# Commonwealth of Massachusetts
# 2003 Air Quality Report

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

Air Assessment Branch
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ACKNOWLEDGEMENTS

This 2003 Air Quality Report was prepared by the Massachusetts Department of Environmental Protection (MADEP) Air Assessment Branch (AAB), which collects representative, complete, and accurate air quality data throughout the Commonwealth.

The following MADEP AAB staff are acknowledged for their efforts to operate and maintain air monitoring equipment and stations: Laurel Carlson, Damon Chaplin, Diana Conti, Mark Ducomb, Kevin Dufour, Vincent Ferlisi, Charlene Flynn, Dennis Flynn, Dan Herman, Jose Kemperman, Mark Lally, Iva Nesin, Jenmina Ojuka, Tony Pikul, Paul Sanborn, Lisa Shore, Yan Song, Sharri Tyas, Kathy Vertefeuille, Greg Warner and Bradley Webber.

The following MADEP staff contributed to the publication of this report: Leslie Collyer, Richard Fields, Glenn Keith, Barbara Kwetz, Thomas McGrath, Sue Ann Richardson, Jerry Sheehan, Ann Sorensen, and Sharon Weber.

This document is available in Adobe Acrobat PDF format from the MADEP web site. The address is www.mass.gov/dep/bwp/daqc.

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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
EOEA..... Executive Office of Environmental Affairs
FRM ..... Federal Reference Method
IMPROVE ... Interagency Monitoring of Protected Visual Environments
MADEP..... Massachusetts Department of Environmental Protection
$mg/m^3$ ..... milligrams per cubic meter
NAAQS..... National Ambient Air Quality Standards
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
$O_3$ ..... 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
$PM_{10}$ ..... Particulate matter 10 microns
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
SUN……..Solar Radiation
TSP..... Total Suspended Particulates
$ug/m^3$ ..... micrograms per cubic meter
USEPA..... United States Environmental Protection Agency
VOC ..... Volatile Organic Compounds
WS/WD..... Wind Speed/Wind Direction

# Section I
# Ambient Air Monitoring Program

## Program Overview

### Introduction

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

MADEP's Air Assessment Branch (AAB) collects ambient air quality data from monitoring sites throughout Massachusetts. During 2003, AAB 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.

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

### Why are Air Quality Data Collected?

Ambient air quality data are 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?

AAB monitors parameters in the following categories:

**Criteria pollutants** are subject to National Ambient Air Quality Standards (NAAQS). The criteria pollutants 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 DEP because of their effects on public health and welfare or because they contribute to the formation of a criteria pollutant (e.g., $NO_x$, VOCs). The non-criteria pollutants 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
- mercury deposition – measured from collected precipitation
- toxics – health relevant VOCs, aldehydes and metals

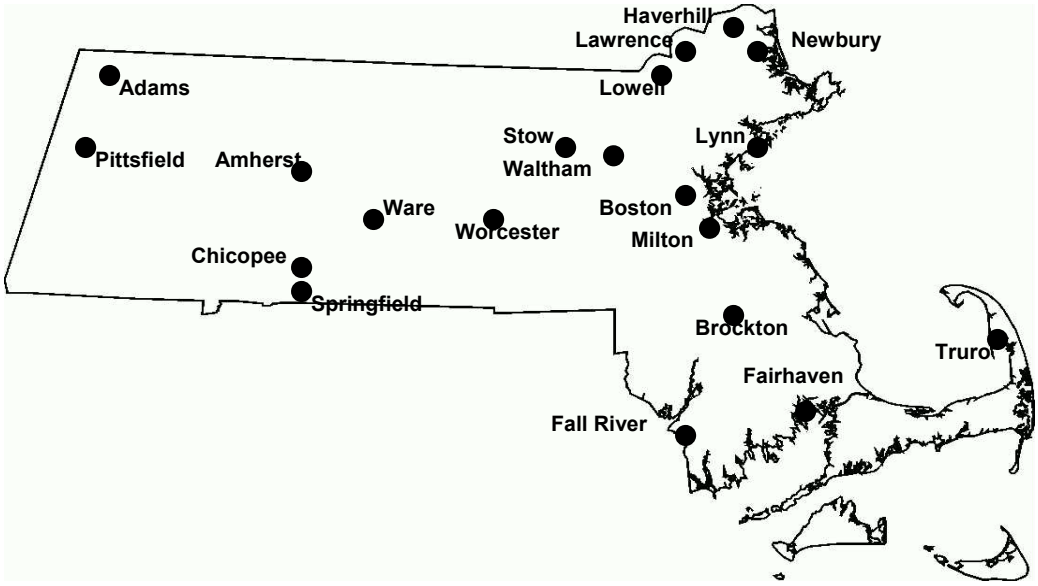
**Meteorological parameters** monitored are:

- wind speed/wind direction (WS/WD)
- relative humidity (RH)
- temperature (TEMP)
- barometric pressure (BP)
- solar radiation
- upper air wind and temperature
- total ultraviolet radiation
- precipitation

## 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 are 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.

A network of monitors for each pollutant is located throughout the state. These networks are designed to reflect pollutant concentrations for all of Massachusetts. Section III contains data summaries for each pollutant 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 state air monitors were located during 2003.



## For Further Information

For further information about this report, contact the Air Assessment Branch. For information about other air quality information, please contact MADEP's Division of Planning and Evaluation in Boston, or a MADEP regional office. The addresses are listed below.

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Information about MADEP's various programs and this report are available on MADEP's web site at www.mass.gov/dep. The USEPA maintains a web site at www.epa.gov/air/data that has air quality information from all the states.

## 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 |
| $O_3$ | 1-Hour | 0.12 ppm (235 ug/m³) | Same as Primary Standard |
| | 8-Hour | 0.08 ppm (157 ug/m³) | Same as Primary Standard |
| • The 1-hour standard is met when the daily maximum 1-hour concentration does not exceed 0.12 ppm at any one monitor on more than 3 days over any 3-year period.<br>• 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 ug/m³ | Same as Primary Standard |
| $PM_{2.5}$ Particulates up to | Annual Arithmetic Mean | 15.0 ug/m³ | Same as Primary Standard |
| 2.5 microns in size | 24-Hour | 65 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 65 ug/m³ (3-year average). | | | |
| $PM_{10}$ Particulates up to | Annual Arithmetic Mean | 50 ug/m³ | Same as Primary Standard |
| 10 microns in size | 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/m$^3$.<br>• The 24-hour standard is attained if the estimated number of days per calendar year above 150 ug/m$^3$ does not exceed one per year. | | | |

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

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

## Pollutant Health Effects and Sources

### Ozone (O3)

- Ground-level and stratospheric $O_3$ are often confused. Stratospheric $O_3$ 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 $O_3$.
- $O_3$ irritates mucous membranes. This causes reduced lung function, nasal congestion, and throat irritation, and reduced resistance to infection.
- $O_3$ is toxic to vegetation, inhibiting growth and causing leaf damage.
- $O_3$ weakens materials such as rubber and fabrics.
- $O_3$ is unique in that it is formed by reactions between other pollutants in the presence of intense, high-energy sunlight (UV) occurring during the 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, nitrogen oxides and hydrocarbons, include motor vehicles and power plants.

### Carbon Monoxide (CO)

- CO binds with hemoglobin, 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.
- High levels of CO are possible near parking lots and city streets with slow-moving cars, particularly during peak traffic times.
- Motor vehicle emissions are the largest source of CO, which is produced from incomplete combustion of carbon in fuels.

### Sulfur Dioxide (SO2)

- $SO_2$ 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, and damage to materials.
- $SO_2$ forms sulfate particles, which are a primary cause of haze that reduces visibility.
- SO2 is a product of fuel combustion (e.g., burning coal and oil). Sources include heat and power generation facilities, and petroleum refineries.

### Nitrogen Dioxide (NO2)

- $NO_2$ 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.
- $NO_2$ forms nitrate particles, which are a signficant cause of haze that reduces visibility.
- $NO_2$ is formed from the oxidation of nitric oxide (NO). Major sources of NO are fuel combustion, heating and 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 (2.5 microns in diameter or smaller) is the result of direct emissions, but also is formed in the atmosphere by chemical reactions involving gaseous pollutants.
- The numbers 2.5 and 10 refer to the particle size, measured in microns. 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. Fine particles can be deposited deep into the lungs, where they can accumulate on the surface or be absorbed by underlying tissue and enter the bloodstream. Studies have linked increased exposure to particiles to increases in premature death as well as a range of serious respiratory and cardiovascular effects, especially for children, the elderly, and people with respiratory ailments.
- 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, heat and power plants.

## Lead (Pb)

- Lead is an elemental metal.
- The primary source for airborne lead used to be motor vehicles, but the use of unleaded gasoline has greatly reduced those emissions. Other sources are lead smelters and battery plants.
- Exposure to lead may occur by inhalation or ingestion of 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

### 2003 Public Monitoring Network

The Air Assessment Branch 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.
  - 6 – CO (carbon monoxide)
  - 11 – $NO_2$ (nitrogen dioxide). NO (nitrogen oxide) and $NO_x$ (total nitrogen oxides) are also measured by these monitors.
  - 13 – $O_3$ (ozone)
  - 6 – $SO_2$ (sulfur dioxide)

- Meteorological monitors track weather conditions.
  - 9 – BP (barometric pressure)
  - 9 – RH (relative humidity)
  - 9 – SOLAR RAD (solar radiation)
  - 11 – TEMP (temperature)
  - 10– WS/WD (wind speed/wind direction)
  - 1 – Upper Meteorology – this monitor measures WS/WD and TEMP at various altitudes. This aids in the analysis of pollutant transport.
  - 2 – Total Ultraviolet 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).
  - 6 – $PM_{2.5}$ (particulate matter – 2.5 microns, BAM)
  - 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 MADEP.

**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 are 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 – $PM_{2.5}$ (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.

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**2003 Industrial Monitoring Network**

Industries monitor air quality and submit data under agreement with MADEP. The data must be collected using quality assurance requirements established by MADEP 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 are 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) are also 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 are 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. USEPA must review the NAAQS every five years and may update the standards based on that review. A state is required to monitor the ambient air to determine whether it meets each standard. If the air does not meet a standard, the state must develop and implement pollution control strategies to attain that standard. Once the air meets a standard, a state must plan to maintain that standard while accounting for future economic and emissions growth. Taken together, those plans and control strategies constitute the State Implementation Plan (SIP).

Ozone is the only pollutant for which Massachusetts monitors indicate violations of the standard. Massachusetts is in attainment for the other criteria pollutants, including carbon monoxide, lead, nitrogen dioxide, sulfur dioxide, and particulate matter (including PM10 and PM2.5).

### 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 decreased. The last violation in the state of the CO NAAQS occurred in 1986. In 2000, MADEP 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 NAAQS particulate matter standards: $PM_{10}$ and a newer $PM_{2.5}$ standard. Massachusetts has been in attainment of the $PM_{10}$ standard for many years. Massachusetts monitors also show attainment of the $PM_{2.5}$ standard.

The particulate matter standard has evolved over the years as additional information has become known about the health effects of particulate matter. As studies have linked exposure to fine particles with adverse health effects, the trend has been to control particulates of smaller sizes and to more stringent concentrations.

- 1970 – The standard was based on Total Suspended Particulates (TSP). The standards were set at 260 ug/$m^3$ (24-hours) and 75 ug/$m^3$ (annual geometric mean).

- 1987 – The TSP standard was replaced by the $PM_{10}$ standard (particulate matter equal to or less than 10 microns in size). The $PM_{10}$ standards were set at 150 ug/$m^3$ (24-hours) and 50 ug/$m^3$ (annual arithmetic mean).
- 1997 – The $PM_{2.5}$ standard (particulate matter equal to or less than 2.5 microns) was promulgated in addition to the $PM_{10}$ standard. The $PM_{2.5}$ standards are set at 65 ug/$m^3$ (24-hours) and 15 ug/$m^3$ (annual arithmetic mean).

Following promulgation of the new $PM_{2.5}$ standard industry groups filed suit challenging the standard. The courts upheld the standard, however implementation has been delayed. USEPA is expected to designate attainment status for areas under the $PM_{2.5}$ standard in December 2004. Based on monitoring data, Massachusetts has recommended to EPA that Massachusetts be designated "Attainment/Unclassifiable" for $PM_{2.5}$ statewide.

**Ozone ($O_3$)**

There are currently two NAAQS $O_3$ standards: a 1-hour $O_3$ standard and a new 8-hour standard. MADEP monitors for both 1-hour and 8-hour $O_3$ levels throughout the state.

The 1-hour $O_3$ standard (0.12 parts per million (ppm) averaged over one hour) has been in place for almost two decades. Massachusetts has been classified as "serious nonattainment" for the 1-hour $O_3$ standard since the early 1990s. However, with the adoption of numerous control programs, Massachusetts has made great progress in reducing the number and severity of 1-hour $O_3$ exceedances.

In 1997, USEPA set a new stricter $O_3$ 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 will remain in effect until June 15, 2005. After June 15, 2005, MADEP will no longer report 1-hour $O_3$ values but only will report 8-hour values. Programs that have been put in place to attain the 1-hour standard will continue as part of MADEP's strategy to attain the new 8-hour standard.

