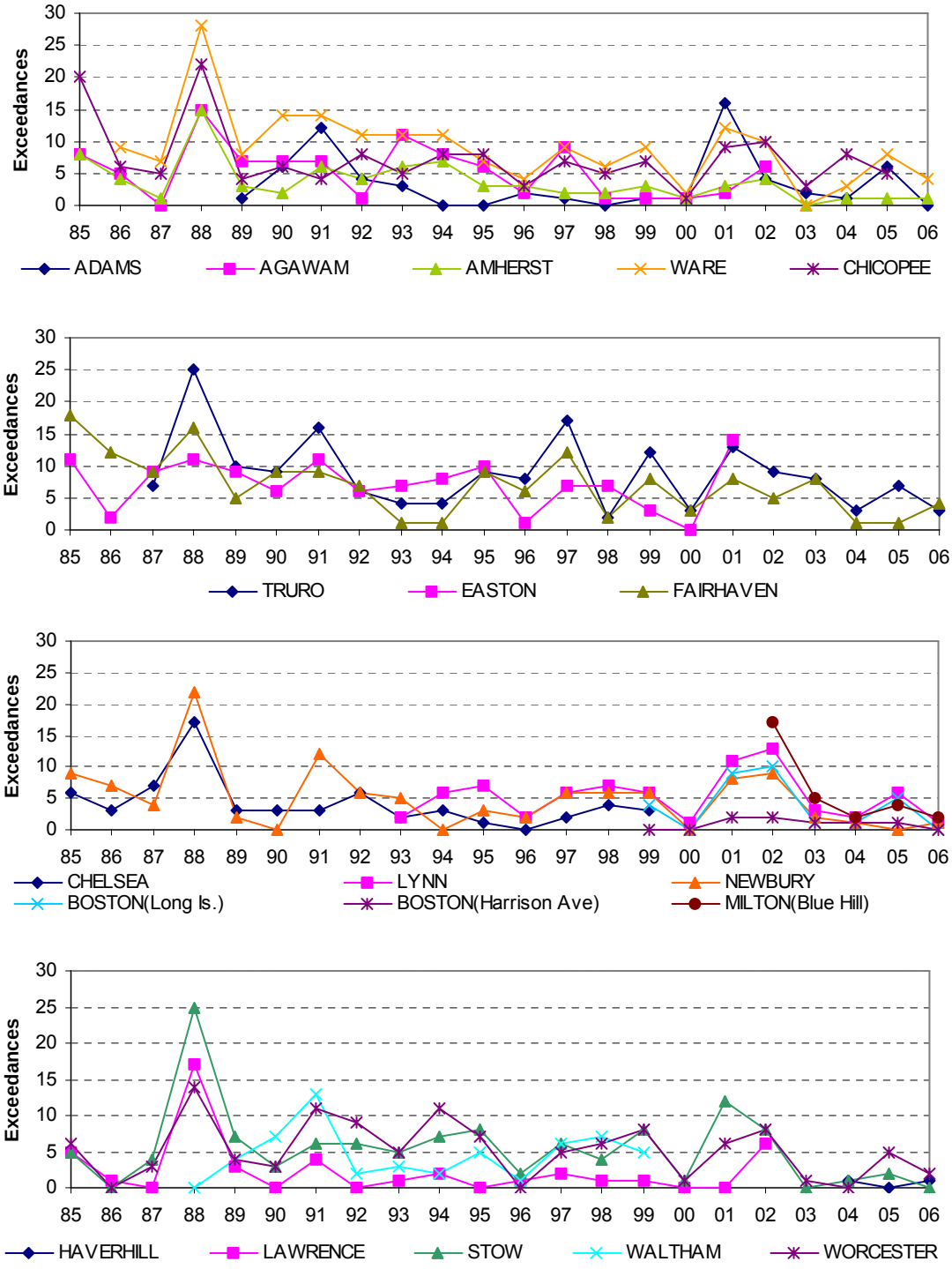



## 8-hour Ozone Exceedance Trends

The long-term trends of 8-hour ozone exceedances for each site are shown below. The 8-hour standard became effective in 1997.

**Figure 4**
**8-hour Ozone Exceedance Trends 1985 – 2006**
**Standard = 0.085 ppm**



## Sulfur Dioxide ($SO_2$) Summary

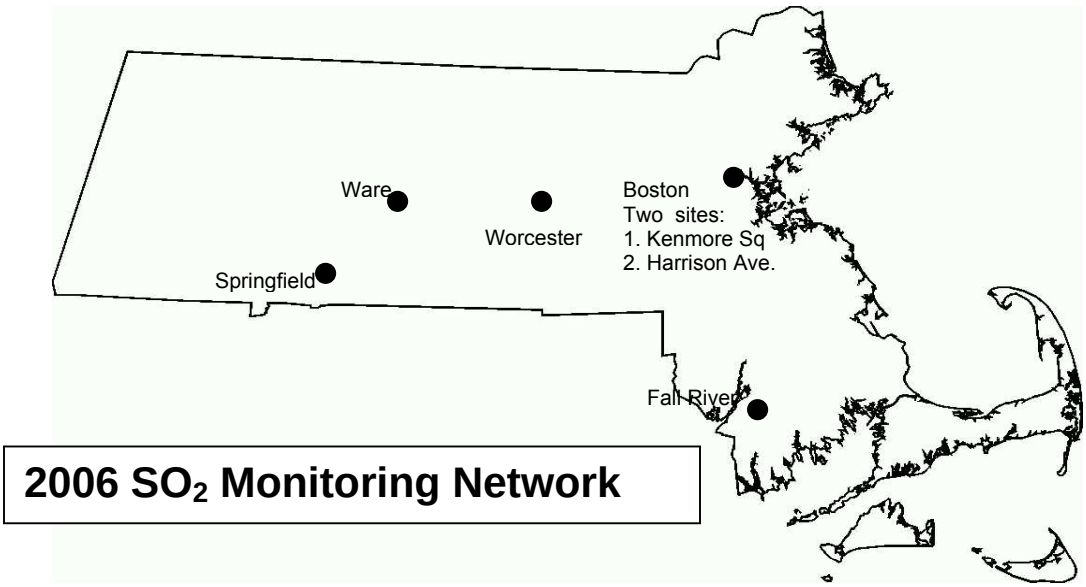
### 2006 $SO_2$ Data Summary

A summary of the 2006 $SO_2$ data is shown below. There were six $SO_2$ sites in operation during 2006 in the state-operated monitoring network. All of the sites achieved the requirement of 75% or greater data capture for the year.

| SITE ID | CITY | COUNTY | ADDRESS | % OBS | 1ST MAX 24-HR | 2ND MAX 24-HR | #OBS >0.14 | 1ST MAX 3-HR | 2ND MAX 3-HR | #OBS >0.5 | 1ST MAX 1-HR | 2ND MAX 1-HR | ARITH MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25-025-0002 | Boston | Suffolk | KENMORE SQUARE | 96 | .020 | .016 | 0 | .031 | .031 | 0 | .036 | .036 | 0.0039 |
| 25-025-0042 | Boston | Suffolk | HARRISON AVE | 97 | .015 | .012 | 0 | .020 | .019 | 0 | .026 | .024 | 0.0028 |
| 25-005-1004 | Fall River | Bristol | GLOBE ST | 97 | .031 | .020 | 0 | .071 | .056 | 0 | .087 | .079 | 0.0048 |
| 25-013-0016 | Springfield | Hampden | LIBERTY ST P-LOT | 98 | .017 | .017 | 0 | .033 | .030 | 0 | .044 | .044 | 0.0041 |
| 25-015-4002 | Ware | Hampshire | QUABBIN SUMMIT | 97 | .011 | .010 | 0 | .018 | .014 | 0 | .021 | .018 | 0.0019 |
| 25-027-0023 | Worcester | Worcester | SUMMER ST | 97 | .014 | .013 | 0 | .020 | .020 | 0 | .034 | .025 | 0.0028 |

Standards: Annual Mean = 0.03 ppm  24-hour = 0.14 ppm  3-hour = 0.50 ppm

**ABBREVIATIONS AND SYMBOLS USED IN TABLE**
**SITE ID** = AIRS SITE IDENTIFICATION NUMBER **% OBS** = DATA CAPTURE PERCENTAGE **1ST, 2ND MAX 24-HR, MAX 3-HR, MAX 1-HR** = FIRST AND SECOND HIGHEST VALUE FOR TIME PERIOD INDICATED **# OBS > 0.14** = NUMBER OF OBSERVATIONS ABOVE THE 24-HOUR STANDARD OF 0.14 PPM **# OBS > 0.50** = NUMBER OF OBSERVATIONS ABOVE THE 3-HOUR STANDARD OF 0.50 PPM **ARITH MEAN** = ANNUAL ARITHMETIC MEAN (STANDARD = 0.03 PPM)

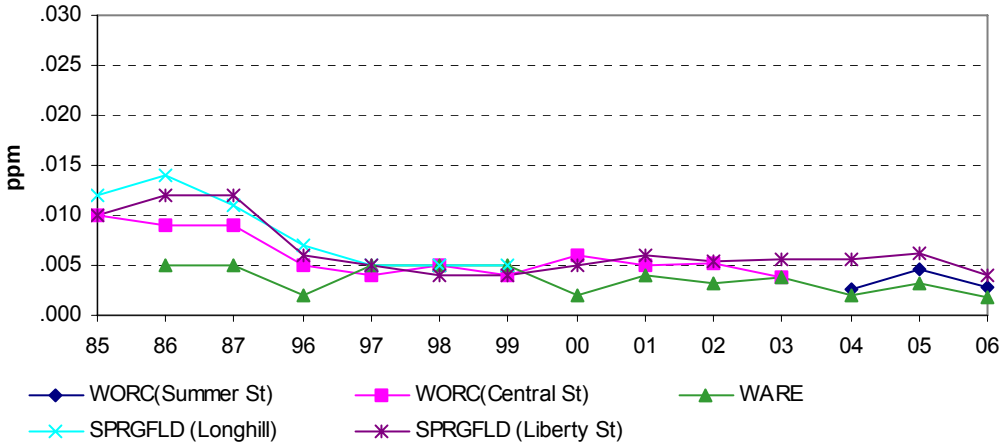


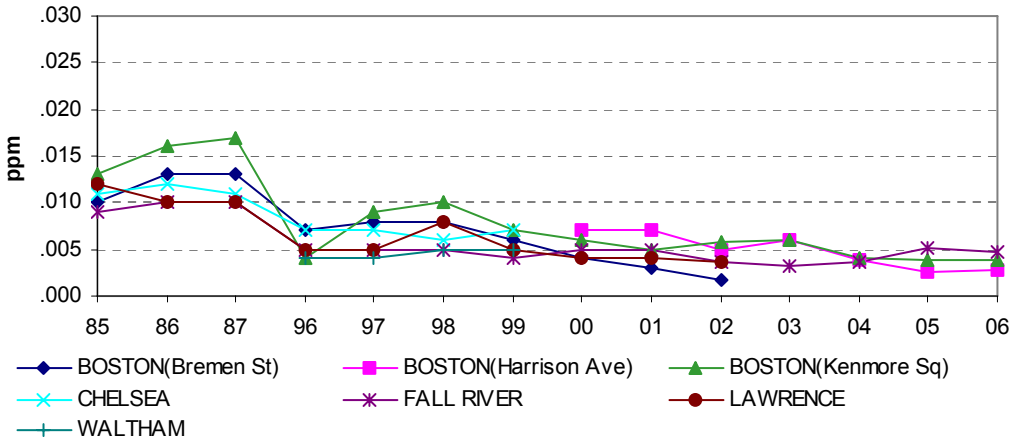

**2006 $SO_2$ Monitoring Network**

## $SO_2$ Trends

The long-term trends of the annual arithmetic mean for each $SO_2$ site are shown below. The trend has been stable for the last few years and downward for the entire period. Massachusetts is well below the standard for $SO_2$.

