2025 Ambient Air Monitoring Network Assessment

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Contents

Section 1 – Introduction

The Massachusetts Department of Environmental Protection (MassDEP) has prepared this 2025 Ambient Air Monitoring Network Assessment pursuant to 40 CFR 58.10(d). The Federal Clean Air Act established a joint Federal-State partnership for protecting the quality of our nation's air. A key component of this partnership is the national system of ambient air quality monitors. State and local air pollution control agencies maintain a network of air monitoring stations that measure ambient concentrations of pollutants for which the U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS). Those pollutants, which are known as "criteria pollutants," include ozone (O_3), particulate matter smaller than 10 microns (PM_{10}), particulate matter smaller than 2.5 microns ($PM_{2.5}$), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), and lead (Pb). The monitoring network is designed to determine if air quality meets the NAAQS as well as to provide data needed to identify, understand, and address ambient air quality problems. EPA promulgates regulations that define minimum monitoring requirements as well as monitoring techniques and procedures.

Monitoring networks are designed to achieve, with limited resources, the best possible scientific data to support the protection of public health, the environment, and public welfare. The number, location, and types of monitors needed to achieve this goal depends on a myriad of factors including demographics, pollution levels, air quality standards, monitoring technology, budgets, and scientific understanding. These factors all change over time. In accordance with EPA monitoring regulations, state and local air pollution control agencies must complete an assessment of their monitoring networks every five years in order to determine:

- if the network meets the monitoring objectives defined in Appendix D of 40 CFR 58.10,
- whether new monitoring sites are needed,
- whether existing sites are no longer needed and can be discontinued, and
- whether new technologies are appropriate for the ambient air monitoring network.

The network assessment must consider the ability of existing and proposed monitoring sites to provide relevant data for air quality characterization for areas with relatively high populations of susceptible individuals (e.g., children with asthma). The assessment also must show the impacts of proposals to discontinue any sites on data users other than the agency itself, such as nearby states and tribes or organizations conducting health effects studies. For the criteria pollutant $PM_{2.5,}$ the assessment also must identify needed changes to population-oriented sites.

MassDEP's Air Assessment Branch (AAB) maintains an ambient air quality monitoring network that consists of 26 monitoring stations located in 21 cities and towns and monitors ambient concentrations of all criteria pollutants; however, lead monitoring is conducted for toxics monitoring and is not submitted for comparison to NAAQS. The Wampanoag Tribe of Gay Head (Aquinnah) operates an additional air monitoring station on Martha's Vineyard. MassDEP also monitors meteorological conditions, black carbon, ultrafine particulates ($PM_{0.1}$), ambient levels of toxic air pollutants as part of the National Air Toxics Trends Sites (NATTS) network, and ozone precursors as part of the Photochemical Assessment Monitoring Stations (PAMS) network. Ozone precursors are substances that react in the atmosphere to form ground-level ozone.

MassDEP's air monitoring network places an emphasis on monitoring ozone and $PM_{2.5}$ levels. In the past, Massachusetts air quality has been in nonattainment of the ozone standard and has been close to the $PM_{2.5}$ standard. Today, Massachusetts is designated in attainment of all standards, with the exception of Dukes County. Dukes County is designated as nonattainment with the 2008 ozone NAAQS (0.075 ppm). However, Dukes County currently meets the 2008 ozone NAAQS and is designated as attainment with the more stringent 2015 ozone NAAQS (0.070 ppm). The Commonwealth still experiences days with elevated levels of ozone, making ozone monitoring a continued priority. The ozone monitoring network is designed to measure concentrations of ozone and its precursors in-state, as well as provide insight into ozone formation and ozone transport. MassDEP also continues to place priority on monitoring $PM_{2.5}$ concentrations due to the significant health effects posed by $PM_{2.5}$ exposure.

Figure 2-1 shows the location of monitoring stations in Massachusetts. EPA approved these sites as meeting applicable siting criteria, as specified in Subpart B of 40 CFR Part 58. As required by EPA, all criteria pollutants are monitored using Federal Reference Methods (FRMs) or Federal Equivalent Methods (FEMs) and monitors are operated according to the procedures specified in Quality Assurance Project Plans (QAPPs) that have been approved by EPA. MassDEP's monitors meet EPA guidelines and requirements for characterizing micro-scale (up to 100 square meters), middle-scale (a few city blocks), neighborhood (up to 4 square kilometer), urban (a city), and regional (up to hundreds of square kilometers) air quality and for measuring the greatest population exposures, highest exposures and regional transport.