## Ozone Exceedances

### What Determines an Exceedance?

An $O_3$ exceedance occurs when monitored $O_3$ concentrations exceed the National Ambient Air Quality Standards (NAAQS). There are two $O_3$ standards based on different averaging times, 1 hour and 8 hours. An exceedance of the 1-hour standard is an hourly value that is equal to or greater than the standard of 0.125 ppm. 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 $O_3$ exceedance occurs when a monitor records ambient levels of $O_3$ above a standard. A violation of an $O_3$ 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 1-hour standard are determined using the number of expected exceedance days. An exceedance day is a day that records an $O_3$ 1-hour average greater than the standard of 0.125 ppm. A monitoring site can only have one reported exceedance per day – the hour with the highest average is used. The term "expected exceedance days" is used to account for both actual exceedance days and missing data.

A violation of the 1-hour standard requires a 3-year average that is greater than one expected exceedance day. In other words, if there are 4 or more days during a 3-year period with $O_3$ 1-hour values that are equal to or greater than 0.125 ppm, a violation of the 1-hour standard (at that specific site) has occurred.

Violations of the 8-hour standard are determined using the annual 4th-highest daily maximum 8-hour $O_3$ value. A violation requires a 3-year average of the annual 4th-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 are ranked from highest to lowest. Then, the 4th-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 (again at that specific site) has occurred.

### Ozone Exceedances and Violations During 2003

*Exceedances*

The Table below shows 2003 $O_3$ exceedances. During 2003, there was one day when the 1-hour $O_3$ standard was exceeded and there were two exceedances (i.e., two different monitors recorded an exceedance on that day). There were 11 days when the 8-hour $O_3$ standard was exceeded and there were 34 exceedances during those 11 days.

*Violations*

Violations of the $O_3$ standard are based on 3-year averages. Using data from 2001–2003, two sites out of 13 violated the 1-hour standard. For the more stringent 8-hour standard, during the same period ten sites out of 13 violated the 8-hour standard.

## 2003 $O_3$ Exceedances (ppm)

| DATE | SITE | 8-HOUR EXC | 1-HOUR EXC | START HOUR |
|---|---|---|---|---|
| June 25, 2003 | Adams | .100 | | 15 |
| June 25, 2003 | Chicopee | .099 | | 10 |
| June 25, 2003 | Fairhaven | .098 | | 12 |
| June 25, 2003 | Lynn | .088 | | 9 |
| June 25, 2003 | Newbury | .092 | | 11 |
| June 25, 2003 | Truro | .094 | | 10 |
| June 25, 2003 | Blue Hill | .090 | | 10 |
| June 26, 2003 | Adams | .104 | | 16 |
| June 26, 2003 | Blue Hill | .091 | | 21 |
| June 26, 2003 | Fairhaven | .100 | | 13 |
| June 27, 2003 | Chicopee | .089 | | 9 |
| June 27, 2003 | Fairhaven | .117 | | 5 |
| June 27, 2003 | Long Island | .102 | | 7 |
| June 27, 2003 | Lynn | .100 | | 9 |
| June 27, 2003 | Newbury | .099 | | 10 |
| June 27, 2003 | Truro | .110 | | 9 |
| June 27, 2003 | Worcester | .089 | | 9 |
| June 27, 2003 | Blue Hill | .109 | | 9 |
| June 27, 2003 | Harrison Ave | .089 | | 9 |
| June 27, 2003 | Fairhaven | | .127 | 18 |
| June 27, 2003 | Blue Hill | | .126 | 12 |
| June 29, 2003 | Chicopee | .093 | | 11 |
| July 4, 2003 | Fairhaven | .086 | | 16 |
| July 4, 2003 | Truro | .087 | | 19 |
| July 4, 2003 | Blue Hill | .088 | | 19 |
| July 5, 2003 | Fairhaven | .094 | | 11 |
| July 5, 2003 | Truro | .094 | | 13 |
| July 8, 2003 | Truro | .088 | | 11 |
| July 26, 2003 | Truro | .087 | | 16 |
| July 26, 2003 | Fairhaven | .087 | | 13 |
| August 16, 2003 | Truro | .089 | | 12 |
| August 16, 2003 | Fairhaven | .101 | | 12 |
| August 21, 2003 | Truro | .087 | | 13 |
| August 21, 2003 | Fairhaven | .085 | | 12 |
| August 22, 2003 | Lynn | .092 | | 9 |
| August 22, 2003 | Blue Hill | .089 | | 11 |

## 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. 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 1-hour standard.

**Figure 1**
**1-hr $O_3$ Exceedance Days and Total Exceedances 1987-2003**
**1-hour standard = 0.125 ppm**

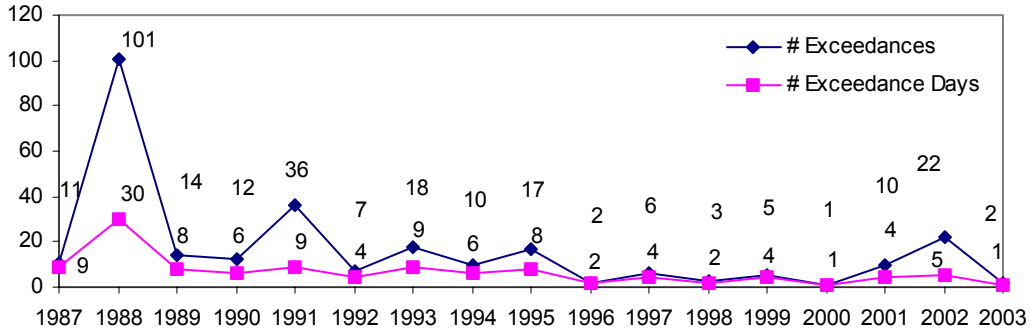
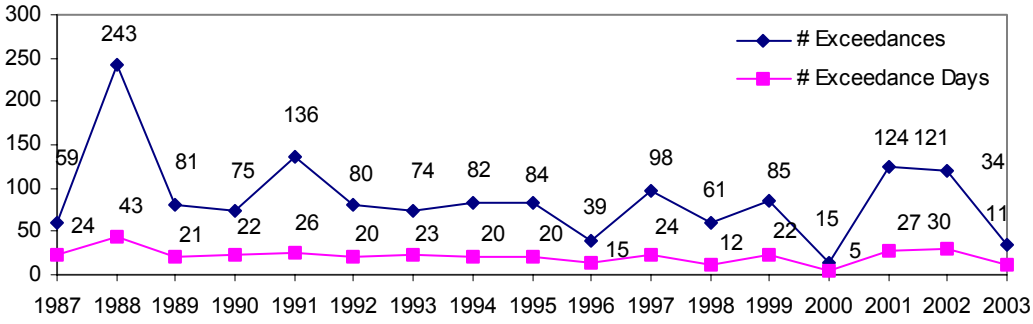



**Figure 2**
**8-hr $O_3$ Exceedance Days and Total Exceedances 1987-2003**
**8-hour standard = 0.085 ppm**



## Daily Ozone ($O_3$) Forecast

### Air Quality Ratings

MADEP produces daily air quality forecasts for $O_3$ from May through September based on whether or not meteorological conditions are favorable for the production of elevated $O_3$ levels. Each day during these months, MADEP predicts the air quality as good, moderate or unhealthful.

The air quality rating is determined through analysis of National Weather Service observations and modeled predictions. Meteorological, $O_3$, and nitrogen oxides data from the statewide and regional monitoring networks also are used.

The daily air quality forecast is available May through September from MADEP's website (www.mass.gov/air) or by calling the Air Quality Hotline (1-800-882-1497). The table below describes the ratings used in the daily air quality forecasts.

| Air Quality Rating | Adverse Health Effects | Ways to Protect Your Health |
|---|---|---|
| Good | None expected. | No precautions necessary. |
| Moderate | $O_3$ levels in the upper part of this range may cause respiratory problems in some children and adults engaged in outdoor activities. These effects are of particular concern for those with existing lung problems. | People with respiratory diseases, such as asthma, and other sensitive individuals should consider limiting outdoor exercise and strenuous activities during the afternoon and early evening hours, when $O_3$ levels are usually the highest. |
| Unhealthy | As $O_3$ levels increase, both the severity of the health effects and the number of people affected increase. Health effects include nose and throat irritation; chest pain; decreased lung function; shortness of breath; increased susceptibility to respiratory infection; and aggravation of asthma.<br><br>It is important to note that individuals react differently when exposed to various $O_3$ levels in the unhealthy range; some people experience problems at lower unhealthy levels, while others may not be affected until higher levels are reached. | In general, everyone should limit strenuous outdoor activity during the afternoon and early evening hours, when $O_3$ levels are usually the highest.<br><br>You should consider scheduling outdoor exercise and children's outdoor activities in the morning hours, when $O_3$ levels are generally lower.<br><br>If you are particularly sensitive to $O_3$, or if you have asthma or other respiratory problems, stay in an area where it is cool and, if possible, where it is air-conditioned. |

### Ozone Maps

USEPA maintains web sites containing current and archived $O_3$ maps and "real-time" $O_3$ movies using $O_3$ data that are provided by participating states: www.epa.gov/region01/topics/air/ and www.epa.gov/airnow.

# Section III
# Massachusetts Air Quality Data Summaries

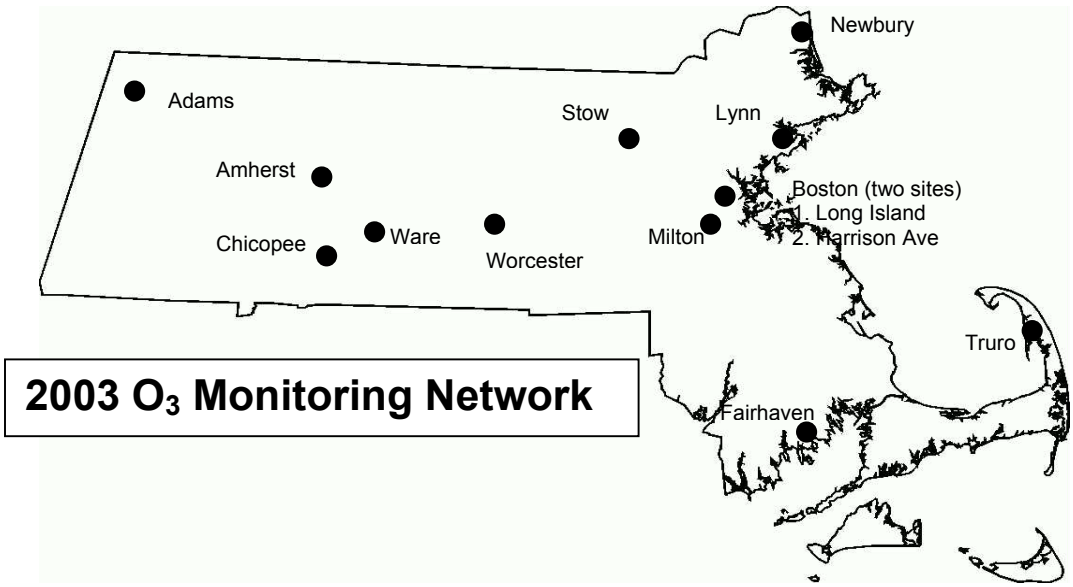
## Ozone ($O_3$) Summary

### 2003 $O_3$ Data Summary

A summary of the 2003 data during $O_3$ season (April 1 – Sept. 30) is shown below. There were 13 $O_3$ sites during 2003 in the state-operated monitoring network. All of the sites achieved the requirement of 75% or greater data capture for the year.

| | | | UNITS: PPM | | 1ST MAX | 2ND MAX | DAY MAX ≥ | 1ST MAX | 2ND MAX | 3RD MAX | 4TH MAX | DAY MAX ≥ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SITE ID | CITY | COUNTY | ADDRESS | %OBS | 1-HR | 1-HR | 0.125 | 8-HR | 8-HR | 8-HR | 8-HR | 0.085 |
| 25-001-0002 | ADAMS | BERKSHIRE | MT. GREYLOCK | 76 | 0.108 | 0.106 | 0 | 0.104 | 0.100 | 0.083 | 0.083 | 2 |
| 25-003-4002 | AMHERST | HAMPSHIRE | NORTH PLEASANT | 97 | 0.079 | 0.075 | 0 | 0.069 | 0.066 | 0.061 | 0.061 | 0 |
| 25-005-1002 | BOSTON | SUFFOLK | LONG ISLAND | 92 | 0.120 | 0.115 | 0 | 0.102 | 0.083 | 0.078 | 0.078 | 1 |
| 25-009-2006 | BOSTON | SUFFOLK | HARRISON AVENUE | 98 | 0.104 | 0.091 | 0 | 0.089 | 0.076 | 0.075 | 0.074 | 1 |
| 25-009-4004 | CHICOPEE | HAMPDEN | ANDERSON ROAD | 97 | 0.111 | 0.109 | 0 | 0.099 | 0.093 | 0.089 | 0.084 | 3 |
| 25-013-0008 | FAIRHAVEN | BRISTOL | LEROY WOOD | 98 | 0.127 | 0.113 | 1 | 0.117 | 0.101 | 0.100 | 0.098 | 8 |
| 25-015-0103 | LYNN | ESSEX | 390 PARKLAND | 95 | 0.118 | 0.108 | 0 | 0.100 | 0.092 | 0.088 | 0.079 | 3 |
| 25-015-4002 | MILTON | NORFOLK | MILTON MA,BLUE | 95 | 0.126 | 0.107 | 1 | 0.109 | 0.091 | 0.090 | 0.089 | 5 |
| 25-017-1102 | NEWBURY | ESSEX | SUNSET BOULEVAR | 97 | 0.117 | 0.112 | 0 | 0.099 | 0.092 | 0.082 | 0.080 | 2 |
| 25-021-3003 | STOW | MIDDLESEX | US MILITARY | 99 | 0.097 | 0.089 | 0 | 0.083 | 0.079 | 0.077 | 0.073 | 0 |
| 25-025-0041 | TRURO | BARNSTABLE | FOX BOTTOM AREA | 93 | 0.119 | 0.108 | 0 | 0.110 | 0.094 | 0.094 | 0.089 | 8 |
| 25-025-0042 | WARE | HAMPSHIRE | QUABBIN SUMMIT | 99 | 0.097 | 0.088 | 0 | 0.084 | 0.080 | 0.077 | 0.075 | 0 |
| 25-027-0015 | WORCESTER | WORCESTER | WORC. AIRPORT | 96 | 0.106 | 0.095 | 0 | 0.089 | 0.084 | 0.080 | 0.080 | 1 |