**Figure 5**
**$SO_2$ Trends 1985 –2006**
**Annual Arithmetic Means**
**Standard = 0.03 ppm**



# Nitrogen Dioxide ($NO_2$) Summary

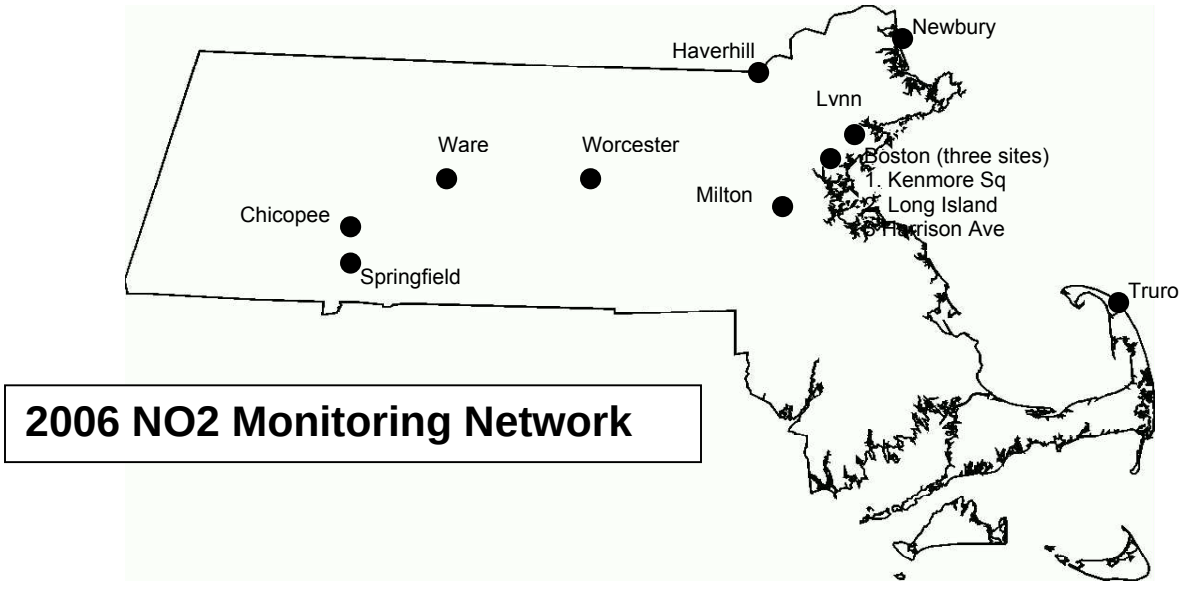
## 2006 $NO_2$ Data Summary

A summary of the 2006 $NO_2$ data is shown below. There were 12 $NO_2$ sites in operation during 2006 in the state-operated monitoring network. All of the sites met the requirement of 75% data capture for the year.

| SITE ID | CITY | COUNTY | ADDRESS | % OBS | 1ST MAX 1-HR | 2ND MAX 1-HR | ARITH MEAN |
|---|---|---|---|---|---|---|---|
| 25-025-0002 | Boston | Suffolk | KENMORE SQUARE | 94 | .079 | .063 | 0.0225 |
| 25-025-0041 | Boston | Suffolk | LONG ISLAND | 92 | .044 | .043 | 0.0074 |
| 25-025-0042 | Boston | Suffolk | HARRISON AVE | 95 | .067 | .060 | 0.0187 |
| 25-013-0008 | Chicopee | Hampden | ANDERSON RD AFB | 95 | .051 | .050 | 0.0095 |
| 25-009-5005 | Haverhill | Essex | CONSENTINO SCHOOL | 94 | .049 | .047 | 0.0086 |
| 25-009-2006 | Lynn | Essex | 390 PARKLAND | 94 | .051 | .048 | 0.0096 |
| 25-021-3003 | Milton | Norfolk | BLUE HILL OBSERVATORY | 90 | .069 | .050 | 0.0048 |
| 25-009-4004 | Newbury | Essex | SUNSET BLVD | 94 | .017 | .017 | 0.0034 |
| 25-013-0016 | Springfield | Hampden | LIBERTY ST P-LOT | 96 | .054 | .051 | 0.0149 |
| 25-001-0002 | Truro | Barnstable | FOX BOTTOM AREA | 95 | .011 | .011 | 0.0027 |
| 25-015-4002 | Ware | Hampshire | QUABBIN SUMMIT | 95 | .043 | .042 | 0.0044 |
| 25-027-0023 | Worcester | Worcester | SUMMER ST | 93 | .054 | .052 | 0.0151 |

Standard: Annual Arithmetic Mean = 0.053 ppm

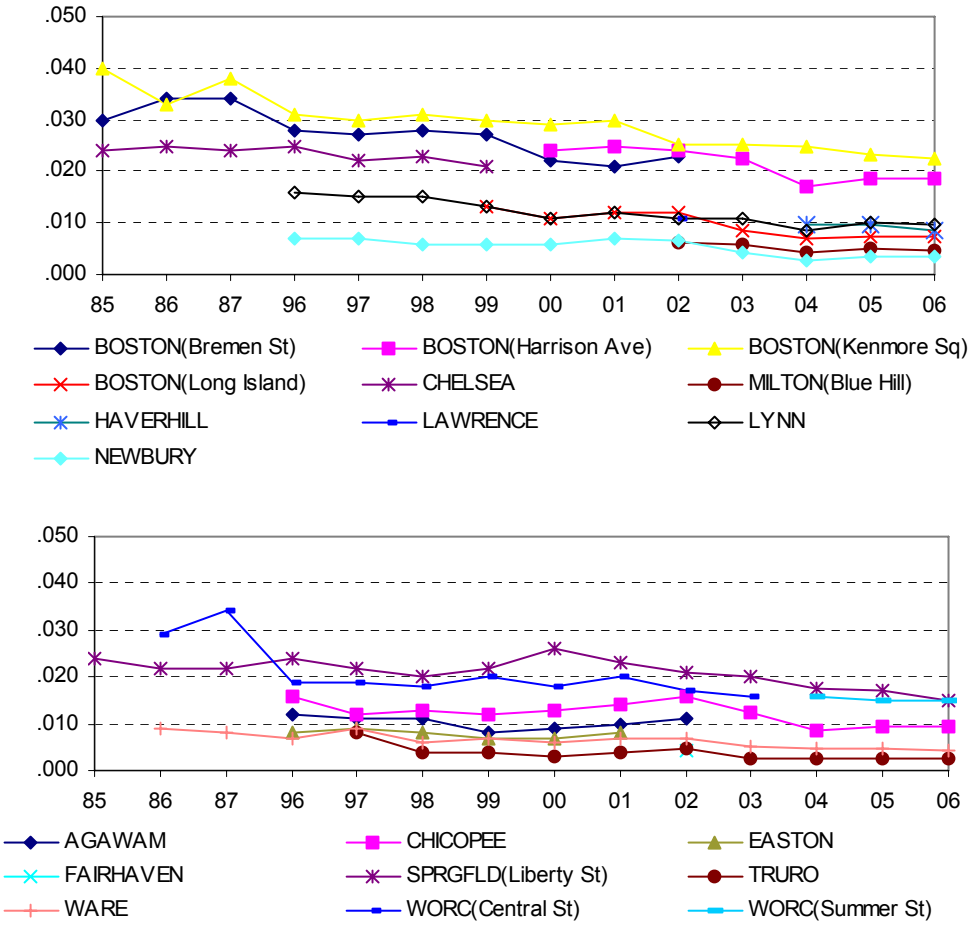
**ABBREVIATIONS AND SYMBOLS USED IN TABLE**
**SITE ID** = AIRS SITE IDENTIFICATION NUMBER **% OBS** = DATA CAPTURE PERCENTAGE **1ST, 2ND MAX 1-HR** = FIRST AND SECOND HIGHEST VALUE FOR TIME PERIOD INDICATED **ARITH MEAN** = ANNUAL ARITHMETIC MEAN



## $NO_2$ Trends

The long-term trends of the annual arithmetic means for each $NO_2$ site are shown below. The trend has been stable the last few years and downward for the entire period. Massachusetts is below the standard.

**Figure 6**
**$NO_2$ Trends 1985 – 2006**
**Annual Arithmetic Means**
**Standard = 0.05 ppm**



# Carbon Monoxide (CO) Summary

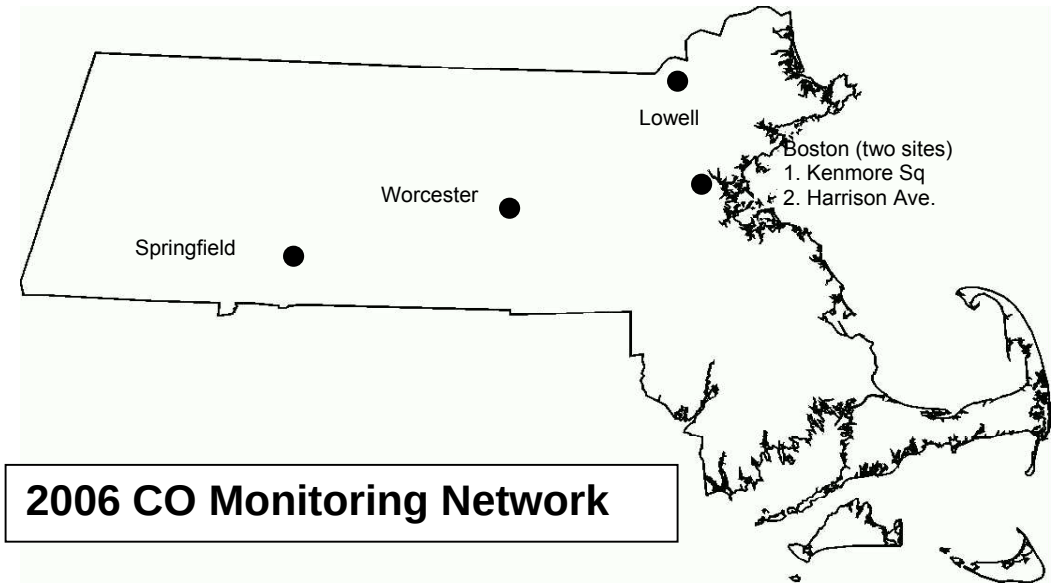
## 2006 CO Data Summary

A summary of the 2006 CO data is shown below. There were five CO sites in operation during 2006 in the state-operated monitoring network. All of the sites achieved the requirement of 75% or greater data capture for the year.