1.1 Update to the 2020 Network Assessment

MassDEP prepared its last Network Assessment in 2020. A summary of changes to MassDEP's monitoring network since the 2020 Assessment is provided below:

- In January 2020, MassDEP discontinued CO monitoring at the Springfield monitoring station.

- In January 2020, MassDEP added a NOy analyzer at the Lynn monitoring station to meet PAMS requirements.

- In June 2020, MassDEP added a continuous FEM $PM_{2.5}$ monitor at the Kenmore Square monitoring station.

- In January 2021, MassDEP discontinued $PM_{2.5}$ filter-based monitors at the Brockton, Haverhill, Worcester – Summer Street and Chicopee monitoring stations.

- In April 2021, MassDEP discontinued the temporary Weymouth – Bridge Street monitoring station and established a permanent monitoring station in Weymouth on Monatiquot Street site that includes O_3, NO_2, $PM_{2.5}$, volatile organic compound (VOC), and carbonyl monitors.

- In April 2021, MassDEP established a new monitoring station in Chelsea with continuous FEM $PM_{2.5}$, VOC and carbonyl monitoring equipment.

- In May 2021, MassDEP installed a ceilometer at the Lynn monitoring station in accordance with PAMS requirements.

- In April 2023, MassDEP established a new monitoring station in the Chinatown neighborhood of Boston with a continuous FEM $PM_{2.5}$ monitor.

- In September 2023, MassDEP discontinued the filter-based $PM_{2.5}$ monitor at the Pittsfield monitoring station.

- In December 2023, MassDEP added an NO_2 monitor at the Pittsfield monitoring station.

- In March 2024, MassDEP moved the Haverhill monitoring station to a new location at the Haverhill High School at 137 Monument Street, approximately one mile north of the previous location. The relocated monitoring station has the same measurements as the former location (O_3, $PM_{2.5}$, meteorological parameters).

- Between March and September 2024, MassDEP added ultrafine particulate ($PM_{0.1}$) monitors at its monitoring stations in Boston-Von Hillern Street, Chelmsford-Near Road, Boston-Chinatown, and Springfield.

- In December 2024, MassDEP added a continuous FEM $PM_{2.5}$ and PM_{10} monitor at the Uxbridge monitoring station to satisfy new EPA $PM_{2.5}$ monitoring network design criteria that requires an additional $PM_{2.5}$ monitor in the Worcester MSA.

- In December 2024, MassDEP established a new monitoring station in Framingham with a continuous FEM $PM_{2.5}$ monitor and a continuous black carbon monitor.

- In December 2024, MassDEP discontinued O_3 monitoring at Chelmsford Near Road.

- MassDEP is in the process of establishing a new monitoring station in Saugus which will include $PM_{2.5}$, PM_{10}, and black carbon monitors.

1.2 Results of the 2025 Network Assessment

MassDEP's review of the Massachusetts monitoring network indicates that the network meets or exceeds EPA's minimum monitoring requirements, that the network is well designed and operated, and adequately characterizes air quality in Massachusetts. While Massachusetts is designated in attainment of the 2015 8-hour ozone NAAQS, MassDEP continues to make ozone monitoring a priority to confirm the overall downward trend in ozone concentrations and to alert the public on days when ozone is elevated. MassDEP also continues to operate a robust $PM_{2.5}$ monitoring network due to the significant health effects posed by $PM_{2.5}$ and increasingly frequent air quality impacts from wildfire smoke.

MassDEP has reviewed changes in population and pollutant emissions and determined that MassDEP's existing monitoring network is properly designed. Massachusetts population centers remain the same geographically, although the overall population has increased (see Figure 3-2); there has been little change in the distribution of vehicle miles travelled across the state (see Figure 4-3); and pollutant emissions have declined fairly uniformly across the state (see Figure 4-4). The absence of major shifts in these factors indicates that adjustment of the basic design of the air monitoring network is unnecessary.

In addition, review of the distribution of sensitive populations (such as children) and of the incidence of various diseases associated with air pollution (such as asthma, respiratory disease, lung cancer, and circulatory diseases), as well as Environmental Justice populations, indicates that the existing network of monitoring sites adequately supports air quality characterization in areas with sensitive populations. However, given the health impacts of $PM_{2.5}$, MassDEP continues to evaluate opportunities to enhance $PM_{2.5}$ monitoring in Environmental Justice communities.