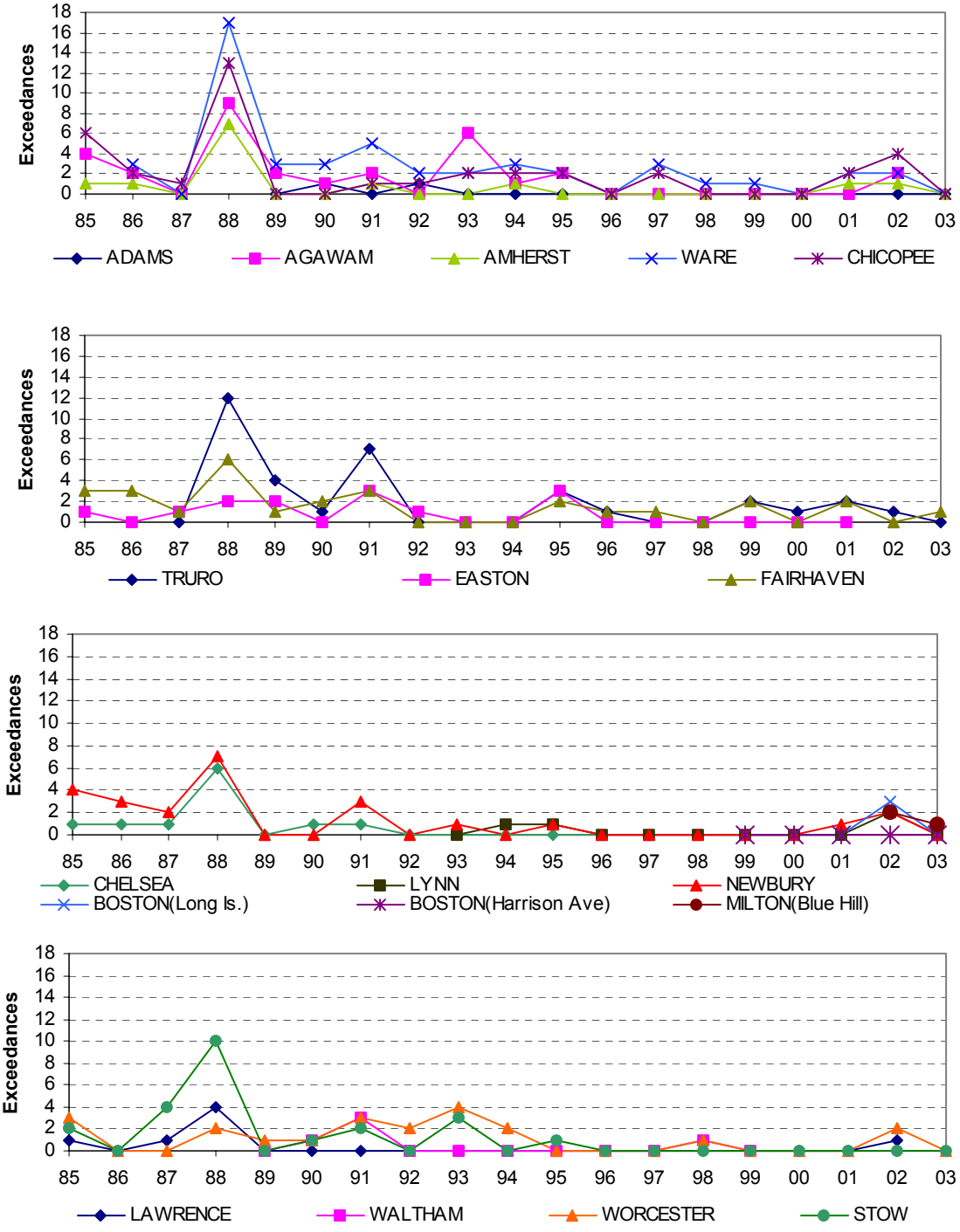
**ABBREVIATIONS AND SYMBOLS USED IN TABLE**
**SITE ID** = AIRS SITE IDENTIFICATION NUMBER **% OBS** = PERCENTAGE OF VALID DAYS MONITORED DURING O3 SEASON **1ST, 2ND 1-HR MAX** = MAXIMUM 1-HR VALUE FOR THE 1ST & 2ND HIGHEST DAY **MAX ≥ 0.125** = NUMBER OF MEASURED DAILY 1-HR MAXIMUM VALUES GREATER THAN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



## 1-hour Exceedance Trends

The long-term trends of 1-hour $O_3$ exceedances for each site are shown below.

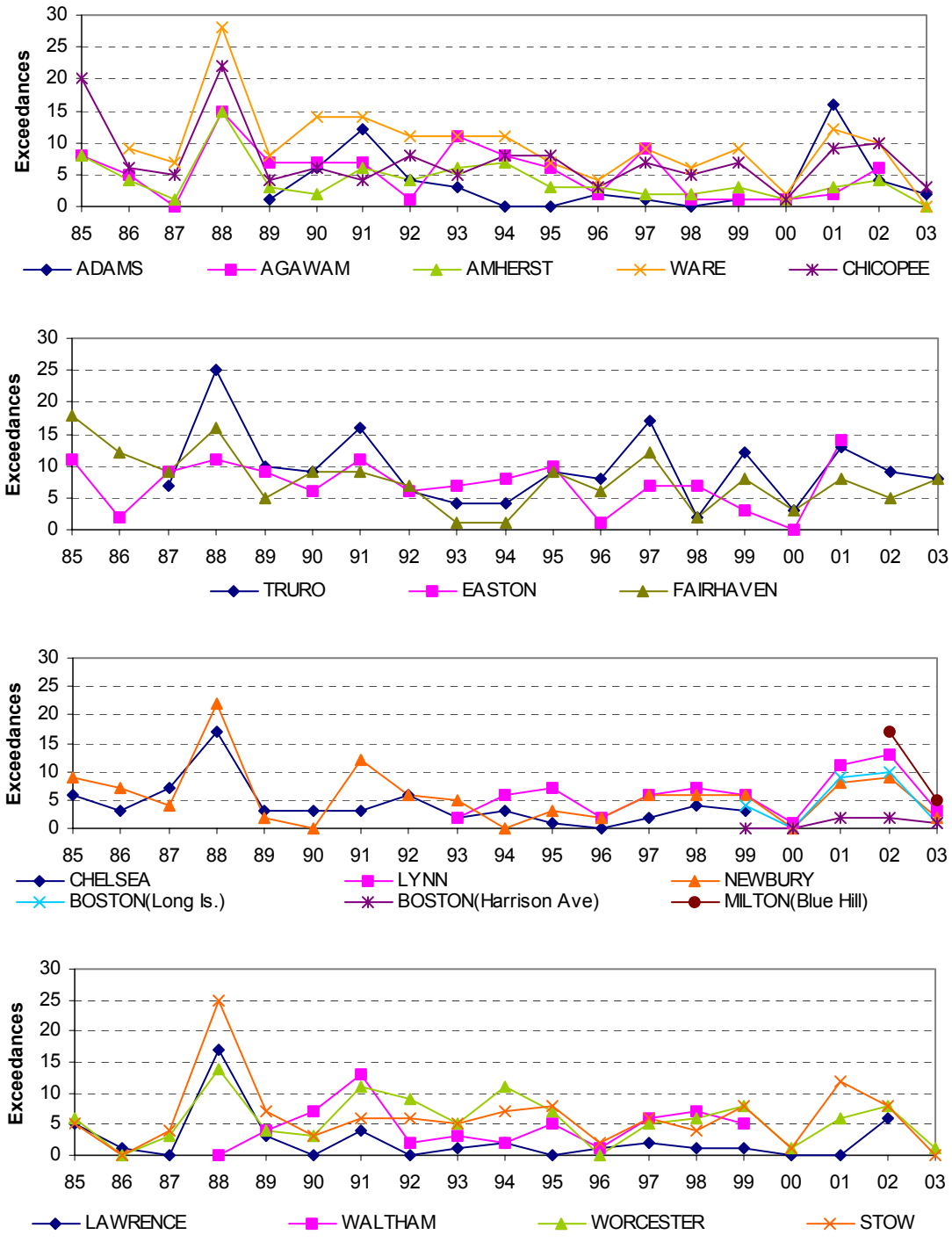
**Figure 3**
**$O_3$ 1-hour Exceedance Trends**
**Standard = 0.125 ppm**



## 8-hour $O_3$ Exceedance Trends

The long-term trends of 8-hour $O_3$ exceedances for each site are shown below.

**Figure 4**
**$O_3$ 8-hour Exceedance Trends**
**Standard = 0.085 ppm**



# Sulfur Dioxide ($SO_2$) Summary

## 2003 $SO_2$ Data Summary

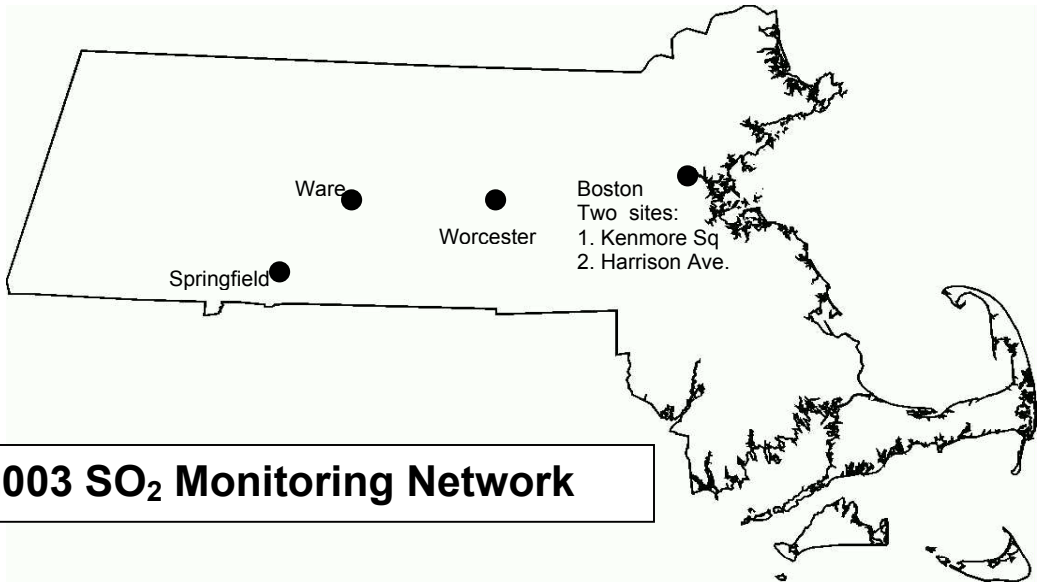
A summary of the 2003 $SO_2$ data is shown below. There were six $SO_2$ sites in operation during 2003 in the state-operated monitoring network. All of the sites except Kenmore Square achieved the requirement of 75% or greater data capture for the year. The Worcester Central St. site closed down at the end of September 2003 and was relocated.

| | | | UNITS: PPM | | 1ST MAX | 2ND MAX | | 1ST MAX | 2ND MAX | | 1ST MAX | 2ND MAX | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SITE ID | CITY | COUNTY | ADDRESS | % OBS | 24-HR | 24-HR | #OBS >0.14 | 3-HR | 3-HR | #OBS >0.5 | 1-HR | 1-HR | ARITH MEAN |
| 25-025-0002 | BOSTON | SUFFOLK | KENMORE SQUARE | 74 | 0.023 | 0.022 | 0 | 0.035 | 0.032 | 0 | 0.044 | 0.042 | 0.006* |
| 25-025-0042 | BOSTON | SUFFOLK | HARRISON AVE | 97 | 0.022 | 0.021 | 0 | 0.047 | 0.035 | 0 | 0.056 | 0.046 | 0.006 |
| 25-005-1004 | FALL RIVER | BRISTOL | GLOBE STREET | 95 | 0.024 | 0.021 | 0 | 0.090 | 0.051 | 0 | 0.130 | 0.100 | 0.003 |
| 25-013-0016 | SPRINGFIELD | HAMPDEN | LIBERTY STREET | 97 | 0.027 | 0.024 | 0 | 0.043 | 0.040 | 0 | 0.060 | 0.052 | 0.006 |
| 25-015-4002 | WARE | HAMPSHIRE | QUABBIN SUMMIT | 97 | 0.025 | 0.019 | 0 | 0.027 | 0.026 | 0 | 0.028 | 0.028 | 0.004 |
| 25-027-0020 | WORCESTER | WORCESTER | CENTRAL STREET | 95 | 0.021 | 0.021 | 0 | 0.028 | 0.028 | 0 | 0.038 | 0.032 | 0.004 |