| SITE ID | CITY | COUNTY | ADDRESS | % OBS | 1ST MAX 1-HR | 2ND MAX 1-HR | OBS >35 | 1ST MAX 8-HR | 2ND MAX 8-HR | OBS >9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 25-025-0002 | Boston | Suffolk | KENMORE SQUARE | 91 | 2.3 | 2.2 | 0 | 1.7 | 1.5 | 0 |
| 25-025-0042 | Boston | Suffolk | HARRISON AVE | 94 | 3.5 | 3 | 0 | 2.1 | 1.7 | 0 |
| 25-017-0007 | Lowell | Middlesex | MERRIMACK ST | 92 | 2.3 | 2.2 | 0 | 1.5 | 1.4 | 0 |
| 25-013-0016 | Springfield | Hampden | LIBERTY ST P-LOT | 94 | 3.3 | 3.1 | 0 | 2.7 | 2.4 | 0 |
| 25-027-0023 | Worcester | Worcester | SUMMER ST | 93 | 2.8 | 2.5 | 0 | 1.5 | 1.5 | 0 |

Standards: 1-hour = 35 ppm  8-hour = 9 ppm

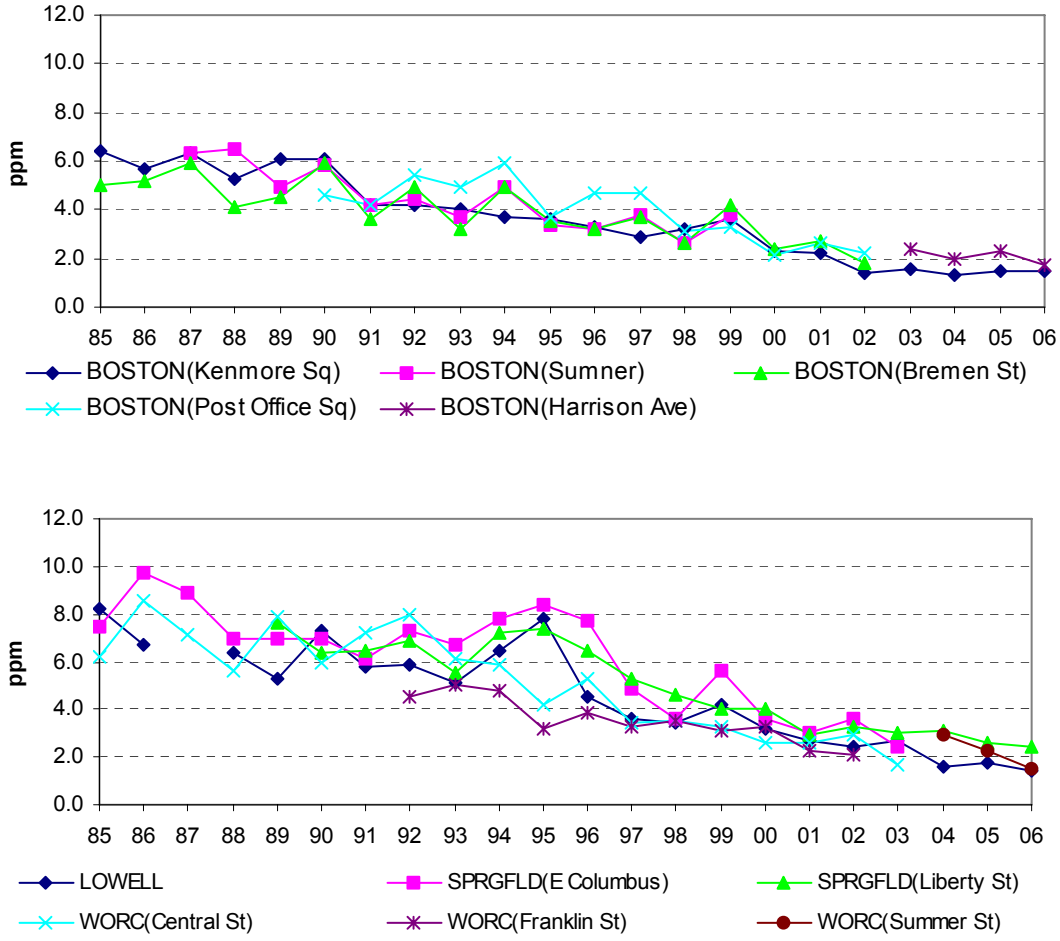
**ABBREVIATIONS AND SYMBOLS USED IN TABLE**
**SITE ID** = AIRS SITE IDENTIFICATION NUMBER **% OBS** = DATA CAPTURE PERCENTAGE **1ST, 2ND MAX 1-HR** = FIRST AND SECOND HIGHEST VALUE FOR TIME PERIOD INDICATED **OBS > 35** = NUMBER OF 1-HR AVG. GREATER THAN 35 PPM (1-HR STANDARD) **1ST, 2ND MAX 8-HR** = FIRST AND SECOND HIGHEST VALUE FOR TIME PERIOD INDICATED **OBS > 9** = NUMBER OF 8-HR AVG. GREATER THAN 9 PPM (8-HR STD)



## CO Trends

The long-term trends for each CO site are shown below. The 2nd maximum value is displayed because it is the value to which the standard applies. The highest 8-hour values occurred in Springfield. Massachusetts is well below both the 1-hour and 8-hour standards.

**Figure 7**
**CO Trends 1985-2006**
**2nd Maximum 8-hour Values**
**Standard = 9 ppm**



# Particulate Matter 10 Microns ($PM_{10}$) Summary

## 2006 $PM_{10}$ Data Summary

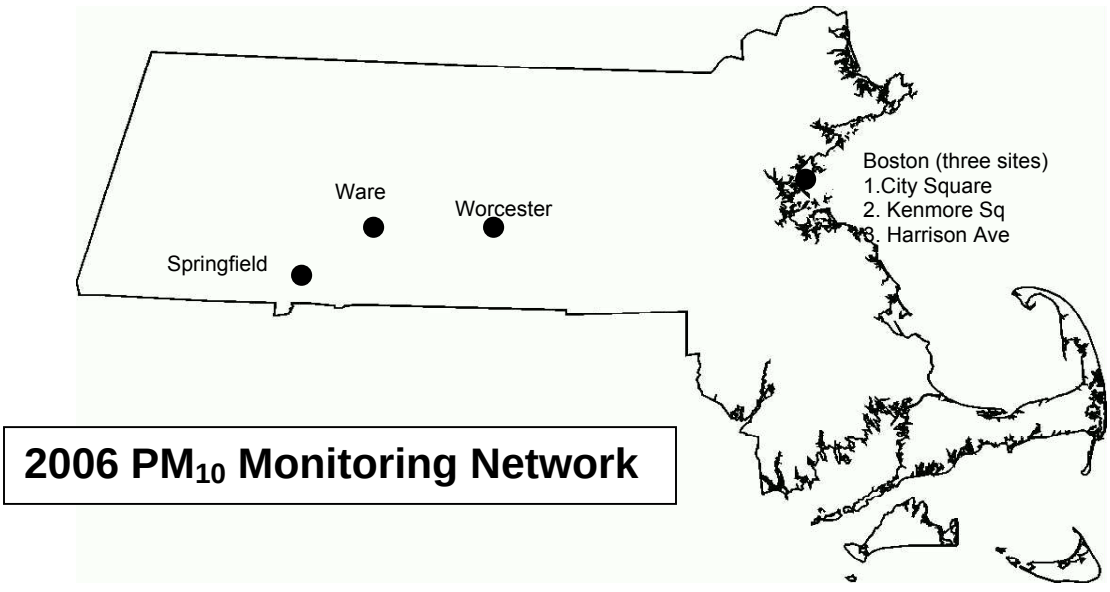
A summary of the 2006 $PM_{10}$ data is shown below. There were six $PM_{10}$ sites in operation during 2006 in the state-operated monitoring network. All of the sites achieved data capture requirements for the year.

| SITE ID | TYPE | CITY | COUNTY | ADDRESS | % OBS | 1ST MAX | 2ND MAX | 3RD MAX | 4TH MAX | DAY MAX >150 | EST DAYS >150 | WTD ARITH MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25-025-0002 | Lo-Vol | Boston | Suffolk | KENMORE SQUARE | 93 | 52 | 41 | 40 | 38 | 0 | 0 | 21.6 |
| 25-025-0027 | Lo-Vol | Boston | Suffolk | ONE CITY SQUARE | 97 | 54 | 46 | 38 | 37 | 0 | 0 | 21.8 |
| 25-025-0042 | Hi-Vol | Boston | Suffolk | HARRISON AVE | 93 | 38 | 32 | 30 | 28 | 0 | 0 | 15.6 |
| 25-025-0042 | Hi-Vol Co-loc | Boston | Suffolk | HARRISON AVE | 92 | 34 | 31 | 30 | 26 | 0 | 0 | 15.4 |
| 25-025-0042 | Lo-Vol | Boston | Suffolk | HARRISON AVE | 93 | 37 | 33 | 31 | 29 | 0 | 0 | 16.6 |
| 25-025-0042 | Lo-Vol Co-loc | Boston | Suffolk | HARRISON AVE | 89 | 49 | 37 | 37 | 35 | 0 | 0 | 18.3* |
| 25-013-2009 | Lo-Vol | Springfield | Hampden | 1860 MAIN ST | 92 | 51 | 49 | 46 | 43 | 0 | 0 | 18.6* |
| 25-015-4002 | Lo-Vol | Ware | Hampshire | QUABBIN SUMMIT | 92 | 34 | 31 | 29 | 28 | 0 | 0 | 11.3 |
| 25-027-0023 | Lo-Vol | Worcester | Worcester | SUMMER ST | 95 | 52 | 40 | 39 | 36 | 0 | 0 | 19.4 |

*INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA (NUMBER OF OBSERVATIONS FOR AT LEAST 1 QUARTER WAS LESS THAN 75%)

$PM_{10}$ Hi Vol Standards: 24-hour = 150 μg/m³ $PM_{10}$ Hi Vol Annual Arithmetic Mean = 50 μg/m³ (Revoked December 2006)

**ABBREVIATIONS AND SYMBOLS USED IN TABLE**
**SITE ID** = AIRS SITE IDENTIFICATION NUMBER **% OBS** = DATA CAPTURE PERCENTAGE **1ST, 2ND, 3RD, 4TH 24-HR MAX** = 1ST, 2ND, 3RD, AND 4TH HIGHEST 24-HOUR VALUES FOR THE YEAR **DAY MAX > 150** = DAILY MAXIMUM VALUE GREATER THAN STANDARD OF 150 μg/m³ **WTD ARITH MEAN** = WEIGHTED ANNUAL ARITHMETIC MEAN (STANDARD = 50 μg/m³)