MassDEP used an analytical tool provided by EPA (NetAssess2025) to evaluate whether any sites are redundant and could be removed and whether any new sites are needed in the monitoring network. The tools evaluate correlations between existing site measurements; distance between sites; the likelihood of the site exceeding a standard; the correlation between site measurements; removal bias (i.e., the difference between the measured concentrations at a site and those that would be estimated for that site based on data from surrounding sites); and create maps that show the coverage area of each monitor.

MassDEP continues to evaluate opportunities to optimize the monitoring network and provides updates for EPA review and approval through Annual Network Plans. MassDEP has taken advantage of opportunities to streamline operations by optimizing travel routes, maintenance schedules, and relying more on automated continuous monitors for most parameters. MassDEP continues to rely on continuous Federal Equivalent Method (FEM) $PM_{2.5}$ monitors to limit weighting of particulate filters.

Section 2 – Network Purpose and Description

The Massachusetts ambient air quality monitoring network serves several purposes:

- **Provide information about air quality to the public.** MassDEP's website provides near real-time data from continuous monitoring sites, explanations of the health effects of pollution, information about the NAAQS, and the ability to chart historical air quality monitoring data and air quality trends. The network also supports MassDEP's daily air quality forecast and alert system. Both data and forecasts are posted at MassDEP's MassAir Online website.

- **Verify compliance with NAAQS.** EPA specifies the minimum number of monitors that must be located in Massachusetts to demonstrate whether the state is in attainment of each of the criteria pollutants.

- **Assess the effectiveness of current air pollution control regulations and initiatives / support development of policies and regulations aimed at reducing air pollution.** MassDEP uses air monitoring data to develop and track progress of State Implementation Plans (SIPs) that specify the air pollution controls and strategies to attain and maintain the NAAQS and meet Regional Haze requirements.

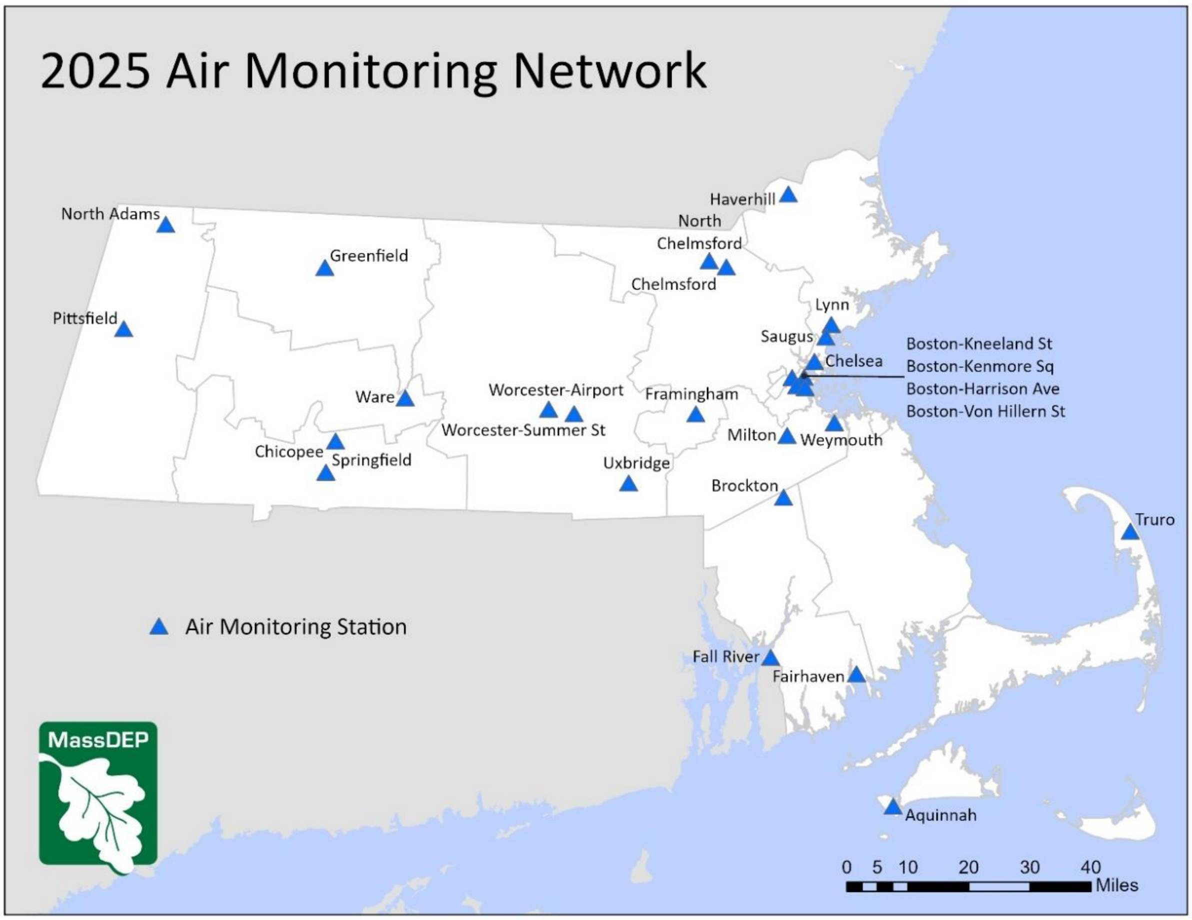
- **Ambient monitoring data are used in conjunction with modeling to characterize the extent of air pollution problems, including transport into and out of the state, as well as to evaluate the impacts of alternative control strategies.** MassDEP's monitoring data are important to regional air pollution control planning efforts. Massachusetts is a member of three interstate regional organizations that coordinate the development of air pollution control plans - Ozone Transport Commission (OTC), Mid-Atlantic/Northeast Visibility Union (MANEVU), and Northeast States for Coordinated Air Use Management (NESCAUM).