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

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 **MAX 24-HR, MAX 3-HR, MAX 1-HR 1ST 2ND** = 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 > 0.5** = NUMBER OF OBSERVATIONS ABOVE THE 3-HOUR STANDARD OF 0.5 PPM **ARITH MEAN** = ANNUAL ARITHMETIC MEAN (STANDARD = 0.03 PPM)

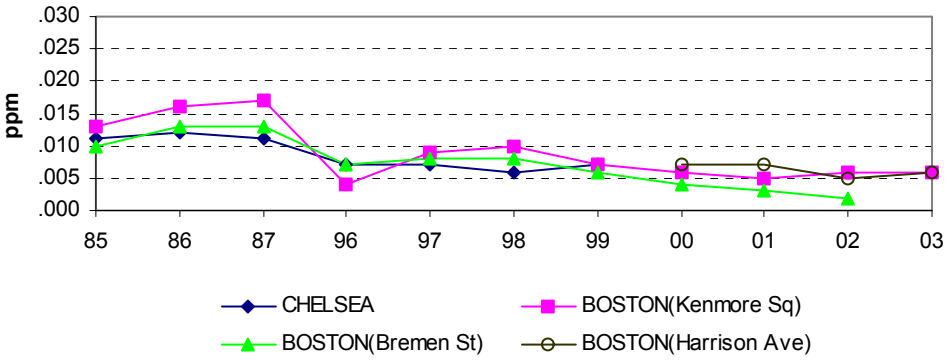


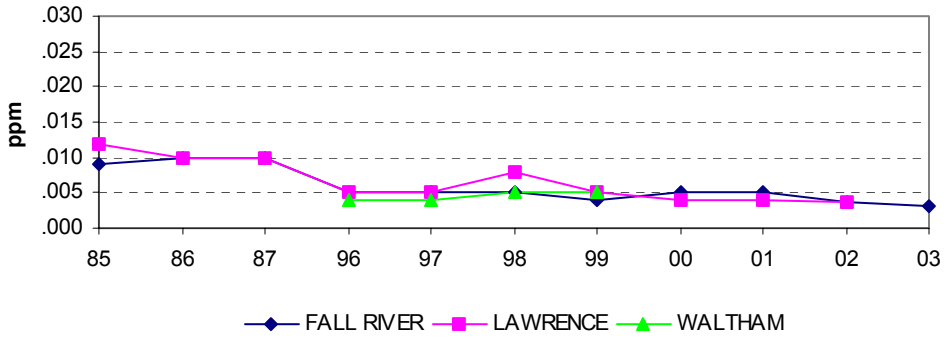

**2003 $SO_2$ Monitoring Network**

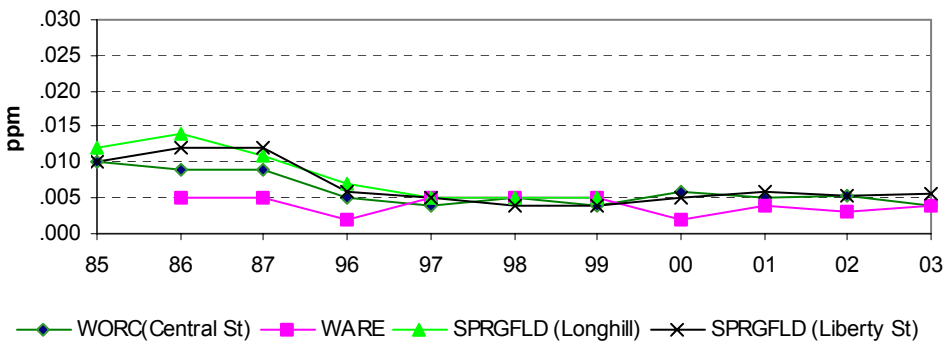
## $SO_2$ Trends

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 – 2003**
**Annual Arithmetic Means**
**Standard = 0.03 ppm**



# Nitrogen Dioxide ($NO_2$) Summary

## 2003 $NO_2$ Data Summary

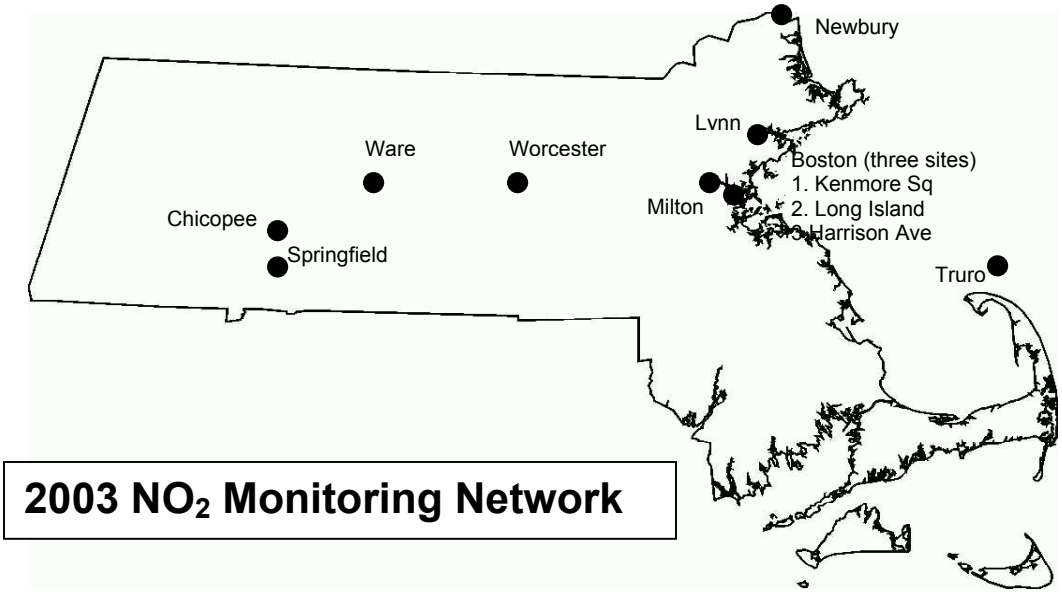
There were 15 $NO_2$ sites in operation during 2003 in the state-operated monitoring network. All sites except Kenmore Square met the requirement of 75% data capture for the year. A summary of the 2003 data is shown below. The Worcester Central St. site was closed in September 2003 and relocated.

| | | | UNITS: PPM | | 1ST | 2ND | |
|---|---|---|---|---|---|---|---|
| | | | | % | MAX | MAX | ARITH |
| SITE ID | CITY | COUNTY | ADDRESS | OBS | 1-HR | 1-HR | MEAN |
| 25-025-0002 | BOSTON | SUFFOLK | KENMORE SQUARE | 73 | 0.073 | 0.070 | 0.025* |
| 25-025-0041 | BOSTON | SUFFOLK | LONG ISLAND | 96 | 0.045 | 0.044 | 0.009* |
| 25-025-0042 | BOSTON | SUFFOLK | HARRISON AVENUE | 95 | 0.073 | 0.071 | 0.023 |
| 25-013-0008 | CHICOPEE | HAMPDEN | ANDERSON ROAD | 92 | 0.060 | 0.060 | 0.013 |
| 25-009-2006 | LYNN | ESSEX | 390 PARKLAND | 94 | 0.055 | 0.052 | 0.011 |
| 25-021-3003 | MILTON | NORFOLK | MILTON MA,BLUE HILL | 79 | 0.040 | 0.039 | 0.006* |
| 25-009-4004 | NEWBURY | ESSEX | SUNSET BOULEVARD | 96 | 0.025 | 0.022 | 0.004* |
| 25-013-0016 | SPRINGFIELD | HAMPDEN | LIBERTY STREET | 94 | 0.093 | 0.080 | 0.020 |
| 25-001-0002 | TRURO | BARNSTABLE | FOX BOTTOM AREA | 91 | 0.012 | 0.010 | 0.003* |
| 25-015-4002 | WARE | HAMPSHIRE | QUABBIN SUMMIT | 96 | 0.050 | 0.050 | 0.005 |
| 25-027-0020 | WORCESTER | WORCESTER | CENTRAL STREET | 89 | 0.074 | 0.052 | 0.016 |

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

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 **ARITH MEAN** = ANNUAL ARITHMETIC MEAN

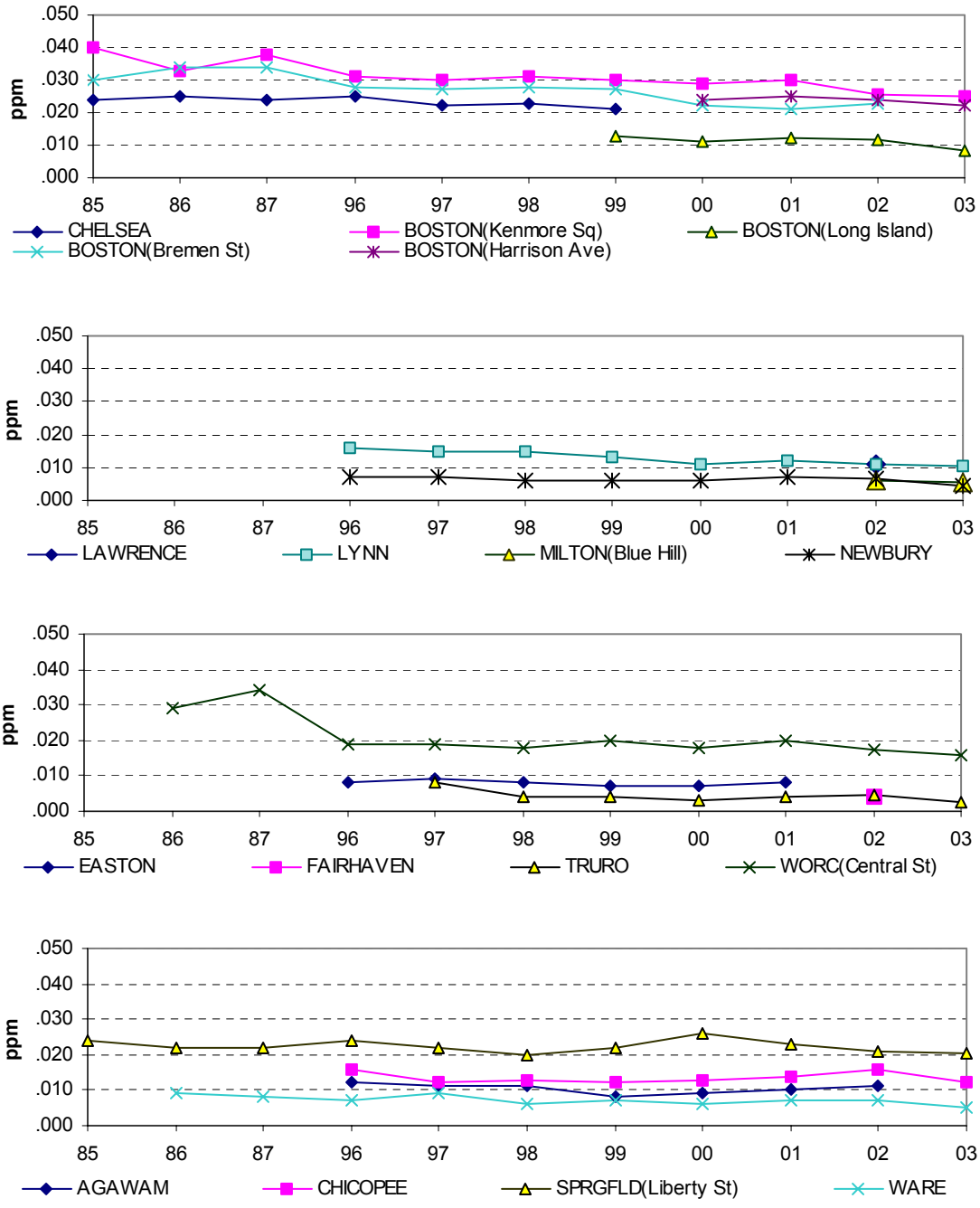



**2003 $NO_2$ Monitoring Network**

## $NO_2$ 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 1985-2003**
**Annual Arithmetic Means**
**Standard = 0.05 ppm**