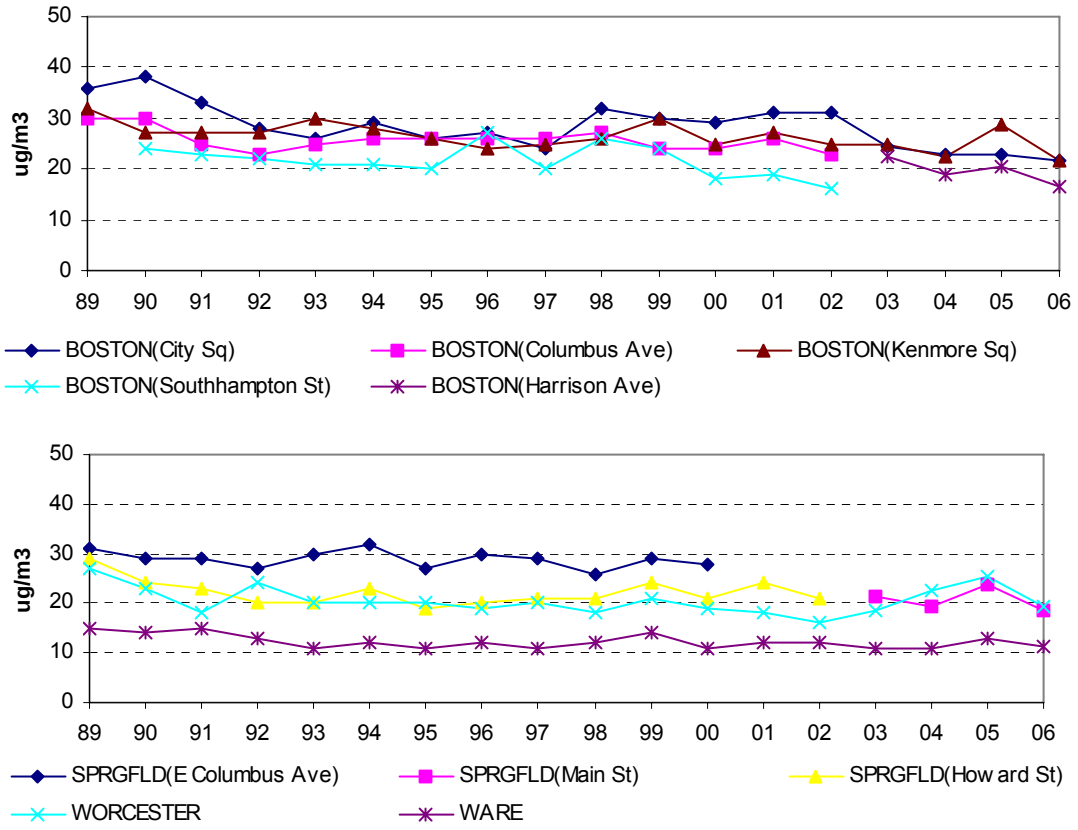



**2006 $PM_{10}$ Monitoring Network**

## $PM_{10}$ Trends

Long-term trends for each $PM_{10}$ site are shown below for the annual arithmetic mean. The data shows a yearly variability at most sites, with the overall trend being downward.

**Figure 8**
**$PM_{10}$ Trends 1989-2006**
**Annual Arithmetic Mean**
**Standard = 50 ug/m3 (Revoked December 18, 2006)**



## Particulate Matter 2.5 Microns ($PM_{2.5}$) Summary

### 2006 $PM_{2.5}$ Operations

The MassDEP $PM_{2.5}$ sampling network has been operating since January 1999. In December 2004, USEPA designated the entire State as "Attainment/Unclassifiable" on the basis of measured $PM_{2.5}$ concentrations. An ambitious program of sampler replacement has since been accomplished in conjunction with a rigorous preventative maintenance program that has helped to improve overall data capture.

### Semi-Continuous $PM_{2.5}$ Measurement

MassDEP started deploying semi-continuous $PM_{2.5}$ monitors, capable of measuring $PM_{2.5}$ concentrations on an hourly basis, in 2001. The Beta Attenuation Monitor (BAM) method is referred to as a semi-continuous method because only one measurement is made every hour, in contrast to the truly continuous measurements made by the gaseous pollutant monitors in which sample collection is ongoing. MassDEP now operates eleven BAM instruments across the state, ten of these are single instrument sites and one is collocated.

Beginning in 2001, Massachusetts installed BAMs at a limited number of urban sites to gain experience with the new technology and to compare the data from the new samplers with data coming from the existing Federal Reference Method (FRM) $PM_{2.5}$ network. BAM samplers generate hourly $PM_{2.5}$ values, thereby providing more information regarding short-term variations in fine particulate concentrations than the single 24-hour/every third day Federal Reference Method. They also generate real time values that can be used to assess current air quality conditions, whereas FRM filter results are not available until several weeks of processing are completed. The FRM samples remain the only USEPA-recognized basis for comparison with the NAAQS, but tests are ongoing to allow BAM results to be used for comparison to the NAAQS.

There are several advantages to using BAMs technology for collecting $PM_{2.5}$ data, one being that samples are collected hourly seven days a week, unlike the conventional $PM_{2.5}$ methods that collect only 2 samples per week. Another big advantage is the ability to immediately retrieve data from the monitoring stations remotely using a standard modem and phone line. This makes the data very useful for examining daily fluctuations in pollutant levels and providing the public with near real-time information on local air quality.

In 2003, USEPA began providing a website where the public can view concentration gradient maps that graphically display data coming in from the ten semi-continuous monitoring stations. Different colors on the map are used to indicate the PM concentration of the samples that were collected for each hour of the day. The website address for viewing the map is: www.epa.gov/airnow/.

A summary of the 2006 $PM_{2.5}$ data is shown below.

## 2006 $PM_{2.5}$ FRM Data Summary

| SITE ID | TYPE | CITY | COUNTY | ADDRESS | % OBS | 1ST MAX | 2ND MAX | 3RD MAX | 4TH MAX | 98TH PERCENTILE VALUE | WTD ARITH MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25-025-0002 | FRM | Boston | Suffolk | KENMORE SQUARE | 96 | 40.5 | 29.6 | 28.5 | 27.5 | 28.5 | 10.80 |
| 25-025-0027 | FRM | Boston | Suffolk | ONE CITY SQUARE | 94 | 39.5 | 34.0 | 27.4 | 26.6 | 27.4 | 11.08 |
| 25-025-0042 | FRM | Boston | Suffolk | HARRISON AVE | 97 | 37.3 | 29.8 | 27.3 | 27.1 | 27.3 | 9.69 |
| 25-025-0043 | FRM | Boston | Suffolk | 174 NORTH ST | 98 | 39.2 | 34.1 | 32.7 | 32.3 | 27.4 | 11.21 |
| 25-025-0043 | FRM Co-loc | Boston | Suffolk | 174 NORTH ST | 81 | 42.2 | 39.5 | 32.7 | 32.5 | 31.1 | 11.78* |
| 25-023-0004 | FRM | Brockton | Plymouth | COMMERCIAL ST | 99 | 34.2 | 32.0 | 31.1 | 24.4 | 31.1 | 8.95 |
| 25-023-0004 | FRM Co-loc | Brockton | Plymouth | COMMERCIAL ST | 95 | 34.8 | 34.6 | 31.5 | 24.7 | 31.5 | 9.11 |
| 25-013-0008 | FRM | Chicopee | Hampden | ANDERSON RD AFB | 100 | 40.2 | 28.9 | 28.9 | 28.3 | 28.9 | 8.83 |
| 25-013-0008 | FRM Co-loc | Chicopee | Hampden | ANDERSON RD AFB | 75 | 39.3 | 27.5 | 24.1 | 23.9 | 27.5 | 9.20* |
| 25-005-1004 | FRM | Fall River | Bristol | GLOBE ST | 95 | 36.9 | 27.9 | 24.5 | 22.6 | 24.5 | 8.11 |
| 25-009-5005 | FRM | Haverhill | Essex | CONSENTINO SCHOOL | 94 | 40.2 | 30.1 | 27.2 | 24.6 | 27.2 | 8.25 |
| 25-009-6001 | FRM | Lawrence | Essex | SHATTUCK ST | 95 | 41.6 | 35.3 | 29.0 | 27.5 | 29.0 | 8.88 |
| 25-009-2006 | FRM | Lynn | Essex | 390 PARKLAND | 96 | 39.2 | 31.3 | 25.2 | 23.8 | 25.2 | 8.46 |
| 25-003-5001 | FRM | Pittsfield | Berkshire | 78 CENTER ST | 100 | 38.2 | 30.6 | 26.7 | 26.2 | 26.7 | 9.03 |
| 25-013-0016 | FRM | Springfield | Hampden | LIBERTY ST P-LOT | 96 | 38.5 | 34.3 | 34.1 | 33.6 | 34.1 | 11.30 |
| 25-013-2009 | FRM | Springfield | Hampden | 1860 MAIN ST | 93 | 39.1 | 37.3 | 35.1 | 33.9 | 35.1 | 10.95 |
| 25-027-0016 | FRM | Worcester | Worcester | WASHINGTON ST | 93 | 40.2 | 28.7 | 28.3 | 26.6 | 28.3 | 9.71 |
| 25-027-0023 | FRM | Worcester | Worcester | SUMMER ST | 90 | 41.2 | 31.6 | 29.6 | 28.2 | 29.6 | 10.22 |

## 2006 $PM_{2.5}$ BAM Data Summary

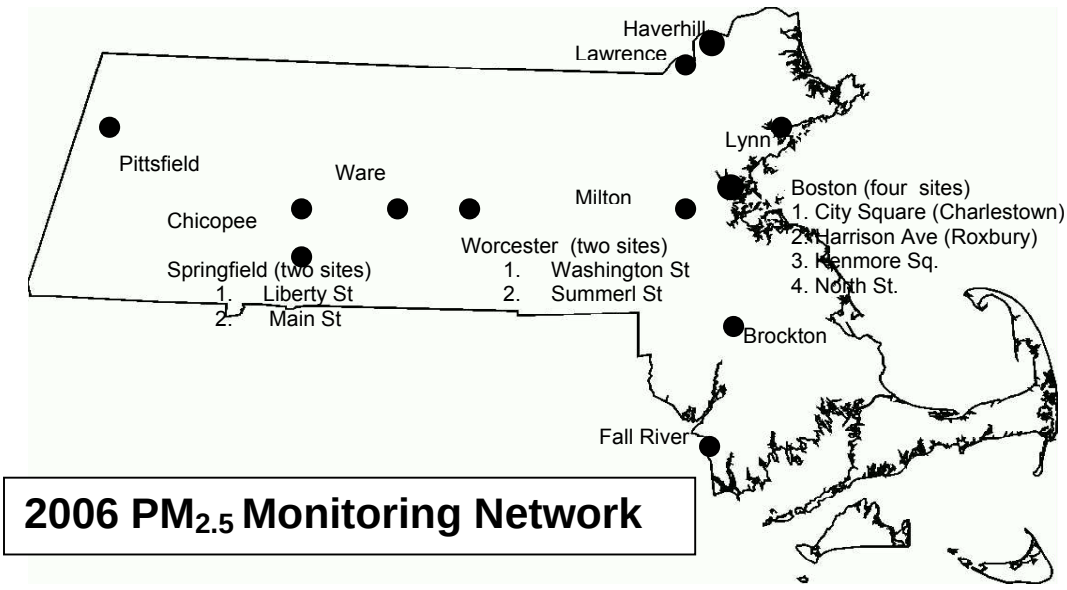
| SITE ID | CITY | COUNTY | ADDRESS | % OBS | 1ST MAX | 2ST MAX | 3RD MAX | 4TH MAX | ARITH MEAN |
|---|---|---|---|---|---|---|---|---|---|
| 25-025-0042 | Boston | Suffolk | HARRISON AVE | 99 | 79.9 | 77.4 | 69.1 | 66.5 | 10.87 |
| 25-025-0043 | Boston | Suffolk | 174 NORTH ST | 98 | 68.7 | 67.2 | 66.0 | 64.5 | 14 |
| 25-005-1004 | Fall River | Bristol | GLOBE STREET | 99 | 78.1 | 77.2 | 75.5 | 74.1 | 9.64 |
| 25-009-5005 | Haverhill | Essex | CONSENTINO SCHOOL | 99 | 76.5 | 64.1 | 59.7 | 58.0 | 8.55 |
| 25-009-2006 | Lynn | Essex | 390 PARKLAND | 99 | 89.4 | 83.5 | 70.9 | 63.6 | 7.77 |
| 25-021-3003 | Milton | Norfolk | BLUE HILL OBSERVATORY | 95 | 52.2 | 51.4 | 50.9 | 49.9 | 6.89 |
| 25-003-0006 | Pittsfield | Berkshire | BERKSHIRE COMMONS | 99 | 69.8 | 68.1 | 64.0 | 61.2 | 9.52 |
| 25-013-0016 | Springfield | Hampden | LIBERTY ST P-LOT | 99 | 74.7 | 62.0 | 61.6 | 60.2 | 10.33 |
| 25-015-4002 | Ware | Hampshire | QUABBIN SUMMIT | 99 | 57.8 | 56.7 | 55.3 | 51.7 | 3.78 |
| 25-027-0023 | Worcester | Worcester | SUMMER ST | 98 | 148.8 | 85.0 | 59.6 | 57.4 | 8.64 |

* INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA (NUMBER OF OBSERVATIONS FOR AT LEAST 1 QUARTER WAS LESS THAN 75%) (Currently BAM data has no standard)

Standards (based on 3-year averages): 24-hours = 65 $\mu g/m^3$ Annual Arithmetic Mean = 15.0 $\mu g/m^3$

**ABBREVIATIONS AND SYMBOLS USED IN TABLE**

**SITE ID** = AIRS SITE IDENTIFICATION **TYPE** = TYPE OF INSTRUMENT **FRM** = FEDERAL REFERENCE METHOD; **FRM COLOC** = FED. REF. METH. COLOCATED **BAM** = BETA ATENUATION MONITOR **1ST, 2ND, 3RD, 4TH MAX** = 1ST, 2ND, 3RD, AND 4TH HIGHEST 24-HOUR VALUES FOR THE YEAR **WTD ARITH MEAN** = WEIGHTED ANNUAL ARITHMETIC MEAN (STANDARD = 15.0 $\mu g/m^3$)




## Speciation

MassDEP has been collecting $PM_{2.5}$ samples for speciation at the air monitoring station in Roxbury since 2000 and in Chicopee since 2001. Speciation is the analysis of particulate matter collected on teflon, nylon and quartz filters simultaneously to determine the chemical composition of the particulate matter collected. The results are used to determine the levels of specific toxic air pollutants present in the atmosphere, and to provide clues about the nature and identity of air pollution sources that impact the monitoring station area. During each sampling event, the three separate filters are collected and shipped to an out-of-state national contract laboratory for analysis. Each different filter medium is analyzed for a different category of pollutant. These include elements (e.g., metals), sulfates, nitrates, and carbon (total and organic).

## IMPROVE (Interagency Monitoring of Protected Visual Environments)

Massachusetts currently has two IMPROVE monitors at the Ware and Truro sites. The Wampanoag Indian Tribe operates a third IMPROVE sampler at its Martha's Vineyard site. These samplers acquire $PM_{2.5}$ filter samples for speciation analysis using a different protocol than that of the speciation program described above. IMPROVE is a nationwide program designed to assess air quality at rural locations where air pollution may impact visibility over long distances (e.g., mountain ranges or scenic vistas). Data can be viewed at the IMPROVE web site at http://vista.cira.colostate.edu/improve/Data/data.htm.

# Lead (Pb) Summary

## 2006 Pb Data Summary

MassDEP operates a total suspended particulates (TSP) sampler at only one site to measure airborne lead levels. The concentrations monitored are low. Since 1975, the use of unleaded gasoline has greatly diminished lead emissions from automobiles, which in the past were the primary source of airborne lead in the atmosphere. A summary of the 2006 Pb data is shown below.

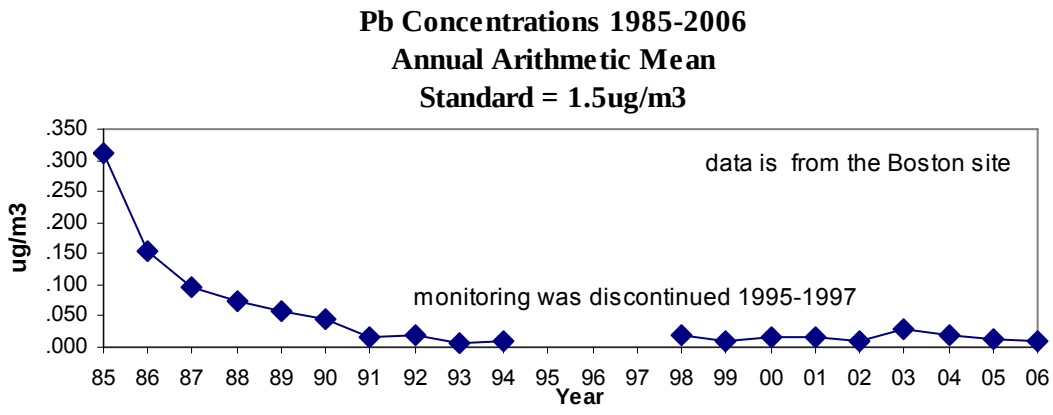
| SITE ID | CITY | COUNTY | ADDRESS | # OBS | QTR1 ARITH MEAN | QTR2 ARITH MEAN | QTR3 ARITH MEAN | QTR4 ARITH MEAN | # MEANS > 1.5 | 1ST MAX | 2ND MAX |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25-025-0002 | Boston | Suffolk | KENMORE SQUARE | 59 | 0.01 | 0.01 | 0.01 | 0.01 | 0 | 0.01 | 0.01 |

*INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA (NUMBER OF OBSERVATIONS FOR AT LEAST 1 QUARTER WAS LESS THAN 75%)

Standard: 1.5 μg/m³ (Calendar Quarter Arithmetic Mean)

**ABBREVIATIONS AND SYMBOLS USED IN TABLE**
**SITE ID** = AIRS SITE IDENTIFICATION # **OBS** = # OBSERVATIONS **QTR1,QTR2, QTR3, QTR4 ARITH MEAN** = THE MEANS FOR THE 1ST, 2ND, 3RD AND 4TH CALENDAR QUARTERS **# MEANS > 1.5** = THE NUMBER OF CALENDAR QUARTER MEANS GREATER THAN THE STANDARD (1.5 μg/m³) **1ST, 2ND MAX** = THE 1ST AND 2ND MAXIMUM 24 HOUR VALUES

**Figure 9**



## Industrial Network Summary

### Introduction

The industrial ambient air quality network is comprised of monitoring stations operated by facilities that have the potential to emit large amounts of pollutants. An example would be a fossil fuel-fired power plant that has the potential to emit large quantities of $SO_2$.

The monitoring stations in the industrial network are sited to measure the maximum values from the specific point source. When the pollutant $SO_2$ value reaches certain trigger values, the power plant switches to lower-sulfur content fuel.

The data from the industrial network is submitted to MassDEP's Air Assessment Branch. AAB submits the data to the USEPA AQS database after completing the quality assurance process.

### Continuous Emission Monitoring System (CEMS)

In addition to the ambient monitoring network, in-stack Continuous Emission Monitoring System (CEMS) equipment is required at certain facilities by a MassDEP-issued permit or other state and federal regulations. For example, the federal Acid Rain Program requires CEMS enabling measurement of $SO_2$, $NO_x$ and $CO_2$ emissions from the nation's largest power generating facilities. The information on emissions collected by CEMS monitors can be found on USEPA's web site at www.epa.gov/airmarkets/arp/.

### Sulfur Dioxide ($SO_2$) summary

There were four $SO_2$ sites in operation during 2006 in the industrial network. All of the sites achieved the requirement of 75% or greater data capture for the year. There were no measured violations of the $SO_2$ air quality standards during the year in the reported data. A summary of the 2006 $SO_2$ data is shown below.

| SITE ID | CITY | COUNTY | ADDRESS | % OBS | 1ST MAX 24-HR | 2ND MAX 24-HR | #OBS >0.14 | 1ST MAX 3-HR | 2ND MAX 3-HR | #OBS >0.5 | 1ST MAX 1-HR | 2ND MAX 1-HR | ARITH MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25-025-0019 | Boston | Suffolk | LONG ISLAND | 81 | .012 | .011 | 0 | .016 | .013 | 0 | .021 | .021 | 0.0032 |
| 25-025-0020 | Boston | Suffolk | DEWAR STREET | 93 | .016 | .013 | 0 | .022 | .019 | 0 | .025 | .024 | 0.0036 |
| 25-025-0021 | Boston | Suffolk | 340 BREMEN STREET | 93 | .015 | .013 | 0 | .033 | .020 | 0 | .044 | .034 | 0.0035 |
| 25-025-0040 | Boston | Suffolk | 531A EAST FIRST STREET | 96 | .014 | .012 | 0 | .027 | .025 | 0 | .042 | .040 | 0.0044 |

**ABBREVIATIONS AND SYMBOLS USED IN TABLE**
**SITE ID** = AIRS SITE IDENTIFICATION NUMBER **%OBS** = DATA CAPTURE PERCENTAGE **1ST, 2ND MAX 24-HR, MAX 3-HR, MAX 1-HR** = FIRST AND SECOND HIGHEST 24-HOUR, 3-HOUR, AND 1-HOUR VALUES FOR TIME PERIOD INDICATED # **OBS** > 0.14 = NUMBER OF OBSERVATIONS ABOVE THE 24-HOUR STANDARD OF 0.14 PPM # **OBS** > 0.5 = NUMBER OF OBSERVATIONS ABOVE THE 3-HOUR STANDARD OF 0.5 PPM **ARITH MEAN** = ARITHMETIC MEAN (STANDARD = 0.03 PPM)

## Nitrogen Dioxide ($NO_2$) summary

There was one $NO_2$ site that operated during 2006 in the industrial network. The site was owned by Exelon Energy in Boston (East First St.) but was operated by ENSR International. The site met the requirement of 75% or greater data capture. There were no reported violations of the $NO_2$ air quality standard during the year.