- **Site-specific permitting.** MassDEP staff and consultants use ambient air quality and meteorological monitoring data to make site-specific permitting decisions that ensure that emissions from new or modified facilities do not cause or contribute to violations of NAAQS or consume Prevention of Significant Deterioration increments. In addition, meteorological and toxic chemical monitoring information is used in conjunction with models to estimate if emissions are likely to result in exceedances of MassDEP's Ambient Air Limits (AALs) and Threshold Effect Exposure Limits (TELs) for toxic pollutants.

- **Research.** Environmental and medical academics, the Massachusetts Department of Public Health, the World Health Organization, conservation groups, environmental advocates, and consultants use ambient air monitoring data to evaluate the public health and environmental impacts of air pollution and to develop and "ground truth" ambient air quality models. Air quality data also are used to better characterize the behavior of contaminants in the atmosphere.

MassDEP operates 26 monitoring stations located in 21 cities and towns. The Wampanoag Tribe of Gay Head (Aquinnah) operates an air monitoring station on Martha's Vineyard. Figure 2-1 shows the location of monitoring stations.

Figure 2-1
Massachusetts Air Monitoring Stations in 2025



2.1 Monitor Descriptions

Figure 2-2 summarizes the monitors included in the Massachusetts network for criteria pollutants and non-criteria pollutants:

Figure 2-2 Air Monitoring Instruments			
Pollutant	Locations in Network	Continuous or Intermittent	Make/Model
Criteria Pollutants			
CO	3	Continuous	Teledyne T300U or Thermo 48iQ
NO_2	11	Continuous	Teledyne T200, Teledyne T500, or Thermo 42iQ
O_3	17	Continuous	Teledyne T400
SO_2	6	Continuous	Teledyne T100U or Thermo 43iQ
$PM_{2.5}$	18	Continuous	Teledyne T640 or T640x
$PM_{2.5}$	5	Intermittent	Thermo 2025i
PM_{10}	3	Continuous	Teledyne T640x
NCore, NATTS, and PAMS Pollutants			
VOCs	4	Intermittent	Xontech
VOCs	1	Continuous	CAS Chromatotec AirmOzone Auto-GC
Carbonyls	4	Intermittent	ATEC 2200
PAHs	2	Intermittent	Tisch PUF
Metals	1	Intermittent	Thermo 2025i
Speciation	2	Intermittent	MetOne SuperSass and URG-3000N
NO_2 CAPS	1	Continuous	Teledyne T500U
NOy	3	Continuous	Teledyne T200U
Other Particle Pollutants			
$PM_{0.1}$ (UFP)	4	Continuous	TSI 3783
Black Carbon	7	Continuous	Magee AE33 or MetOne C-12
Meteorological Parameters			
WS/WD	13	Continuous	MetOne 010C / 020D or RM Young 820457
RH	13	Continuous	MetOne 083E-1-35
BP	13	Continuous	MetOne 092
Solar	13	Continuous	MetOne 096-1
Temperature	13	Continuous	MetOne 083E-1-35
UV	1	Continuous	Kipp & Zonen SUV5-V
Precipitation	1	Continuous	MetOne 375D