# Carbon Monoxide (CO) Summary

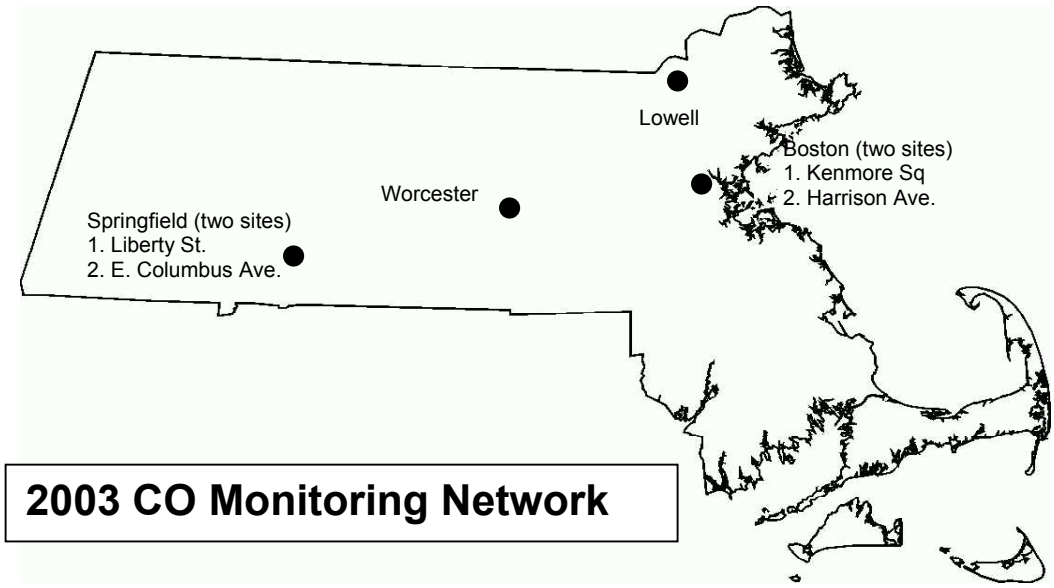
## 2003 CO Data Summary

There were six CO sites in operation during 2003 in the state-operated monitoring network. The East Columbus site closed in March 2003 and the Worcester Central St. site closed in September 2003 and was relocated. All of the sites except Kenmore Square achieved the requirement of 75% or greater data capture for the year. A summary of the 2003 data is shown below.

| 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, | 65 | 2.1 | 2.1 | 0 | 1.7 | 1.6 | 0 |
| 25-025-0042 | BOSTON | SUFFOLK | HARRISON AVENUE | 93 | 4.1 | 4 | 0 | 2.6 | 2.4 | 0 |
| 25-017-0007 | LOWELL | MIDDLESEX | OLD CITY HALL | 94 | 4 | 3.8 | 0 | 3.2 | 2.7 | 0 |
| 25-013-0016 | SPRINGFIELD | HAMPDEN | LIBERTY STREET | 93 | 3.9 | 3.6 | 0 | 3.1 | 3 | 0 |
| 25-013-2007 | SPRINGFIELD | HAMPDEN | EAST COLUMBUS | 81 | 4 | 3.9 | 0 | 2.8 | 2.4 | 0 |
| 25-027-0020 | WORCESTER | WORCESTER | CENTRAL STREET | 87 | 3.8 | 3.6 | 0 | 2.3 | 1.7 | 0 |

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

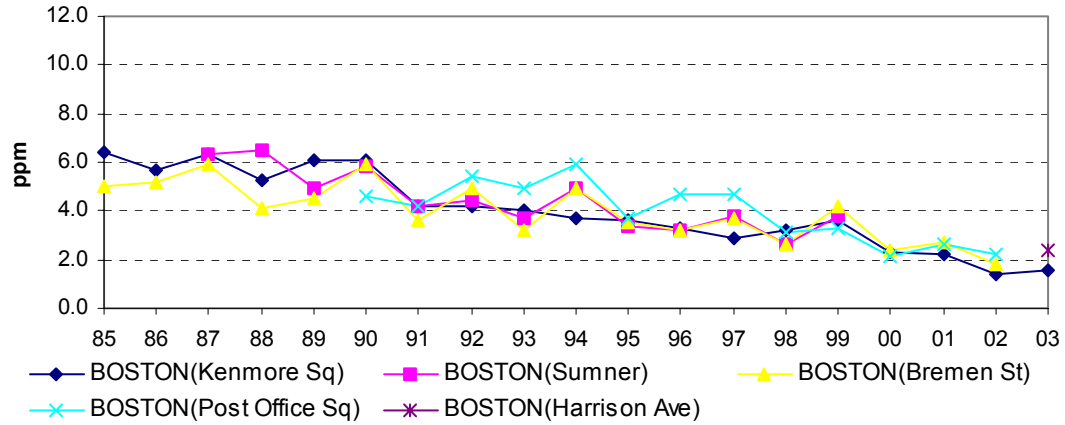
**ABBREVIATIONS AND SYMBOLS USED IN TABLE**
**SITE ID** = AIRS SITE IDENTIFICATION NUMBER **% OBS** = DATA CAPTURE PERCENTAGE **MAX 1-HR 1ST 2ND** = FIRST AND SECOND HIGHEST VALUE FOR TIME PERIOD INDICATED **OBS > 35** = NUMBER OF 1-HR AVG. GREATER THAN 35 PPM (1-HR STANDARD) **MAX 8-HR 1ST 2ND** = FIRST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

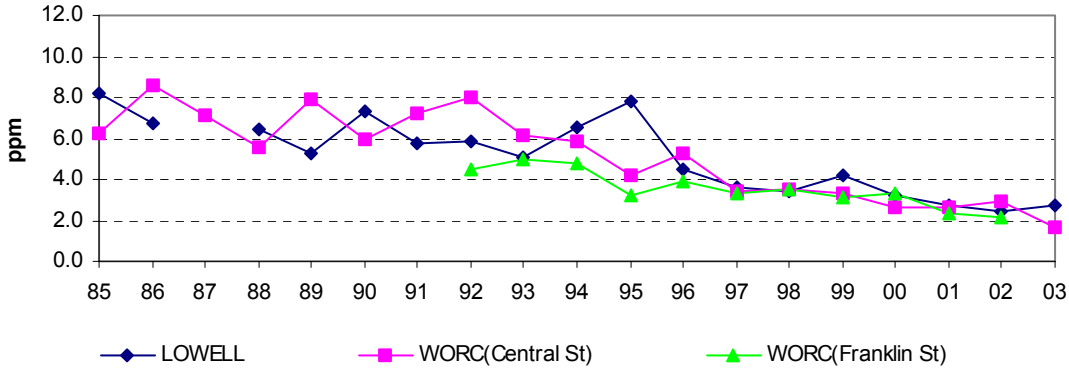


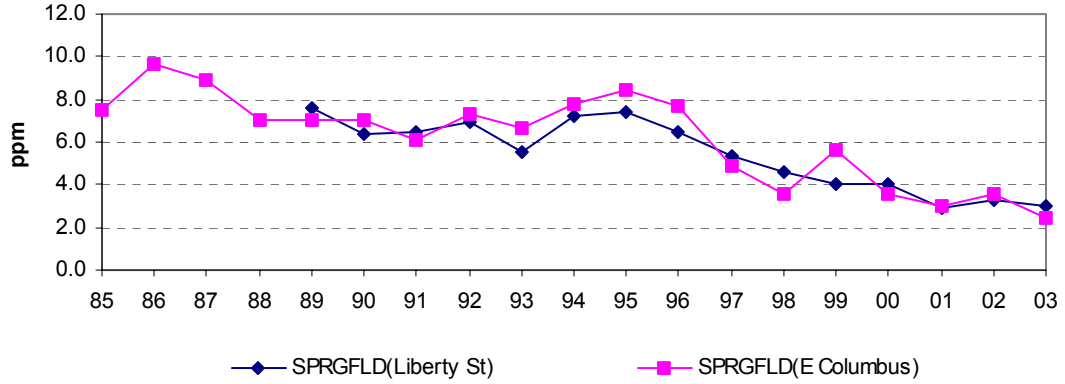
## CO Trends

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 1985-2003**
**2nd Maximum 8-hour Values**
**Standard = 9 ppm**



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

## 2003 $PM_{10}$ Data Summary

In 2003, MADEP began collecting $PM_{10}$ samples at six sites using a new Low Volume (LoVol) sample collection method that has distinct advantages over the older High Volume (HiVol) sampling method but provides comparable results. The LoVol $PM_{10}$ method uses the same samplers and filters as those deployed in the $PM_{2.5}$ network. The only difference between the two samplers is the removal of a size discriminating "impactor" from the sample flow path within the $PM_{10}$ instrument that allows particles up to 10 microns in size to be sampled. Since the $PM_{10}$ and $PM_{2.5}$ samples now are collected in the same manner using identical samplers, filter handling and processing are standardized resulting in tighter quality control. In 2003, MADEP ran both methods concurrently at three sites to compare results. The remaining HiVol $PM_{10}$ network was shut down at the end of 2002. A summary of the 2003 data is shown below.

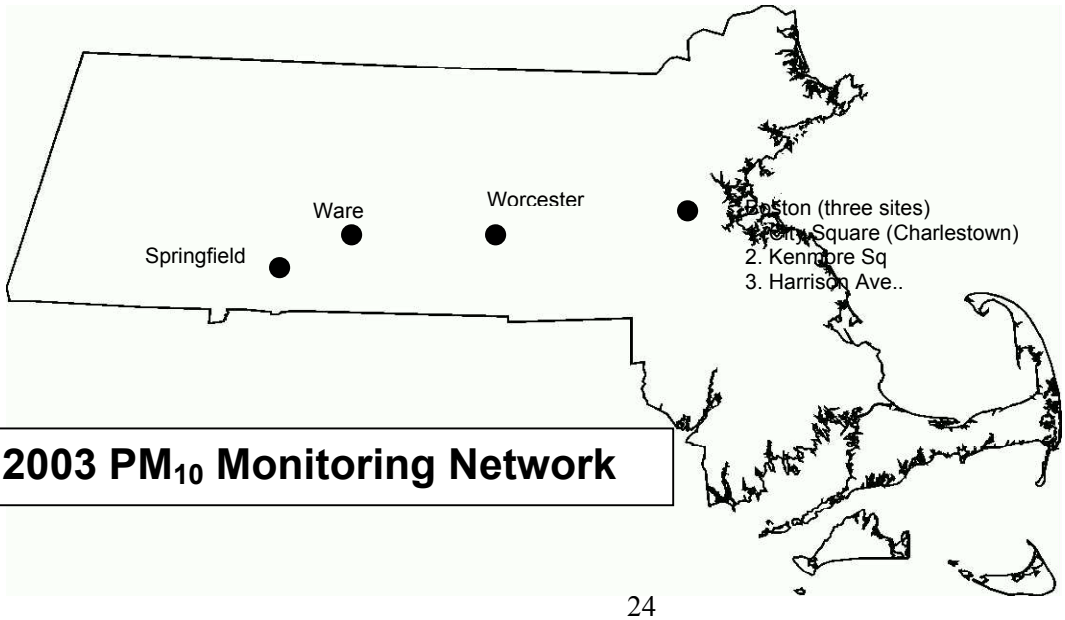
| SITE ID | TYPE | CITY | COUNTY | ADDRESS | % OBS | 1ST MAX 24-HR | 2ND MAX 24-HR | 3RD MAX 24-HR | 4TH MAX 24-HR | DAY MAX >150 | WTD ARITH MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25-025-0002 | Hi Vol | BOSTON | SUFFOLK | KENMORE SQUARE | 63 | 55 | 36 | 34 | 34 | 0 | 25* |
| 25-025-0002 | Lo Vol | BOSTON | SUFFOLK | KENMORE SQUARE | 43 | 49 | 37 | 32 | 31 | 0 | 18* |
| 25-025-0027 | Lo Vol | BOSTON | SUFFOLK | ONE CITY SQUARE | 82 | 59 | 46 | 43 | 41 | 0 | 24* |
| 25-025-0027 | Lo Vol Coloc | BOSTON | SUFFOLK | ONE CITY SQUARE | 63 | 53 | 46 | 29 | 29 | 0 | 26* |
| 25-025-0042 | Hi Vol | BOSTON | SUFFOLK | HARRISON AVENUE | 93 | 31 | 29 | 29 | 25 | 0 | 19* |
| 25-025-0042 | Hi Vol Coloc | BOSTON | SUFFOLK | HARRISON AVENUE | 79 | 29 | 27 | 24 | 24 | 0 | 20* |
| 25-025-0042 | Lo Vol | BOSTON | SUFFOLK | HARRISON AVENUE | 84 | 72 | 65 | 46 | 35 | 0 | 24* |
| 25-013-2009 | Hi Vol | SPRINGFIELD | HAMPDEN | 1860 MAIN STREET | 100 | 22 | 21 | 17 | N/A | 0 | 20* |
| 25-013-2009 | Lo Vol | SPRINGFIELD | HAMPDEN | 1860 MAIN STREET | 89 | 58 | 54 | 53 | 48 | 0 | 22 |
| 25-015-4002 | Lo Vol | WARE | HAMPSHIRE | QUABBIN SUMMIT | 93 | 41 | 26 | 25 | 22 | 0 | 11 |
| 25-027-0020 | Lo Vol | WORCESTER | WORCESTER | CENTRAL STREET | 80 | 114 | 94 | 47 | 35 | 0 | 23* |