A summary of the 2006 $NO_2$ data is shown below.

| SITE ID | CITY | COUNTY | ADDRESS | % OBS | 1ST MAX 1-HR | 2ND MAX 1-HR | ARITH MEAN |
|---|---|---|---|---|---|---|---|
| 25-025-0040 | Boston | Suffolk | 531A EAST FIRST STREET | 82 | .157 | .099 | 0.0143 |

PRIMARY STANDARD: ANNUAL ARITHMETIC MEAN = 0.053 PPM

**ABBREVIATIONS AND SYMBOLS USED IN TABLE**
**SITE ID** = AIRS SITE IDENTIFICATION NUMBER %**OBS** = DATA CAPTURE PERCENTAGE **MAX 1-HR 1ST, 2ND** = FIRST AND SECOND HIGHEST VALUE FOR TIME PERIOD INDICATED **ARIT MEAN** = ARITHMETIC MEAN (STANDARD = 0.053 PPM)

## Total Suspended Particulates (TSP) summary

There were four TSP sites that operated during 2006 in the industrial network. The sites were owned by Exelon Energy in Boston but were operated by ENSR International. All of the sites met the requirement of 75% or greater data capture.

TSP is no longer a criteria pollutant ($PM_{10}$ replaced it as the course particulate standard in 1987), so there is no longer a standard for it. A summary of the 2006 TSP data is shown below.

| SITE ID | CITY | COUNTY | ADDRESS | # OBS | 1ST MAX | 2ND MAX | 3RD MAX | 4TH MAX | ARITH MEAN | GEO MEAN | GEO STD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25-025-0019 | Boston | Suffolk | LONG ISLAND | 100 | 51 | 47 | 45 | 38 | 20.4 | 18.1 | 1.6 |
| 25-025-0020 | Boston | Suffolk | DEWAR STREET | 100 | 324 | 253 | 243 | 203 | 80 | 61.6 | 2.1 |
| 25-025-0021 | Boston | Suffolk | 340 BREMEN STREET | 100 | 140 | 109 | 107 | 91 | 48.9 | 43.3 | 1.7 |
| 25-025-0040 | Boston | Suffolk | 531A EAST FIRST STREET | 92 | 100 | 82 | 76 | 63 | 36.2* | 32.8 | 1.6 |
| 25-025-0040 | Boston | Suffolk | 531A EAST FIRST STREET | 97 | 94 | 81 | 78 | 66 | 36 | 32.6 | 1.6 |

**ABBREVIATIONS AND SYMBOLS USED IN TABLE**
**SITE ID** = AIRS SITE IDENTIFICATION NUMBER **TYPE =** TYPE OF INSTRUMENT **– NC** = NON CONTINUOUS, **NC COLOC** – NON CONTINUOUS COLOCATED**. % OBS** = DATA CAPTURE PERCENTAGE **1ST, 2ND, 3RD, 4TH MAX** = 1ST, 2ND, 3RD AND 4TH HIGHEST 24-HOUR VALUES FOR THE YEAR **ARITH MEAN** = ARITHMETIC MEAN **GEO MEAN** = GEOMETRIC MEAN **GEO STD** = GEOMETRIC STANDARD DEVIATION

## Sulfate ($SO_4$) summary

There were four $SO_4$ sites that operated during 2006 in the industrial network. The sites were owned by Exelon Energy in Boston but were operated by ENSR International. All of the sites met the requirement of 75% or greater data capture.

$SO_4$ is not a criteria pollutant so there are no ambient air quality standards for $SO_4$. A summary of the 2006 $SO_4$ data is shown below.

| SITE ID | | CITY | COUNTY | ADDRESS | # OBS | 1ST MAX | 2ND MAX | 3RD MAX | 4TH MAX | ARITH MEAN |
|---|---|---|---|---|---|---|---|---|---|---|
| 25-025-0019 | NC | Boston | Suffolk | LONG ISLAND | 100 | 10 | 8 | 8 | 8 | 4.3 |
| 25-025-0020 | NC | Boston | Suffolk | DEWAR STREET | 100 | 12 | 12 | 10 | 9 | 5.23 |
| 25-021-0021 | NC | Boston | Suffolk | 340 BREMEN STREET | 100 | 11 | 11 | 9 | 9 | 5.64 |
| 25-025-0040 | NC | Boston | Suffolk | 531A EAST FIRST STREET | 92 | 12 | 11 | 11 | 10 | 5.23 |
| 25-025-0040 | NC Coloc | Boston | Suffolk | 531A EAST FIRST STREET | 97 | 11 | 10 | 10 | 9 | 5.15 |

**ABBREVIATIONS AND SYMBOLS USED IN TABLE**
**SITE ID** = AIRS SITE IDENTIFICATION NUMBER **TYPE** = TYPE OF INSTRUMENT **– NC** = NON CONTINUOUS, **NC COLOC** = NON CONTINUOUS COLOCATED **% OBS** = DATA CAPTURE PERCENTAGE **1ST, 2ND, 3RD, 4TH MAX VALUE** = 1ST, 2ND, 3RD AND 4TH HIGHEST 24-HOUR VALUES FOR THE YEAR **ARITH MEAN** = ARITHMETIC MEAN

## Quality Control and Quality Assurance

### Introduction

To ensure that ambient air quality data is of high quality, MassDEP has developed standard operating procedures (SOPs) that include quality control and quality assurance techniques that systematically assess the quality of the data and document the activities performed in collecting the data.

### Quality Control

MassDEP's Air Assessment Branch has a data group within the Quality Assurance Section that reviews all of the data collected by the field staff. The data group checks the raw data, evaluates precision and accuracy results and ensures that all QC activities are carried out in accordance with prescribed methods. The data is screened using computer software tools, report queries and manual "eyes on" data scans. Edits are made as required and the data is submitted to the USEPA AQS database where it undergoes additional statistical checks before being moved into the permanent database.

### Data Quality Review

MassDEP's Air Assessment Branch has a data group that reviews data. This group checks all precision and accuracy activities as well as raw data, quality assurance checks, and documentation. The group uses report software for data validation. The data group edits the data as required and transfers it to the USEPA AQS database where it undergoes further scrutiny before being moved into the permanent database.

### Quality Assurance

Quality Assurance (QA) is comprised of those activities performed by personnel who are not directly involved in the generation of the data and who may therefore make an unbiased assessment of the data quality. QA activities include performance audits of the ambient air monitors and monitoring stations to assess the accuracy of the data.

### Precision and Accuracy

Precision is defined as a measure of the repeatability of a measurement system. Accuracy is defined as a measure of the closeness of an observed measurement value to the actual value.

QC and QA performance checks allow the precision and accuracy of ambient air monitors to be quantified. This is accomplished by testing the monitor's response to known inputs in order to assess the measurement error. The QC performance checks assess the precision, while the QA performance checks assess the accuracy. The requirements and techniques for performing precision and accuracy performance checks are established in the Code of Federal Regulations (CFR), Title 40, Part 58, Appendix A.

### How Precision and Accuracy are Described

Precision and accuracy are given in the context of upper and lower 95$^{th}$ percentile probability limits for each pollutant parameter. The meaning of the 95$^{th}$ percentile limits is that 95% of the

data for a parameter is estimated to be precise or accurate to within the percentage range defined by the upper and lower limits.

As an example, if the upper and lower 95th percentile limits for a parameter based upon precision checks are calculated to be +4.3% and –7.4%, then 95% of the data is precise within the range of +4.3% through –7.4%.

## 2006 Precision and Accuracy Summary

As a goal, the 95th percentile probability limits for precision (all parameters) and $PM_{10}$ and TSP accuracy should be less than ±15%. The 95th percentile probability limits for accuracy for all other parameters should be less than ±20%. Three response levels are audited: low (L1) 6-16% of full scale, mid (L2) 30- 40%, and high (L3) 70-90%. A summary of the 2006 precision and accuracy data is shown below.

| | | | | | | | PRECISION DATA | | | | ACCURACY DATA | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRECISION AND BIAS DATA KEY | | | | | | | # OF | # PREC | PROB | LIM | # AUDITS | PROB | LIM | PROB | LIM | PROB | LIM |
| RG | ST | RO | TYP | CLASS | POLL | YEAR-Q | ANLYZRS | CHECKS | LO | UP | L1-3 | LO-L1 | -UP | LO-L2 | -UP | LO-L3 | -UP |
| 01 | 25 | 001 | C | A | CO | 2006 | 5 | 125 | -5.3 | 2.6 | 15 | -11.5 | 6.8 | -15.8 | 1.4 | -15.0 | 3.8 |
| CARBON MONOXIDE | | | | | | 2006-1 | 5 | 30 | -6.2 | 4.4 | 6 | -6.5 | -6.5 | -13.3 | -9.2 | -14.2 | -5.7 |
| | | | | | | 2006-2 | 5 | 32 | -3.7 | 1.6 | 3 | -8.6 | -2.6 | -13.9 | -6.6 | -14.1 | -3.1 |
| | | | | | | 2006-3 | 5 | 30 | -3.8 | 0.6 | 3 | | | | | | |
| | | | | | | 2006-4 | 5 | 33 | -5.6 | 2.1 | 3 | -0.9 | 6.0 | -2.6 | -2.6 | -7.3 | 5.1 |
| 01 | 25 | 001 | C | A | SO2 | 2006 | 6 | 156 | -8.8 | 1.9 | 18 | -7.0 | 4.8 | -8.3 | 0.1 | -6.2 | 0.3 |
| SULFUR DIOXIDE | | | | | | 2006-1 | 6 | 40 | -7.7 | 0.4 | 6 | -7.6 | 3.6 | -8.3 | 1.6 | -6.4 | 1.9 |
| | | | | | | 2006-2 | 6 | 37 | -8.7 | 2.2 | | | | | | | |
| | | | | | | 2006-3 | 6 | 41 | -8.8 | 0.0 | 9 | -6.0 | 1.7 | -7.9 | -2.9 | -6.0 | -2.1 |
| | | | | | | 2006-4 | 6 | 38 | -7.4 | 2.7 | 3 | -7.4 | 6.0 | -8.8 | -0.1 | -6.5 | -0.2 |
| 01 | 25 | 001 | C | A | NO2 | 2006 | 12 | 238 | -8.9 | 6.4 | 30 | -18.4 | 9.7 | -17.4 | 8.1 | -16.1 | 8.3 |
| NITROGEN DIOXIDE | | | | | | 2006-1 | 8 | 51 | -7.4 | 6.5 | 6 | -4.9 | -1.5 | -9.1 | 0.9 | -6.5 | 0.7 |
| | | | | | | 2006-2 | 12 | 80 | -9.0 | 5.8 | 6 | -24.8 | 23.3 | -22.5 | 20.9 | -17.7 | 19.4 |
| | | | | | | 2006-3 | 12 | 51 | -7.2 | 4.4 | 9 | -14.2 | 10.8 | -16.2 | 9.4 | -13.8 | 8.4 |
| | | | | | | 2006-4 | 8 | 56 | -9.1 | 6.4 | 9 | -22.8 | 2.5 | -21.0 | 3.4 | -19.8 | 1.7 |
| 01 | 25 | 001 | C | A | O3 | 2006 | 14 | 237 | -6.5 | 2.4 | 30 | -1.3 | 9.6 | -0.3 | 9.2 | 0.3 | 8.8 |
| OZONE | | | | | | 2006-1 | 5 | 29 | -7.4 | 1.9 | 3 | | | | | | |
| | | | | | | 2006-2 | 14 | 91 | -6.5 | 2.5 | 9 | 1.2 | 6.2 | 2.0 | 6.0 | 3.0 | 5.9 |
| | | | | | | 2006-3 | 14 | 90 | -5.3 | 1.0 | 12 | -3.2 | 9.9 | -0.7 | 8.7 | -0.1 | 8.2 |
| | | | | | | 2006-4 | 4 | 27 | -3.0 | 0.8 | 6 | -0.7 | 14.1 | -3.2 | 15.8 | -3.5 | 15.2 |