NCore = National Core
NATTS = National Air Toxics Trends Stations
PAMS = Photochemical Assessment Monitoring Stations
VOCs = volatile organic compounds
Auto-GC = Automated Gas Chromatography
PAHs = polyaromatic hydrocarbons
PUF = poly urethane filters
CAPS = Cavity Attenuated Phase Shift
UFP = Ultrafine Particles
WS/WD = Wind speed / Wind direction
RH = Relative humidity
BP = Barometric pressure
Solar = Solar radiation
UV = Ultraviolet radiation

MassDEP operates “continuous” and “intermittent” monitors. Continuous monitors sample and measure air quality 24 hours per day and generally report out hourly averages of individual pollutants. In general, monitors process automated analysis minute by minute and roll the measurements into an hourly average.

Intermittent monitors obtain discrete samples that are collected by staff and brought to a laboratory for analysis; examples include VOC canisters, carbonyl cartridges and $PM_{2.5}$ filter samples. Depending on the regulatory or analytical requirements, samples may be obtained every day, every third day, every sixth day, or on some other prescribed schedule. The data are averaged in 8-hour or 24-hour intervals based on EPA requirements for each specific pollutant.

MassDEP is moving toward greater reliance on automated methods such as continuous $PM_{2.5}$ monitors and automated gas chromatography (Auto-GC) for VOCs where possible. Advantages of automated analysis in the field include near real-time reporting of ambient air quality data to the public using data loggers and telemetry systems, a continuous record of air quality data 24 hours per day, and fewer labor hours spent retrieving and analyzing samples. However, continuous monitors are expensive, usually require climate-controlled shelters (unlike intermittent samplers that can be placed on rooftops or compact spaces), and can more easily break (requiring back-up equipment).

2.2 Quality Control and Quality Assurance

Whether measurements are continuous or intermittent, all analyzers must be tested to ensure data validity, accuracy and precision, and to ensure that the analyzer is operating properly and can be expected to continue to operate in an acceptable manner. A large portion of MassDEP monitoring staff time is spent calibrating equipment, challenging equipment performance in the field, and reviewing the quality of air monitoring data.

AAB has an active, independent Quality Assurance (QA) Section ensuring that proper data collection and analysis procedures are followed, equipment is maintained appropriately, and equipment is calibrated properly using the appropriate test gases. This QA Section performs periodic performance and systems audits at air monitoring sites throughout the network. This is essential to operating the monitoring network, analyzing samples, and producing air data of sufficient quality to satisfy the needs of users.

2.3 Monitor Siting

Appendix D of 40 CFR Part 58 defines spatial monitoring scales that are useful in describing the purpose of individual monitors at specific locations:

- **Micro scale** – Concentrations in air volumes associated with area dimensions ranging from several meters up to about 100 meters. An example is the Boston – Kenmore NOx located near major roadways and within street canyons, where the influence of emissions is not expected to spread much beyond the immediate area.

- **Middle scale** – Concentrations typical of areas up to several city blocks in size with dimensions ranging from about 100 meters to 0.5 kilometers. Monitors at this scale characterize local conditions, similar to micro scale, but for a larger surrounding area. Examples include urban PM_{10} monitors.
- **Neighborhood scale** – Concentrations within some extended area of the city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometers range. This might be an urban area influenced by a major point source or area sources or the air quality surrounding a defined area of similar conditions. Boston – Harrison Avenue is an example of an urban neighborhood.
- **Urban scale** – Overall, citywide conditions with dimensions on the order of 4 to 50 kilometers. This scale would usually require more than one monitoring site. Ozone networks around Boston, Worcester and Springfield are partially laid out on an urban scale.
- **Regional** – Usually a rural area of reasonably homogeneous geography that extends from tens to hundreds of kilometers. Examples include monitors in Fairhaven, Uxbridge and Truro.