* 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

**ABBREVIATIONS AND SYMBOLS USED IN TABLE**

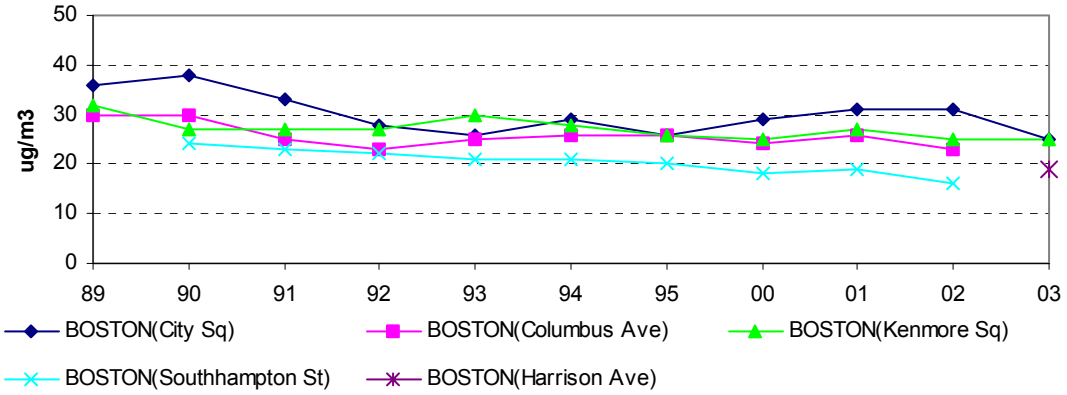
**SITE ID** = AIRS SITE IDENTIFICATION NUMBER **% OBS** = DATA CAPTURE PERCENTAGE **24-HR MAX 1ST, 2ND, 3RD, 4TH** = 1ST, 2ND, 3RD, AND 4TH HIGHEST 24-HOUR VALUES FOR THE YEAR **DAY MAX > 150** = DAILY MAXIMUM VALUE GREATER THAN STANDARD OF 150 μg/m³ **WTD ARITH MEAN** = WEIGHTED ANNUAL ARITHMETIC MEAN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

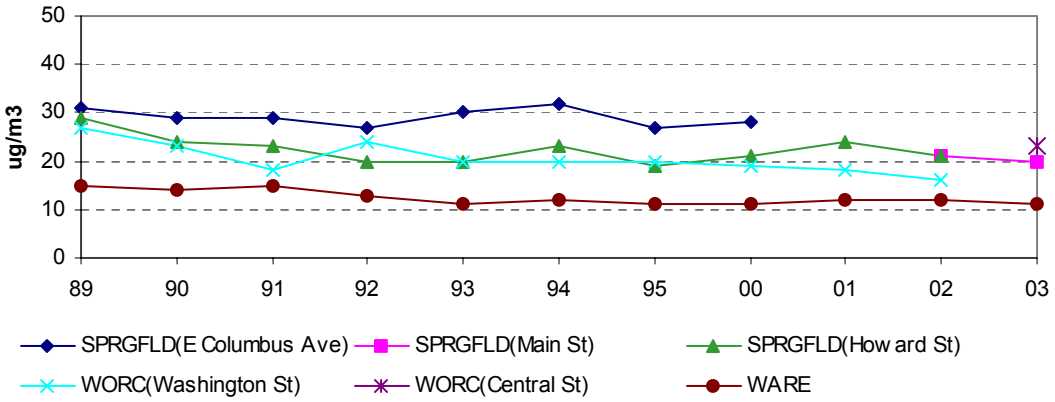


## $PM_{10}$ trends

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

**Figure 8**
**$PM_{10}$ Hi Vol Trends 1989-2003**
**Annual Arithmetic Mean**
**Standard = 50 ug/m3**



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

### 2003 $PM_{2.5}$ Operations

The MADEP $PM_{2.5}$ sampling network has been operating since January 1999. The $PM_{2.5}$ network underwent a significant reconfiguration at the end of 2002 to eliminate redundant sites. A total of six sites were eliminated during this process. In 2003, Massachusetts operated 14 sites that included three collocated pairs for determining precision.

In 2003, equipment malfunctions and other factors contributed to significant data losses throughout the network. Even with the network reconfiguration in 2002 and consolidation of sites, data capture rates were below expectations. Staff resources were diverted from other projects to focus on efforts to maintain and repair equipment. Many of the lessons learned during this time period are being used to maintain data capture rates of greater than 75% at all sites.

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

Massachusetts started the deployment of a Semi-Continuous $PM_{2.5}$ monitoring network in the Fall of 2001. This emerging network of sites employs Beta Attenuation Monitoring (BAM) technology to conduct hourly measurements of $PM_{2.5}$ particulate concentrations. The method is referred to as semi-continuous because one analysis is performed and one concentration is generated every hour, in contrast to hourly averages of second-to-second measurements generated by truly continuous gaseous pollutant monitors.

In contrast to the Federal Reference Method (FRM) for measuring $PM_{2.5}$, where one 24-hour value is generated for each sampling day and data are not immediately available because of the time required for collection, transport and weighing of individual filters, semi-continuous $PM_{2.5}$ measurement technology offers immediately available hourly concentration values. This type of data is preferable for tracking $PM_{2.5}$ events as they occur and for monitoring particulate concentrations and events on dates that are not covered by the USEPA's once-every-third-day sampling schedule. The current and future technical challenge is to demonstrate that data generated by semi-continuous instrumentation are indisputably comparable to data generated by the FRM method, which could ultimately result in the replacement of FRM 24-hour samplers with hourly semi-continuous monitors for measuring $PM_{2.5}$.

In October 2003, USEPA made available a new, online $PM_{2.5}$ concentration gradient map at www.epa.gov/oar/oaqps/pm25/ that incorporates the current six Massachusetts BAM sites. Massachusetts added three semi-continuous $PM_{2.5}$ BAM sites (in Springfield, Milton and Fall River) during 2003 to the existing three-site network (Harrison Ave. and North Street in Boston and in Worcester). A seventh site will be added in Haverhill during Summer 2004.

## 2003 $PM_{2.5}$ data summary

A summary of the 2003 data is shown below.

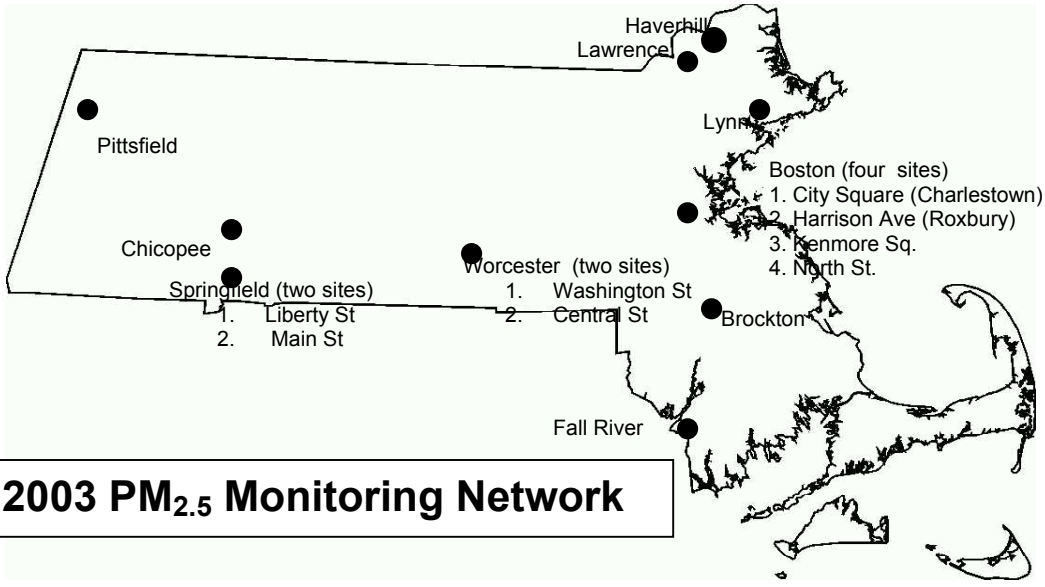
| SITE ID | TYPE | CITY | COUNTY | ADDRESS | 1ST MAX | 2ND MAX | 3RD MAX | 4TH MAX | 98TH PERCENTILE VALUE | WTD ARITH MEAN |
|---|---|---|---|---|---|---|---|---|---|---|
| 25-025-0002 | NC | BOSTON | SUFFOLK | KENMORE SQUARE | 40.9 | 29.7 | 29.2 | 27.5 | 29.7 | 12.8* |
| 25-025-0027 | NC | BOSTON | SUFFOLK | ONE CITY SQUARE | 48.0 | 43.2 | 42.3 | 34.3 | 42.3 | 12.5 |
| 25-025-0027 | NC Coloc | BOSTON | SUFFOLK | ONE CITY SQUARE | 53.7 | 41.3 | 25.7 | 24.1 | 41.3 | 12.0* |
| 25-025-0042 | NC | BOSTON | SUFFOLK | HARRISON AVENUE | 50.7 | 40.9 | 39.6 | 36.5 | 30.6 | 11.4* |
| 25-025-0042 | BAM | BOSTON | SUFFOLK | HARRISON AVENUE | 96.9 | 60.8 | 53.2 | 47.5 | 35.7 | 14.4 |
| 25-025-0043 | NC | BOSTON | SUFFOLK | 174 NORTH STREET | 44.8 | 42.5 | 35.5 | 34.1 | 35.5 | 13.6* |
| 25-025-0043 | BAM | BOSTON | SUFFOLK | 174 NORTH STREET | 69.5 | 54.4 | 50.4 | 42.3 | 37.1 | 14.3 |
| 25-023-0004 | NC | BROCKTON | PLYMOUTH | 120 COMMERCIAL ST | 41.3 | 36.8 | 34.5 | 24.7 | 34.5 | 9.8 |
| 25-023-0004 | NC Coloc | BROCKTON | PLYMOUTH | 120 COMMERCIAL ST | 40.8 | 40.3 | 30.4 | 24.7 | 40.3 | 10.6* |
| 25-013-0008 | NC | CHICOPEE | HAMPDEN | ANDERSON ROAD | 40.4 | 39.1 | 36.1 | 34.5 | 32.6 | 10.3* |
| 25-005-1004 | NC | FALL RIVER | BRISTOL | GLOBE STREET | 43.6 | 32.4 | 27.5 | 27.3 | 32.4 | 10.2* |
| 25-005-1004 | BAM | FALL RIVER | BRISTOL | GLOBE STREET | 35.3 | 33.3 | 29.4 | 25.6 | 33.3 | 9.5* |
| 25-009-5005 | NC | HAVERHILL | ESSEX | WASHINGTON STREET | 37.1 | 34.6 | 30.2 | 24.3 | 34.6 | 9.0* |
| 25-009-6001 | NC | LAWRENCE | ESSEX | WALL EXPERIMENT STA | 49.5 | 29.2 | 26.9 | 25.6 | 29.2 | 11.9* |
| 25-009-2006 | NC | LYNN | ESSEX | 390 PARKLAND | 61.4 | 47.6 | 40.0 | 39.0 | 47.6 | 9.8* |
| 25-021-3003 | BAM | MILTON | NORFOLK | MILTON MA,BLUE HILL | 18.8 | 14.8 | 13.8 | 11.3 | 18.8 | 8.1* |
| 25-003-5001 | NC | PITTSFIELD | BERKSHIRE | 78 CENTER STREET | 40.0 | 37.2 | 33.4 | 28.2 | 37.2 | 11.1* |
| 25-013-0016 | NC | SPRINGFIELD | HAMPDEN | LIBERTY STREET | 49.5 | 47.6 | 46.3 | 43.0 | 46.3 | 12.9 |
| 25-013-0016 | NC Coloc | SPRINGFIELD | HAMPDEN | LIBERTY STREET | 51.1 | 41.9 | 39.2 | 35.4 | 41.9 | 12.5* |
| 25-013-0016 | BAM | SPRINGFIELD | HAMPDEN | LIBERTY STREET | 45.0 | 43.6 | 43.4 | 39.0 | 39.0 | 10.7* |
| 25-013-2009 | NC | SPRINGFIELD | HAMPDEN | 1860 MAIN STREET | 37.7 | 37.5 | 35.5 | 32.6 | 37.5 | 11.5* |
| 25-027-0016 | NC | WORCESTER | WORCESTER | 2 WASHINGTON STREET | 25.5 | 23.1 | 17.9 | 17.1 | 25.5 | 10.0* |
| 25-027-0020 | NC | WORCESTER | WORCESTER | CENTRAL STREET | 49.5 | 42.4 | 40.8 | 37.6 | 35.5 | 10.8 |
| 25-027-0020 | NC Coloc | WORCESTER | WORCESTER | CENTRAL STREET | 43.3 | 33.2 | 29.7 | 25.4 | 33.2 | 9.0* |
| 25-027-0020 | BAM | WORCESTER | WORCESTER | CENTRAL STREET | 52.2 | 42.4 | 40.5 | 39.7 | 34.7 | 11.4* |

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

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 - **NC** = NON CONTINUOUS; **NC COLOC** = NON CONTINUOUS COLOCATED; **BAM** = BETA ATENUATION MONITOR **MAX 1ST, 2ND, 3RD, 4TH** = 1ST, 2ND, 3RD, AND 4TH HIGHEST 24-HOUR VALUES FOR THE YEAR **WTD ARITH MEAN** = WEIGHTED ANNUAL ARITHMETIC MEAN (STANDARD = 15.0 $\mu g/m^3$)




**2003 $PM_{2.5}$ Monitoring Network**

## Speciation

MADEP has taken samples for $PM_{2.5}$ speciation at the air monitoring sites in Roxbury since 2000 and in Chicopee since 2001. Speciation is the analysis of particulate matter collected on quartz filters to determine chemical composition. The results can be used to determine the levels of specific toxic air pollutants, as well as provide information about the nature and identity of air pollution sources which impact the monitoring station area. During each sampling event, three different filters composed of different materials 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 their 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 atmospheric visibility. Data can be viewed at the IMPROVE web site at http://vista.cira.colostate.edu/improve/Data/data.htm.