| PRECISION AND ACCURACY DATA KEY | | | | | | | # OF | COLLOC | PROB | LIM | # AUDITS | | PROB LIM | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RG | ST | RO | TYP | CLASS | POLL | YEAR-Q | SAMP | SITES | LO | UP | L1-L3 | | LO-L2 | UP | | |
| 01 | 25 | 001 | I | F | PM2.5 | 2006 | 547 | 4 | 9.9 | 11.2 | 62 | | -0.9 | -0.3 | | |
| PM2.5 LOCAL CONDITIONS | | | | | | 2006-1 | 137 | 4 | 9.9 | 12.8 | 13 | | -1.6 | 0.0 | | |
| | | | | | | 2006-2 | 161 | 4 | 8.7 | 11.3 | 14 | | -1.0 | 0.3 | | |
| | | | | | | 2006-3 | 120 | 3 | 9.9 | 12.9 | 17 | | -1.0 | 0.3 | | |
| | | | | | | 2006-4 | 129 | 3 | 8.8 | 11.1 | 18 | | -1.5 | -0.3 | | |
| 01 | 25 | 001 | I | F | PM10 | 2006 | 106 | 2 | -10.5 | 12.8 | 34 | | -5.8 | 4.0 | | |
| PM10 TOTAL 0-10UM | | | | | | 2006-1 | 26 | 2 | -10.9 | 1.1 | 8 | | -6.8 | 4.9 | | |
| | | | | | | 2006-2 | 22 | 2 | -14.1 | 24.7 | 8 | | -7.3 | 5.0 | | |
| | | | | | | 2006-3 | 26 | 2 | -6.7 | 13.7 | 9 | | -5.4 | 4.0 | | |
| | | | | | | 2006-4 | 32 | 2 | -7.6 | 5.1 | 9 | | -4.6 | 2.9 | | |

**ABBREVIATIONS AND SYMBOLS USED IN TABLE**
**RG** = EPA REGION **ST** = STATE **RO** = REPORTING ORGANIZATION **TYP** = ANALYZER TYPE (CONTINUOUS OR INTERMITTENT) **CLASS** = ANALYTICAL (A); FLOW (F) **YR** = YEAR **# OF ANLYZRS** = NUMBER OF ANALYZERS **PREC CHECKS** = NUMBER OF PRECISION CHECKS **PROB LIM LO/UP** = LOWER AND UPPER 95% PROBABILITY LIMITS **# AUDITS L1-3** = NUMBER OF AUDITS **PROB LIM LO-L1-UP** = LOWER AND UPPER 95% PROBABILITY LIMITS AT LOW RANGE **PROB LIM LO-L2-UP** = LOWER AND UPPER 95% PROBABILITY LIMITS AT MIDDLE RANGE **PROB LIM LO-L3-UP** = LOWER AND UPPER 95% PROBABILITY LIMITS AT HIGH RANGE **# OF SMPLS** =NUMBER OF SAMPLERS **COLLOC SITES** = NUMBER OF COLLOCATED SITES **# AUD** = NUMBER OF AUDITS

# Section IV
# PAMS/Air Toxics Monitoring

## PAMS Monitoring

### Introduction

Unlike other pollutants, ground-level ozone is unique because it is a secondary pollutant and is not discharged directly to the atmosphere from a stack or tailpipe, but rather forms in the atmosphere from the photochemical reactions of other pollutants such as volatile organic compounds (VOCs) and NOx. Ozone formation can occur many miles downwind from the source of the original emissions. These reactions occur in the presence of strong sunlight and are most pronounced during the hottest days of the summer. The PAMS (Photochemical Assessment Monitoring Stations) program was conceived as part of the 1990 Clean Air Act Amendments as an accurate way to collect data for assessing NAAQS attainment progress independent of the meteorological variation that occurs between years and for identifying appropriate pollution control strategies.

PAMS is a special designation for enhanced monitoring stations that are designed to gather information on the ozone formation process. Instrumentation at these sites measures pollutants and meteorological parameters that are specific to the photochemical processes by which ozone is created in the atmosphere at ground level. In addition to the standard NAAQS pollutants (ozone, $NO_2$, etc.) that are measured at other sites, non-criteria pollutants, including VOCs, are measured at PAMS stations on either an hourly basis or at regular intervals during the hottest part of the summer in June, July and August. Meteorology is a critical component of ozone formation and each PAMS site has a full compliment of meteorological sensors including wind speed, wind direction, temperature, relative humidity, barometric pressure, solar radiation and at some sites, total ultraviolet light and precipitation. MassDEP also operates a sophisticated PAMS associated Doppler Radar atmospheric profiler at a non-PAMS site in Stow, Massachusetts. This instrument measures temperature and wind profiles at different levels of the atmosphere that provides valuable information on upper level conditions that contribute to ozone formation.

Since the PAMS project started in 1993, USEPA has required Massachusetts to conduct enhanced ozone precursor measurements in the Boston and Springfield Metropolitan Areas and to assist Rhode Island in the measurement of ozone precursors and reactants at locations down wind of Providence, RI. The PAMS monitoring network was phased in during the 1990's. Competition for attention and resources from newer monitoring initiatives (including $PM_{2.5}$) has halted the expansion of the program and led to a consolidation of the network over the last several years. Looking toward the future, a holistic strategy that includes PAMs measurements at fewer but more enhanced air monitoring stations is being developed by USEPA. New USEPA regulations will reduce the number of PAMS sites in each area from the originally envisioned five sites per network to two.

**PAMS Monitoring Areas**

| Boston | Springfield | Providence |
|---|---|---|
| *Blue Hill (Milton) | Chicopee | *Blue Hill (Milton) |
| Lynn | Ware | |
| Newbury | | |
| Long Island | | |

* Provides data for both Boston and Providence networks.

# Air Toxics Monitoring

## Introduction

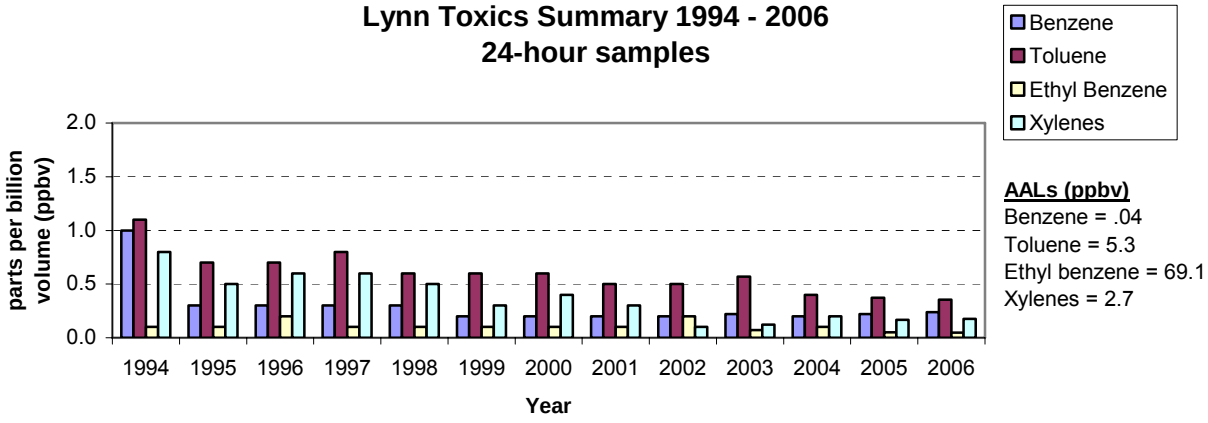
Toxic air pollutants are distinct from criteria air pollutants such as ozone and CO. The list includes pollutants known or suspected to cause cancer or other serious health effects, and includes volatile organic compounds (VOCs) and toxic metals (e.g., mercury).

MassDEP monitors VOCs as part of the PAMS monitoring program, many of which are classified as air toxics. From June through August, VOCs are monitored at six PAMS sites. In addition, in 1999 MassDEP added two monitors to measure specific health-relevant VOCs.

A new toxics monitoring project was started at the Harrison Avenue monitoring site in Roxbury in 2003 and has been designated as a National Air Toxics Trends Station (NATTS) designed to collect and quantify a number of toxic air pollutants including VOCs, metals, aldehydes and black carbon. Data from this site will be compared with data from a network of similar sites positioned across the country to identify transport, trends and site-specific characteristics of these pollutants. VOCs and black carbon have been collected at this site since 1999.

Figure 10 summarizes concentrations of 24-hour health-relevant PAMS target compounds for samples taken at the Lynn PAMS site from 1994 to 2006. Significant mean concentration decreases seen between 1994 and 1995 are likely due to the introduction of reformulated gasoline at the beginning of 1995. Allowable Ambient Limit (AAL) values are presented next to Figure 10 for reference. AALs are health-based air toxics guidelines developed by MassDEP based on known or suspected carcinogenic and toxic health properties of individual compounds. Safety factors are incorporated into the AALs to account for exposures from pathways other than air. AALs are reviewed and updated periodically to reflect current toxicity information. AAL concentrations were developed for a 70-year lifetime exposure, but are frequently used for comparison with annual averages.

**Figure 10**



Below is a table that summarizes results from the analysis of 24-hour samples for selected target VOCs from the two sites for 2006. The central city sampling location is Harrison Avenue and the area background site was Lynn.

| Compound | BOSTON (Harrison Ave) | | LYNN | |
|---|---|---|---|---|
| | Max Value ppb | Mean ppb | Max Value ppb | Mean ppb |
| 1,3-butadiene | .191 | .057 | .085 | .025 |
| 1,1,1-trichloroethane | .041 | .012 | .023 | .011 |
| trichloroethylene | .054 | .006 | .038 | .004 |
| tetrachloroethylene | .131 | .033 | .136 | .022 |
| Benzene | .869 | .346 | 1.664 | .239 |
| Toluene | 2.428 | .756 | 1.614 | .355 |
| Xylenes | 1.492 | .445 | .577 | .176 |
| Ethylbenzene | .385 | .112 | .156 | .048 |