In general, Massachusetts air monitoring stations are sited to characterize one of the following:

- highest expected concentration in an area
- general background levels
- general population exposure
- welfare impacts
- pollutant transport

Most MassDEP monitoring activities are mandated by EPA regulations and guidelines, and MassDEP works very closely with EPA to make sure that Federal air monitoring initiatives are implemented in Massachusetts.

Monitoring Site Details

A full list of the Massachusetts monitor locations, when they were established, their purpose, what they measure, and the equipment used are presented in Figures 2-3 through 2-6.

Figure 2-3: Air Monitoring Site Locations				
Site ID	Site Name	County	Address	City / Town
25-025-0045	Boston - Chinatown	Suffolk	125 Kneeland Street	Boston
25-025-0002	Boston - Kenmore	Suffolk	Kenmore Square	Boston
25-025-0042	Boston - Harrison Ave	Suffolk	1159 Harrison Avenue	Boston
25-025-0044	Boston - Von Hillern	Suffolk	19 Von Hillern Street	Boston
25-023-0005	Brockton	Plymouth	170 Clinton Street	Brockton
25-017-0009	Chelmsford - EPA	Middlesex	11 Technology Drive	Chelmsford
25-017-0010	Chelmsford - Near Road	Middlesex	Manning Road	Chelmsford
25-025-1004	Chelsea	Suffolk	Highland Park	Chelsea
25-013-0008	Chicopee	Hampden	Anderson Road	Chicopee
25-005-1006	Fairhaven	Bristol	30 School Street	Fairhaven
25-005-1004	Fall River	Bristol	659 Globe Street	Fall River
25-017-0011	Framingham	Middlesex	110 Western Avenue	Framingham
25-011-2005	Greenfield	Franklin	16 Barr Avenue	Greenfield
25-009-5006	Haverhill - HS	Essex	685 Washington Street	Haverhill
25-009-2006	Lynn	Essex	390 Parkland	Lynn
25-021-3003	Milton - Blue Hill	Norfolk	1904 Canton Avenue	Milton
25-003-6001	North Adams	Berkshire	86 Holden Street	North Adams
25-003-0008	Pittsfield	Berkshire	25 Silver Lake Blvd	Pittsfield
25-009-2007	Saugus	Essex	Bristow Street	Saugus
25-013-0018	Springfield	Hampden	600 Liberty Street	Springfield
25-001-0002	Truro	Barnstable	6 Collins Road	Truro
25-027-0024	Uxbridge	Worcester	366 E. Hartford Avenue	Uxbridge
25-015-4002	Ware	Hampshire	Quabbin Hill Road	Ware
25-021-2005	Weymouth	Norfolk	59 Monatiquot Street	Weymouth
25-027-0015	Worcester - Airport	Worcester	375 Airport Drive	Worcester
25-027-0023	Worcester - Summer St	Worcester	260 Asylum Street	Worcester
25-007-0001	Aquinnah	Dukes	1 Herring Creek Road	Martha’s Vineyard