# Lead (Pb) Summary

## 2003 Pb Data Summary

MADEP operates one total suspended particulates (TSP) sampler to measure 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 was the primary source of airborne lead in the atmosphere. A summary of the 2003 data is shown below. Monitor malfunctions caused the data capture to be low.

| | | | UNITS: UG/CU METER | | QTR1 | QTR2 | QTR3 | QTR4 | # | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | # | ARITH | ARITH | ARITH | ARITH | MEANS | 1ST | 2ND |
| SITE ID | CITY | COUNTY | ADDRESS | OBS | MEAN | MEAN | MEAN | MEAN | > 1.5 | MAX | MAX |
| 25-025-0002 | BOSTON | SUFFOLK | KENMORE SQUARE | 21 | .04* | .03* | .02* | .01* | 0 | 0.08 | 0.04 |

* 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/m$^3$ (Calendar Quarter Arithmetic Mean)

**ABBREVIATIONS AND SYMBOLS USED IN TABLE**
**SITE ID** = AIRS SITE IDENTIFICATION # **OBS** = # OBSERVATIONS **QUARTERLY ARITH MEANS 1ST, 2ND, 3RD, 4TH** = 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/m$^3$) **MAX 1ST, 2ND** = THE 1ST AND 2ND MAXIMUM 24 HOUR VALUES

# Industrial Network Summary

## Introduction

The industrial ambient air quality network is comprised of monitoring stations operated by facilities that potentially emit large amounts of pollutants. An example would be a coal-burning power plant, which emits $SO_2$.

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 are submitted to the Air Assessment Branch. AAB submits the date into the USEPA AQS database after the quality assurance process has been completed.

## The 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 MADEP-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 during 2003 in the industrial network. All of the sites achieved the requirement of 80% or greater data capture for the year. There were no known violations of the $SO_2$ air quality standards during the year in the reported data. A summary of the 2003 data is shown below.

| SITE ID | CITY | COUNTY | UNITS: PPM 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 | 98 | 0.019 | 0.017 | 0 | 0.035 | 0.025 | 0 | 0.039 | 0.035 | 0.004 |
| 25-025-0020 | BOSTON | SUFFOLK | DEWAR STREET | 98 | 0.021 | 0.021 | 0 | 0.044 | 0.038 | 0 | 0.047 | 0.046 | 0.005 |
| 25-025-0021 | BOSTON | SUFFOLK | 340 BREMAN ST | 99 | 0.022 | 0.021 | 0 | 0.045 | 0.036 | 0 | 0.050 | 0.049 | 0.005 |
| 25-025-0040 | BOSTON | SUFFOLK | 531A EAST FIRST | 98 | 0.022 | 0.021 | 0 | 0.073 | 0.045 | 0 | 0.182 | 0.101 | 0.006 |

**ABBREVIATIONS AND SYMBOLS USED IN TABLE**
**SITE ID** = AIRS SITE IDENTIFICATION NUMBER **%OBS** = DATA CAPTURE PERCENTAGE **MAX 24-HR, MAX 3-HR, MAX 1-HR 1ST, 2ND** = 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 **ARIT MEAN** = ARITHMETIC MEAN (STANDARD = 0.03 PPM)

## Nitrogen Dioxide ($NO_2$) summary

There was one $NO_2$ site during 2003 in the industrial network, operated by Exelon Energy in Boston (East First St.). It met the requirement of 80% or greater data capture. There were no reported violations of the $NO_2$ air quality standard during the year.

A summary of the 2003 data is shown below.

| | | | UNITS: PPM | | 1ST | 2ND | |
|---|---|---|---|---|---|---|---|
| | | | | % | MAX | MAX | ARITH |
| SITE ID | CITY | COUNTY | ADDRESS | OBS | 1-HR | 1-HR | MEAN |
| 25-025-0041 | BOSTON | SUFFOLK | 531A EAST FIRST ST | 95 | 0.099 | 0.094 | 0.021 |

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 during 2003 in the industrial network, operated by Exelon Energy in the city of Boston. All of the sites met the requirement of 80% or greater data capture.

TSP is not a criteria pollutant ($PM_{10}$ replaced it as the particulate standard in 1987), so there is no longer a standard for it. A summary of the 2003 data is shown below.

| | | | | UNITS: UG/CU METER | % | 1ST | 2ND | 3RD | 4TH | ARITH | GEO. | GEO. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SITE ID | TYPE | CITY | COUNTY | ADDRESS | OBS | MAX | MAX | MAX | MAX | MEAN | MEAN | STD |
| 25-025-0019 | NC | BOSTON | SUFFOLK | LONG ISLAND | 97 | 51 | 45 | 43 | 41 | 23.1 | 21.7 | 1.4 |
| 25-025-0020 | NC | BOSTON | SUFFOLK | DEWAR STREET | 97 | 581 | 392 | 267 | 249 | 99.2 | 73.4 | 2.1 |
| 25-025-0021 | NC | BOSTON | SUFFOLK | 340 BREMAN ST | 95 | 153 | 136 | 114 | 114 | 53.7 | 48.4 | 1.6 |
| 25-025-0040 | NC | BOSTON | SUFFOLK | 531A EAST FIRST | 97 | 130 | 114 | 103 | 98 | 49.9 | 45.2 | 1.6 |
| 25-025-0040 | NC Coloc | BOSTON | SUFFOLK | 531A EAST FIRST | 95 | 157 | 114 | 108 | 106 | 53.1 | 47.9 | 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 **MAX 1ST, 2ND, 3RD, 4TH** = 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 during 2003 in the industrial network, operated by Exelon Energy in the city of Boston. All sites met the requirement of 80% 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 2003 data is shown below.

| SITE ID | TYPE | CITY | COUNTY | UNITS: UG/CU METER ADDRESS | % OBS | 1ST MAX VALUE | 2ND MAX VALUE | 3RD MAX VALUE | 4TH MAX VALUE | ARITH. MEAN | DURATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25-025-0019 | NC | BOSTON | SUFFOLK | LONG ISLAND | 97 | 13 | 13 | 11 | 10 | 5.8 | 24 HOURS |
| 25-025-0020 | NC | BOSTON | SUFFOLK | DEWAR STREET | 95 | 18 | 14 | 12 | 11 | 6.82 | 24 HOURS |
| 25-025-0021 | NC | BOSTON | SUFFOLK | BREMEN STREET | 95 | 21 | 15 | 14 | 13 | 7.18 | 24 HOURS |
| 25-025-0040 | NC | BOSTON | SUFFOLK | 531A EAST FIRST ST | 92 | 21 | 13 | 13 | 13 | 7.25 | 24 HOURS |
| 25-025-0040 | NC Coloc | BOSTON | SUFFOLK | 531A EAST FIRST ST | 93 | 22 | 13 | 13 | 12 | 7.05 | 24 HOURS |

**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 **MAX VALUE 1ST, 2ND, 3RD, 4TH** = 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 the ambient air quality data are of high quality, MADEP has developed standard operating procedures (SOPs) that include quality control and quality assurance techniques that assess the quality and document the activities performed in collecting the data.

### Quality Control

Quality control (QC) is comprised of those activities performed by personnel who are directly involved in the generation of the data. Examples of personnel who perform QC functions are site operators and laboratory support personnel. QC activities include calibrations, data validation procedures, and performance checks of the ambient air monitors to assess the precision of the data. Documentation of all activities and site information further augment accurate data collection.

### Data Quality Review

The AAB data group reviews data. All precision and accuracy activities are checked as well as raw data, quality assurance checks, and documentation. Report software also is used for data validation. The data group edits the data as required and transfers it into the USEPA AIRS 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 audit checks of the ambient air monitors 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 is Described

Precision and accuracy are given in the context of upper and lower 95-percentile probability limits for each pollutant parameter. The meaning of the 95-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 95-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%.

## 2003 Precision and Accuracy Summary

As a goal, the 95-percentile probability limits for precision (all parameters) and $PM_{10}$ and TSP accuracy should be less than ±15%. The 95 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 2003 data is shown below.

| | | | | | | | PRECISION DATA | | | | ACCURACY DATA | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRECISION AND ACCURACY 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 | 2003 | 6 | 115 | -7.2 | 4.8 | 21 | -14.3 | 8.5 | -12.6 | 0.3 | -10.3 | 1.9 |
| CARBON MONOXIDE | | | | | | 2003-1 | 6 | 30 | -9.8 | 5.0 | 6 | -8.5 | 13.9 | -8.4 | 1.7 | -4.2 | 2.0 |
| | | | | | | 2003-2 | 5 | 28 | -4.0 | 3.6 | 3 | -10.4 | 11.4 | -7.6 | 0.0 | -7.3 | 2.5 |
| | | | | | | 2003-3 | 5 | 32 | -5.1 | 1.5 | 9 | -18.1 | 6.0 | -14.9 | -2.7 | -11.5 | -2.1 |
| | | | | | | 2003-4 | 4 | 25 | -5.3 | 4.9 | 3 | -15.6 | 4.5 | -13.9 | -2.1 | -11.6 | 0.4 |
| 01 | 25 | 001 | C | A | SO2 | 2003 | 6 | 150 | -7.4 | 3.9 | 33 | -9.8 | 12.7 | -7.2 | 7.7 | -5.2 | 9.0 |
| SULFUR DIOXIDE | | | | | | 2003-1 | 6 | 37 | -5.7 | 3.3 | 12 | -2.1 | 10.9 | -3.4 | 5.7 | -2.7 | 8.2 |
| | | | | | | 2003-2 | 6 | 40 | -8.3 | 5.7 | 6 | -6.8 | -6.8 | -12.6 | 8.1 | -11.0 | 10.0 |
| | | | | | | 2003-3 | 6 | 40 | -5.6 | 1.9 | 12 | -9.6 | 12.3 | -9.9 | 9.9 | -7.2 | 11.0 |
| | | | | | | 2003-4 | 5 | 33 | -7.3 | 2.0 | 3 | -8.2 | 13.1 | -8.3 | 9.6 | -5.8 | 10.1 |
| 01 | 25 | 001 | C | A | NO2 | 2003 | 11 | 226 | -10.2 | 10.3 | 15 | -16.4 | -3.2 | -17.1 | -0.8 | -14.9 | -5.8 |
| NITROGEN DIOXIDE | | | | | | 2003-1 | 7 | 45 | -9.7 | 14.2 | 9 | -11.5 | -3.7 | -13.1 | -0.2 | -10.1 | -7.7 |
| | | | | | | 2003-2 | 11 | 69 | -6.2 | 6.8 | | | | | | | |
| | | | | | | 2003-3 | 11 | 72 | -10.9 | 8.3 | 6 | -14.8 | -11.4 | -18.1 | -6.6 | -17.4 | -7.5 |
| | | | | | | 2003-4 | 6 | 40 | -8.1 | 7.1 | | | | | | | |
| 01 | 25 | 001 | C | A | O3 | 2003 | 13 | 229 | -6.9 | 5.0 | 42 | -4.8 | 12.8 | -2.6 | 12.0 | -1.8 | 11.5 |
| OZONE | | | | | | 2003-1 | 5 | 26 | -6.4 | -0.1 | 9 | -3.5 | 12.4 | -5.0 | 14.1 | -4.4 | 13.4 |
| | | | | | | 2003-2 | 13 | 83 | -6.1 | 6.7 | 9 | -12.3 | 14.0 | -7.4 | 13.1 | -6.8 | 13.8 |
| | | | | | | 2003-3 | 13 | 90 | -6.2 | 3.7 | 15 | -2.7 | 14.9 | -0.3 | 13.1 | 0.8 | 11.8 |
| | | | | | | 2003-4 | 5 | 30 | -4.9 | 1.4 | 9 | 1.6 | 4.6 | 1.0 | 7.0 | 1.0 | 7.5 |

| PRECISION AND ACCURACY DATA KEY | | | | | | | # OF | COLLOC | PROB | LIM | # AUDITS | PROB | LIM | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RG | ST | RO | TYP | CLASS | POLL | LO-L2 | -UP | SITES | LO | UP | L1-L3 | LO-L2 | -UP | | | |
| 01 | 25 | 001 | I | F | PM2.5 | 2003 | 294 | 4 | 12.6 | 14.8 | 67 | -1.2 | -0.3 | | | |
| PM2.5 LOCAL CONDITIONS | | | | | | 2003-1 | 77 | 4 | 11.9 | 15.9 | 16 | -2.4 | -0.3 | | | |
| | | | | | | 2003-2 | 69 | 4 | 9.9 | 14.3 | 15 | -1.1 | 1.3 | | | |
| | | | | | | 2003-3 | 76 | 4 | 9.3 | 13.0 | 17 | -1.9 | -0.3 | | | |
| | | | | | | 2003-4 | 72 | 4 | 14.9 | 20.9 | 19 | -1.2 | 0.1 | | | |
| 01 | 25 | 001 | I | F | PM10 | 2003 | 30 | 2 | -12.5 | 7.1 | | | | | | |
| PM10 TOTAL 0-10UM | | | | | | 2003-1 | 0 | 0 | 0 | 0 | | | | | | |
| | | | | | | 2003-2 | 11 | 1 | 4.1 | 4.1 | | | | | | |
| | | | | | | 2003-3 | 1 | 1 | -17.2 | 7.9 | | | | | | |
| | | | | | | 2003-4 | 18 | 2 | -17.1 | 2.4 | | | | | | |

**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 **PRECIS** 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

Ground-level ozone is unique in that it is a secondary pollutant, that is, it is not discharged directly to the atmosphere from a stack or flue, but rather forms in the atmosphere from the photochemical reactions of other pollutants. Ozone formation can occur many miles down wind from the original emissions source. These reactions only occur in the presence of strong sunlight, which is present during the hottest days of the summer. The PAMS 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 between years and for identifying appropriate pollutant control strategies.