# Appendix A

## 2006 State Monitoring Station Locations

| SITE ID | CITY | COUNTY | ADDRESS | DATE SITE ESTABLISHED | MONITORED |
|---|---|---|---|---|---|
| 25-001-0002 | ADAMS | BERKSHIRE | MT. GREYLOCK | 5/1/1989 | O3 |
| 25-003-4002 | AMHERST | HAMPSHIRE | NORTH PLEASANT | 4/1/1988 | O3 |
| 25-025-0002 | BOSTON | SUFFOLK | KENMORE SQUARE | 1/1/1965 | SO2, NO2, CO, Lead, PM2.5 FRM, PM10, TEMP |
| 25-025-0027 | BOSTON | SUFFOLK | ONE CITY SQUARE | 1/1/1985 | PM2.5 FRM, PM10 |
| 25-025-0041 | BOSTON | SUFFOLK | LONG ISLAND | 12/1/1998 | O3, NO2, VOCs, WS/WD, TEMP, Solar Rad, RH, BP |
| 25-025-0042 | BOSTON | SUFFOLK | HARRISON AVENUE | 12/15/1998 | O3, SO2, NO2, CO, PM2.5 FRM & BAM (w/Speciation), PM10, Toxics, Black Carbon, WS/WD, TEMP, Solar Rad, RH, BP |
| 25-025-0043 | BOSTON | SUFFOLK | 174 NORTH ST | 1/1/2000 | PM2.5 FRM & BAM, Black Carbon |
| 25-023-0004 | BROCKTON | PLYMOUTH | 120 COMMERCIAL ST | 12/15/1998 | PM2.5 FRM |
| 25-013-0008 | CHICOPEE | HAMPDEN | ANDERSON RD | 1/1/1983 | O3, NO2, PM2.5 FRM (w/Speciation), VOCs, Toxics, TEMP, WS/WD, Solar Rad, RH, BP |
| 25-013-0008 | FAIRHAVEN | BRISTOL | LEROY WOOD | 1/1/1982 | O3, WS/WD, TEMP, Solar Rad, RH, BP |
| 25-005-1004 | FALL RIVER | BRISTOL | GLOBE ST | 2/1/1975 | PM2.5 FRM & BAM, SO2 |
| 25-009-5005 | HAVERHILL | ESSEX | WASHINGTON ST | 7/19/1994 | O3, NO2, PM2.5 FRM & BAM, WS/WD, TEMP, Solar Rad, RH, BP |
| 25-009-6001 | LAWRENCE | ESSEX | WALL EXP. STATION | 4/3/1999 | PM2.5 FRM |
| 25-017-0007 | LOWELL | MIDDLESEX | OLD CITY HALL | 7/17/1981 | CO |
| 25-009-2006 | LYNN | ESSEX | 390 PARKLAND | 1/1/1992 | O3, NO2, PM2.5 FRM & BAM, VOCs, Toxics, WS/WD, TEMP, Solar Rad, RH, BP, UVB, PRECIP |
| 25-021-3003 | MILTON | NORFOLK | BLUE HILL | 4/2/2002 | O3, NO2, NOy, PM2.5 BAM, VOCs, WS/WD, TEMP, Solar Rad, RH, BP |
| 25-009-4004 | NEWBURY | ESSEX | SUNSET BOULEVARD | 8/1/1994 | O3, NO2, NOy, VOCs, WS/WD, TEMP, Solar Rad, RH, BP |
| 25-003-5001 | PITTSFIELD | BERKSHIRE | 78 CENTER STREET | 12/15/2005 | PM2.5 FRM |
| 25-003-0006 | PITTSFIELD | BERKSHIRE | BERKSHIRE COMMONS | 1/1/79 | PM2.5 BAM |
| 25-013-0016 | SPRINGFIELD | HAMPDEN | LIBERTY STREET | 4/1/1988 | SO2, NO2, CO, PM2.5 FRM & BAM |
| 25-013-2009 | SPRINGFIELD | HAMPDEN | 1860 MAIN STREET | 1/1/2002 | PM2.5 FRM, PM10 |
| 25-021-3003 | STOW | MIDDLESEX | US MILITARY | 4/1/1998 | O3, Profiler, WS/WD, TEMP, Solar Rad, RH, BP |
| 25-001-0002 | TRURO | BARNSTABLE | FOX BOTTOM AREA | 4/1/1987 | O3, NO2, NOy, IMPROVE, WS/WD, TEMP, Solar Rad, RH, BP |
| 25-017-4003 | WALTHAM | MIDDLESEX | BEAVER STREET | 1/1/1982 | Acid Deposition |
| 25-015-4002 | WARE | HAMPSHIRE | QUABBIN SUMMIT | 6/1/1985 | O3, SO2, NO2, NOy, PM10, VOCs, PM2.5 BAM, IMPROVE, WS/WD, TEMP, Solar Rad, RH, BP, UVB, PRECIP |
| 25-027-0015 | WORCESTER | WORCESTER | WORC. AIRPORT | 5/7/1979 | O3, WS/WD, TEMP, RH, BP, Solar Rad |
| 25-027-0016 | WORCESTER | WORCESTER | 2 WASHINGTON ST | 12/31/2002 | PM2.5 FRM |
| 25-027-0023 | WORCESTER | WORCESTER | SUMMER STREET | 1/1/2004 | SO2, NO2, CO, PM2.5 FRM & BAM, PM10 |

## 2006 Industrial Monitoring Station Locations

| SITE ID | CITY | COUNTY | ADDRESS | DATE SITE ESTABLISHED | MONITORED |
|---|---|---|---|---|---|
| 25-025-0019 | BOSTON | SUFFOLK | LONG ISLAND | 1/1/1978 | SO2, TSP, SO4, WS/WD |
| 25-025-0020 | BOSTON | SUFFOLK | DEWAR STREET | 1/1/1978 | SO2, TSP, SO4, WS/WD |
| 25-025-0021 | BOSTON | SUFFOLK | BREMEN STREET | 1/1/1979 | SO2, TSP, SO4, WS/WD |
| 25-025-0040 | BOSTON | SUFFOLK | 531A EAST FIRST ST | 1/1/1993 | SO2, TSP, SO4, NO2, WS/WD |

# Appendix B
# Air Quality Web Sites

Below is a listing of web sites that have air quality data or related information.

| Web Address | Organization | Description |
|---|---|---|
| www.mass.gov/dep/ | MassDEP | MassDEP Home Page. Links to MassDEP programs, regions and publications. Links to the Daily Ozone Forecast during ozone season (May 1 through September 30). |
| www.airbeat.org | MassDEP/EMPACT | Current AIR Quality in Roxbury – web page of MassDEP and EMPACT's Roxbury monitor that shows current levels of ozone and particulates in the air. |
| www.turi.org | TURI | Toxics Use Reduction Institute – a multi-disciplinary research, education, and technical support center located at the University of Massachusetts/Lowell. Promotes reduction in the use of toxic chemicals and the generation of toxic by-products in industry and commerce in Massachusetts. The web site includes a link to TURAData, which makes information available to the public about toxics use in their communities. |
| www.airnow.gov | USEPA | Ozone Mapping Project – color-coded animated maps using near real-time data that show how ozone is formed and transported downwind. |
| www.epa.gov/ ne/aqi/index.html | USEPA | AQI New England Forecast and Real Time Ozone. |
| www.epa.gov/ne/airquality/ index.html | USEPA | EPA Smog Alert System – sign up and receive e-mail alerts whenever Massachusetts predicts unhealthy ozone levels. |
| www.epa.gov/air/data/ | USEPA | AIRSData - Access to air pollution data for the entire U.S. |
| www.epa.gov/bioindicators/ | USEPA | Center for Environmental Information and Statistics – a single convenient source for information on environmental quality. |
| www.epa.gov/oar/ oaqps | USEPA | EPA's Office of Air and Radiation/Office of Air Quality Planning and Standards |
| www.epa.gov/region01/ | USEPA | EPA Region 1 Home Page |
| www.epa.gov/ttn/ | USEPA | EPA Technology Transfer Network - a collection of technical Web sites containing information about many areas of air pollution science, technology, regulation, measurement, and prevention. |

# Appendix B (continued)

| Web Address | Organization | Description |
|---|---|---|
| www.epa.gov/enviro/ | USEPA | EPA Envirofacts – data extracted from (4) major EPA databases: • PCS (Permit Compliance System) • RCRIS (Resource Conservation and Recovery Information System) • CERCLIS (Comprehensive Environmental Response, Compensation and Liability Information System) • TRIS (Toxic Release Inventory System) |
| www.epa.gov/index.html | USEPA | Enviro$en$e Network - a free, public environmental information system. Provides users with pollution prevention/cleaner production solutions, compliance and enforcement assistance information, and innovative technology options. |
| www.epa.gov/docs/ozone/index.html | USEPA | EPA Ozone Depletion Home Page – learn about the importance of the "good" ozone in the stratospheric ozone layer. |
| www.epa.gov/airmarkets/acidrain/ | USEPA | The Acid Rain Program – overall goal is to achieve significant environmental and public health benefits through reductions in emissions of sulfur dioxide ($SO_2$) and nitrogen oxides ($NO_X$), the primary causes of acid rain. Emissions data from the nation's largest power generating facilities is available here. |
| www.wampweather.org | Wampanoag Tribe | Weather monitoring information is listed under Natural Resources. |
| Maine<br>www.state.me.us/dep/air/<br><br>New Hampshire<br>www.des.state.nh.us/ard/ozone.htm<br><br>New York<br>www.dec.state.ny.us/<br><br>New Jersey<br>www.state.nj.us/dep/airmon/<br><br>Rhode Island<br>www.dem.ri.gov/programs/benviron/air/pm.htm | | Ozone predictions and some real-time ozone data from neighboring states (some states report other pollutants, as well). |

# Appendix B (continued)

| Web Address | Organization | Description |
|---|---|---|
| www.epa.gov/ttn/atw/ | USEPA | Unified Air Toxics Website - This site is a central clearinghouse and repository for air toxics implementation information |
| www.epa.gov/airtrends | USEPA | AIRTrends - information on USEPA's evaluation of status and trends in the nation's outdoor air quality. |
| www.cleanairworld.org/ | NACAA | National Association of Clean Air Agencies – site has links to state and local air quality agencies. |
| www.nescaum.org/ | NESCAUM | Northeast States for Coordinated Air Use Management – an interstate association of air quality control divisions from the six New England states, New York and New Jersey. |
| www.wunderground.com/ | University of Michigan | The Weather Underground -. another good source of weather information in the US and world. |
| http://cirrus.sprl.umich.edu/ | University of Michigan | The WeatherNet – a good source of weather information. Also has a great list of weather links. |
| www.nws.noaa.gov/er/ box | NWS | The National Weather Service's Boston office provides local forecasts and climate information. |
| www.thebostonchannel.com/ | WCVB | WCVB TV Pollen Count – provides the daily pollen and mold count. |
| www.hazecam.net/ | NESCAUM (CAMNET) | Real-time Air Pollution Visibility Camera Network - live pictures and air quality conditions for urban and rural vistas across the Northeast U.S. |
| www.arb.ca.gov/homepage.htm | CARB | California Air Resources Board Home Page |
| www.awma.org/ | AWMA | The Air & Waste Management Association - a nonprofit, nonpartisan professional organization that provides training, information, and networking opportunities to 12,000 environmental professionals in 65 countries. |
| http://nadp.sws.uiuc.edu/ | NADP | National Atmospheric Deposition Program – maps and data from the nationwide precipitation monitoring network. Site also has data from the Mercury Deposition Network. |
| http://profiler.noaa.gov/npn/profiler.jsp | NPN | NOAA Profiler Network provides hourly vertical wind profile data. |
| www.lungusa.org/ | American Lung Association | American Lung Association – public health advocacy organization involved in public policy, research, and education mission is to prevent lung disease |
| http://nh.water.usgs.gov/ | NACB | New England Coastal Basins Mercury Deposition Network – Atmospheric deposition |