Figure 2-4: Air Monitoring Site Descriptions					
Site ID	**Site Name**	**Scale**	**Reason for the Monitor**	**Established**	**MSA/MiSA**
25-025-0045	Boston - Chinatown	Neighborhood	Population Exposure	4/1/2023	Boston-Cambridge-Newton MSA
25-025-0002	Boston - Kenmore	Neighborhood/Micro	Highest Concentration; Population Exposure	1/1/1965	Boston-Cambridge-Newton MSA
25-025-0042	Boston - Harrison Ave	Neighborhood	Population Exposure	12/15/1998	Boston-Cambridge-Newton MSA
25-025-0044	Boston - Von Hillern	Middle	Population Exposure; Highest Concentration	6/15/2013	Boston-Cambridge-Newton MSA
25-023-0005	Brockton	Urban/Neighborhood	Population Exposure	6/30/2013	Boston-Cambridge-Newton MSA
25-017-0009	Chelmsford - EPA	Neighborhood	Population Exposure	4/1/2005	Boston-Cambridge-Newton MSA
25-017-0010	Chelmsford - Near Road	Middle	Population Exposure	7/1/2018	Boston-Cambridge-Newton MSA
25-025-1004	Chelsea	Neighborhood	Population Exposure	4/1/2021	Boston-Cambridge-Newton MSA
25-013-0008	Chicopee	Urban	Population Exposure	1/1/1983	Springfield MSA
25-005-1006	Fairhaven	Regional	Population Exposure	6/30/2013	Providence-Warwick MSA
25-005-1004	Fall River	Neighborhood	Population Exposure	2/1/1975	Providence-Warwick MSA
25-017-0011	Framingham	Urban	Population Exposure	1/1/2025	Boston-Cambridge-Newton MSA
25-011-2005	Greenfield	Regional/Neighborhood	Population Exposure	1/1/2014	Greenfield Town MiSA
25-009-5006	Haverhill - HS	Regional/Neighborhood	Population Exposure	7/19/1994	Boston-Cambridge-Newton MSA
25-009-2006	Lynn	Urban/Neighborhood	PAMS - Max Precursor O_3; Population Exposure	1/1/1992	Boston-Cambridge-Newton MSA
25-021-3003	Milton - Blue Hill	Regional	Upwind Background $PM_{2.5}$; Highest O_3	4/2/2002	Boston-Cambridge-Newton MSA
25-003-6001	North Adams	Neighborhood	Population Exposure	7/1/2017	Pittsfield MSA
25-003-0008	Pittsfield	Regional/Neighborhood	Population Exposure	7/1/2018	Pittsfield MSA
25-009-2007	Saugus	Urban	Population Exposure	2025*	Boston-Cambridge-Newton MSA
25-013-0018	Springfield	Urban	Highest Concentration; Population Exposure	5/1/2018	Springfield MSA
25-001-0002	Truro	Regional	General Background	4/1/1987	Barnstable Town MSA
25-027-0024	Uxbridge	Regional	Ozone Transport; Population Exposure	11/1/2008	Worcester MSA
25-015-4002	Ware	Urban	Maximum O_3; Background other pollutants	6/1/1985	Springfield MSA
25-021-2005	Weymouth	Neighborhood	Population Exposure	3/30/2021	Boston-Cambridge-Newton MSA
25-027-0015	Worcester - Airport	Urban	Population Exposure	5/7/1979	Worcester MSA
25-027-0023	Worcester - Summer St	Urban/Middle	Population Exposure	1/1/2004	Worcester MSA
25-007-0001	Aquinnah	Regional	Regional	4/1/2004	Vineyard Haven MiSA

MSA = Metropolitan Statistical Area
MiSA = Micropolitan Statistical Area
* As of the date of this Assessment, the Saugus monitoring station still requires electrical power to begin operating.

Figure 2-5: Site Parameters			
Site ID	**Site Name**	**Meteorological**	**Pollutants**
25-025-0045	Boston - Chinatown	None	$PM_{2.5}$, $PM_{0.1}$
25-025-0002	Boston - Kenmore	None	SO_2, NO_2, $PM_{2.5}$
25-025-0042	Boston - Harrison Ave	WS/WD, TEMP, RH, BP, SOLAR	O_3, SO_2, NO_2, NOy, CO, PM_{10}, $PM_{2.5}$, PM_{Coarse}, $PM_{2.5}$Speciation, Black Carbon, VOCs, Carbonyls
25-025-0044	Boston - Von Hillern	WS/WD, TEMP, RH, BP, SOLAR	NO_2, CO, $PM_{2.5}$, $PM_{0.1}$, Black Carbon
25-023-0005	Brockton	None	O_3, $PM_{2.5}$
25-017-0009	Chelmsford - EPA	None	O_3
25-017-0010	Chelmsford - Near Road	None	NO_2, $PM_{2.5}$, $PM_{0.1}$, Black Carbon
25-025-1004	Chelsea	None	$PM_{2.5}$, VOCs, Carbonyls
25-013-0008	Chicopee	WS/WD, TEMP, RH, BP, SOLAR	O_3, NO_2, $PM_{2.5}$, $PM_{2.5}$Speciation
25-005-1006	Fairhaven	WS/WD, TEMP, RH, BP, SOLAR	O_3
25-005-1004	Fall River	None	O_3, SO_2, $PM_{2.5}$
25-017-0011	Framingham	None	$PM_{2.5}$, Black Carbon
25-011-2005	Greenfield	WS/WD, TEMP, RH, BP, SOLAR	O_3, $PM_{2.5}$, Black Carbon
25-009-5006	Haverhill - HS	WS/WD, TEMP, RH, BP, SOLAR	O_3, $PM_{2.5}$
25-009-2006	Lynn	WS/WD, TEMP, RH, BP, SOLAR, UV, PRECIP	O_3, NO_2, NOy, $PM_{2.5}$, VOCs, Carbonyls
25-021-3003	Milton - Blue Hill	TEMP, RH, BP, SOLAR	O_3, NO_2
25-003-6001	North Adams	None	$PM_{2.5}$, Black Carbon
25-003-0008	Pittsfield	WS/WD, TEMP, RH, BP, SOLAR	O_3, NO_2, $PM_{2.5}$, Black Carbon
25-009-2007	Saugus	None	$PM_{2.5}$, PM_{10}, Black Carbon
25-013-0018	Springfield	None	SO_2, NO_2, $PM_{2.5}$, $PM_{0.1}$, Black Carbon
25-001-0002	Truro	WS/WD, TEMP, RH, BP, SOLAR	O_3
25-027-0024	Uxbridge	WS/WD, TEMP, RH, BP, SOLAR	O_3, PM_{10}, $PM_{2.5}$
25-015-4002	Ware	WS/WD, TEMP, RH, BP, SOLAR	O_3, SO_2, NO_2, NOy, PM_{10}, $PM_{2.5}$
25-021-2005	Weymouth	WS/WD, TEMP, RH, BP, SOLAR	O_3, NO_2, $PM_{2.5}$, VOCs, Carbonyls
25-027-0015	Worcester - Airport	WS/WD, TEMP, RH, BP, SOLAR	O_3
25-027-0023	Worcester - Summer St	None	SO_2, NO_2, CO, PM_{10}, $PM_{2.5}$
25-007-0001	Aquinnah	None	O_3