PAMS (Photochemical Assessment Monitoring Stations) is a special designation for enhanced monitoring stations that measure pollutants and meteorological parameters that are designed to gather information on the ozone formation process. In addition to the standard NAAQS pollutants (Ozone, $NO_2$) that are measured at other sites, non-criteria pollutants, including volatile organic compounds (VOCs), are measured at PAMS stations on either an hourly rate or at regularly scheduled intervals throughout the ozone monitoring season (June, July and August). Meteorology is a critical component of ozone formation and each PAMS site has a full complement of meteorological sensors including wind speed, wind direction, temperature, relative humidity, barometric pressure, solar intensity and at some sites, total ultraviolet light and precipitation. MADEP has one PAMS associated Doppler Radar High Altitude Wind/Temperature Profiler at the Stow site (which is otherwise not a PAMS designated location).

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 seasons. Looking toward the future, a holistic strategy, which includes PAMs measurements at fewer, but more enhanced air monitoring stations, is being developed by USEPA

In 2003, DEP returned to taking more conventional PAMS measurements at several locations that had been modified during the 2002 season. The 2003 changes included reinstatement of automated hourly gas chromatography measurements at Ware and VOC canister sampling at Truro rather than at Fairhaven.

**Coverage of PAMS Monitoring Sites**

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

* Provides data for both Boston and Providence networks.

# Air Toxics Monitoring

## Introduction

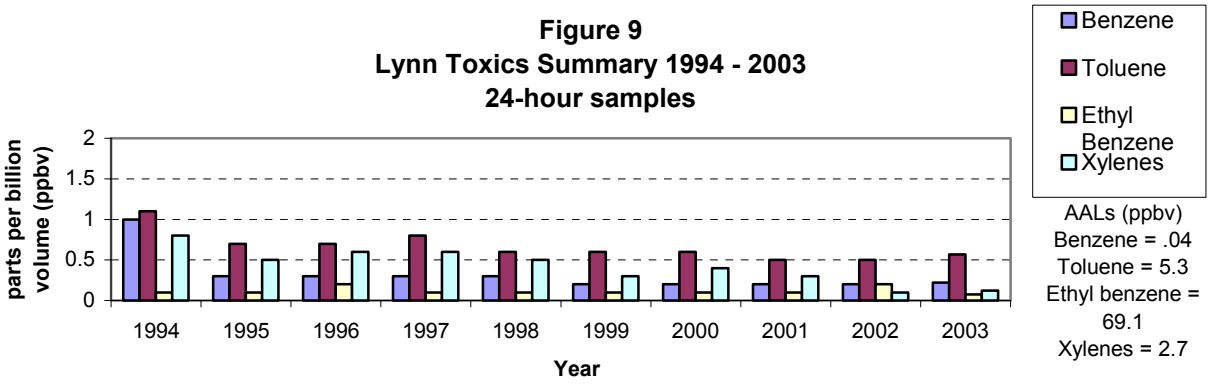
Toxic air pollutants are distinct from criteria air pollutants such as ozone and CO. They include pollutants known or suspected to cause cancer or other serious health effects, and include volatile organic compounds (VOCs) and toxic metals (e.g., mercury).

MADEP monitors VOCs as part of the PAMS monitoring program, many of which are air toxics. From June through August, VOCs are monitored at six PAMS sites. In addition, in 1999 MADEP 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 9 summarizes concentrations of 24-hour health-relevant PAMS target compounds for samples taken at the Lynn PAMS site from 1994 to 2003. Significant mean concentration decreases 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 9 for reference. AALs are health-based air toxics guidelines developed by MADEP 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 9**
**Lynn Toxics Summary 1994 - 2003**
**24-hour samples**



Below is a table that summarizes results from the analysis of 24-hour samples for selected target VOCs from the two sites for 2003. The central city sampling location is Harrison Ave., and the area background site for 2003 was Lynn.

| Compound | BOSTON (Harrison Ave) | | LYNN | |
|---|---|---|---|---|
| | Max Value ppb | Mean ppb | Max Value ppb | Mean ppb |
| 1,3-butadiene | 0.22 | 0.05 | 0.07 | 0.01 |
| 1,1,1-trichloroethane | 0.04 | 0.03 | 0.04 | 0.02 |
| Trichloroethylene | 0.10 | 0.02 | 0.08 | 0.02 |
| Tetrachloroethylene | 0.21 | 0.06 | 0.14 | 0.03 |
| Benzene | 0.96 | 0.39 | 0.51 | 0.21 |
| Toluene | 2.90 | 0.94 | 9.4 | 0.57 |
| Xylenes | 0.75 | 0.27 | 1.52 | 0.12 |
| Ethylbenzene | 0.37 | 0.15 | 0.74 | 0.07 |

## Mercury Deposition Sampling

The Air Assessment Branch continues to collect precipitation samples for mercury analysis at two locations in Massachusetts (Ware and North Andover). This data collection supports a MADEP study on the mechanism of wet mercury deposition.

# Appendix A
# 2003 State Monitoring Station Locations

| SITE ID | CITY | COUNTY | ADDRESS | DATE SITE ESTABLISHED | LATITUDE | LONGITUDE |
|---|---|---|---|---|---|---|
| 25-001-0002 | ADAMS | BERKSHIRE | MT. GREYLOCK | 5/1/1989 | +42:38:12 | -73:10:07 |
| 25-003-4002 | AMHERST | HAMPSHIRE | NORTH PLEASANT | 4/1/1988 | +42:24:01 | -72:31:25 |
| 25-025-0002 | BOSTON | SUFFOLK | KENMORE SQUARE | 1/1/1965 | +42:20:54 | -71:05:57 |
| 25-025-0027 | BOSTON | SUFFOLK | ONE CITY SQUARE | 1/1/1985 | +42:22:22 | -71:03:49 |
| 25-025-0041 | BOSTON | SUFFOLK | LONG ISLAND | 12/1/1998 | +42:19:03 | -70:58:12 |
| 25-025-0042 | BOSTON | SUFFOLK | HARRISON AVENUE | 12/15/1998 | +42:19:46 | -71:04:58 |
| 25-025-0043 | BOSTON | SUFFOLK | 174 NORTH STREET | 1/1/2000 | +42:21:46 | -71:04:58 |
| 25-023-0004 | BROCKTON | PLYMOUTH | 120 COMMERCIAL ST | 12/15/1998 | +42:07:97 | -71:01:52 |
| 25-013-0008 | CHICOPEE | HAMPDEN | ANDERSON ROAD | 1/1/1983 | +42:11:39 | -72:33:22 |
| 25-013-0008 | FAIRHAVEN | BRISTOL | LEROY WOOD | 1/1/1982 | +41:38:07 | -70:52:53 |
| 25-005-1004 | FALL RIVER | BRISTOL | GLOBE STREET | 2/1/1975 | +41:41:07 | -71:09:59 |
| 25-009-5005 | HAVERHILL | ESSEX | WASHINGTON STREET | 7/19/1994 | +42:45:46 | -71:06:21 |
| 25-009-6001 | LAWRENCE | ESSEX | WALL EXPERIMENT STA | 4/3/1999 | +42:41:55 | -71:09:57 |
| 25-017-0007 | LOWELL | MIDDLESEX | OLD CITY HALL | 7/17/1981 | +42:38:42 | -71:18:42 |
| 25-009-2006 | LYNN | ESSEX | 390 PARKLAND | 1/1/1992 | +42:28:28 | -70:58:21 |
| 25-021-3003 | MILTON | NORFOLK | MILTON MA, BLUE HILL | 4/2/2002 | +42:21:22 | -71:11:47 |
| 25-009-4004 | NEWBURY | ESSEX | SUNSET BOULEVARD | 8/1/1984 | +42:47:22 | -70:48:33 |
| 25-003-5001 | PITTSFIELD | BERKSHIRE | 78 CENTER STREET | 12/1/1998 | +42:27:06 | -73:15:18 |
| 25-013-0016 | SPRINGFIELD | HAMPDEN | LIBERTY STREET | 4/1/1988 | +42:06:32 | -72:35:29 |
| 25-013-2007 | SPRINGFIELD | HAMPDEN | EAST COLUMBUS | 11/1/1981 | +42:06:02 | -72:35:30 |
| 25-013-2009 | SPRINGFIELD | HAMPDEN | 1860 MAIN STREET | 1/1/2002 | +42:10:74 | -72:59:74 |
| 25-021-3003 | STOW | MIDDLESEX | US MILITARY | 4/1/1998 | +42:24:49 | -71:29:09 |
| 25-001-0002 | TRURO | BARNSTABLE | FOX BOTTOM AREA | 4/1/1987 | +41:58:33 | -70:01:29 |
| 25-017-4003 | WALTHAM | MIDDLESEX | BEAVER STREET | 1/1/1971 | +42:23:01 | -71:12:50 |
| 25-015-4002 | WARE | HAMPSHIRE | QUABBIN SUMMIT | 6/1/1985 | +42:17:54 | -72:20:05 |
| 25-027-0015 | WORCESTER | WORCESTER | WORC. AIRPORT | 5/7/1979 | +42:11:27 | -71:52:34 |
| 25-027-0016 | WORCESTER | WORCESTER | 2 WASHINGTON STREET | 12/31/2002 | +42:15:33 | -71:47:57 |
| 25-027-0020 | WORCESTER | WORCESTER | CENTRAL STREET | 1/1/1982 | +42:16:02 | -71:47:56 |

# 2003 Industrial Monitoring Station Locations

| SITE ID | CITY | COUNTY | ADDRESS | DATE SITE ESTABLISHED | LATITUDE | LONGITUDE |
|---|---|---|---|---|---|---|
| 25-025-0019 | BOSTON | SUFFOLK | LONG ISLAND | 1/1/1978 | +42:19:00 | -70:58:15 |
| 25-025-0020 | BOSTON | SUFFOLK | DEWAR STREET | 1/1/1978 | +42:18:34 | -71:03:22 |
| 25-025-0021 | BOSTON | SUFFOLK | BREMEN STREET | 1/1/1979 | +42:22:41 | -71:01:42 |
| 25-025-0040 | BOSTON | SUFFOLK | 531A EAST FIRST ST | 1/1/1993 | +42:20:46 | -71:02:28 |

# Appendix B
# Air Quality Related Web Sites

**Web sites of interest:** The table below has a listing of web sites that have air quality data or related information.

| Web Address | Organization | Description |
|---|---|---|
| www.mass.gov/dep/ | MADEP | Massachusetts DEP Home Page. Links to MADEP programs, regions and publications. Links to the Daily Ozone Forecast during ozone season (May 1 through September 30). |
| www.mass.gov/dep/bwp/daqc | MADEP | Air Program Planning Unit. |
| www.mass.gov/dep/bwp/dhm/tura/turhome.htm | MADEP | Toxic Use Reduction Act Program – establishes annual toxics use reporting and bi-annual planning for toxics use reduction. |
| www.airbeat.org | MADEP/EMPACT | Current AIR Quality in Roxbury – web page of MADEP 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 that promotes toxics use reduction. The web site includes a link to TURAData, which makes information available to the public about toxics use in their communities. |
| http://www.epa.gov/region1/aqi/index.html | USEPA | AQI New England Forecast and Real Time Ozone. Includes color-coded animated maps using near real-time data that show how ozone is formed and transported downwind and sign up for Air Quality Smog Alert System. |
| 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 | USEPA | EPA's Office of Air and Radiation |
| www.epa.gov/region01/ | USEPA | EPA Region 1 New England 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. |
| www.epa.gov/enviro/ | USEPA | EPA Envirofacts – data from 4 major EPA databases:<br>• PCS (Permit Compliance System)<br>• RCRIS (Resource Conservation and Recovery Information System)<br>• CERCLIS (Comprehensive Environmental Response, Compensation and Liability Information System)<br>• TRIS (Toxic Release Inventory System) |

| Web Address | Organization | Description |
|---|---|---|
| www.epa.gov/envirosense | 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 (SO2) and nitrogen oxides (NOX), the primary causes of acid rain. Emissions data from the nation's largest power generating facilities is available here. |
| Maine<br>www.state.me.us/dep/air/ozone<br><br>New Hampshire<br>www.des.state.nh.us/ard/ozone.htm<br><br>New York<br>http://www.dec.state.ny.us/apps/aqi/aqi_forecast.cfm<br><br>New Jersey<br>www.state.nj.us/dep/airmon/<br><br>Rhode Island<br>www.state.ri.us/dem/programs/benviron/air/pm.htm | | Ozone predictions and some real-time ozone data from neighboring states (some states report other pollutants, as well). |

| Web Address | Organization | Description |
|---|---|---|
| www.epa.gov/ttn/atw/ | USEPA | Air Toxics Technology Transfer Network - 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/scripts/us_temp.asp?id=307 | STAPPA/ALAPCO | State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials – site has links to air quality related agencies and organizations. |
| 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. |
| www.nws.noaa.gov/er/ | NWS | The National Weather Service's Boston office provides local forecasts and climate information. |
| http://www.thebostonchannel.com/pollen/index.html | 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. |
| 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/CurrentProjects/nawqa/hg_dep.htm | NACB | New England Coastal Basins Mercury Deposition Network – Atmospheric deposition |