Figure 2-6: Sampling and Analytical Methods				
Parameter	**Sample Method**	**Analytical Method**	**Sample Frequency**	**Program(s)**
O_3	Continuous monitor	UV Light Photometry	Continuous / Hourly	SLAMS
CO	Continuous monitor	GFC; NDIR Detection	Continuous / Hourly	SLAMS
SO_2	Continuous monitor	UV Fluorescence	Continuous / Hourly	SLAMS
NO/NO_2/NOx	Continuous monitor	Chemiluminescence	Continuous / Hourly	SLAMS
NO/NO_2/NOx	Continuous monitor	CAPS Spectroscopy	Continuous / Hourly	PAMS
NOy	Continuous monitor	Chemiluminescence	Continuous / Hourly	SLAMS
Lead	Low Volume PM_{10}	ICP/MS x-ray fluorescence	One 24-hr sample every 6 days	NATTS
PM_{10}	Size Selective, Low Volume	Gravimetric	One 24-hr sample every 6 days	SLAMS
PM_{10}	Continuous monitor	Scattered light spectrometry	Continuous / Hourly	SLAMS
$PM_{2.5}$	Size Selective, Low Volume	Gravimetric	One 24-hr sample every 3 to 6 days	SLAMS FRM
$PM_{2.5}$	Continuous monitor	Scattered light spectrometry	Continuous / Hourly	SLAMS
$PM_{2.5}$Speciation	Low Volume; Size Selective	ICP/MS x-ray fluorescence, Ion chromatography	One 24-hr sample every 3 days	NCore
$PM_{2.5}$Speciation	Low Volume; Size Selective	IMPROVE Protocol	One 24-hr sample every 6 days	IMPROVE
Black Carbon	Continuous monitor	Optical transmittance	Continuous / Hourly	SLAMS
Black Carbon	Continuous monitor	Optical attenuation	Continuous / Hourly	SLAMS
$PM_{0.1}$	Continuous monitor	Condensation particle counter	Continuous / Hourly	SLAMS
Metals	Low Volume PM_{10}	ICP/MS x-ray fluorescence	One 24-hr sample every 6 days	NATTS
PAHs	Quartz Filter, PUF Cartridge	GC/MS	One 24-hr sample every 6 days	NATTS
VOCs	Sub-ambient trapping	Auto-GC	Hourly	PAMS
VOCs	Passivated Canister	GC/MS	One 24-hr sample every 6 days	NATTS/PAMS
Carbonyls	DNPH on Silica Gel Traps	HPLC	One 24-hr sample every 6 days	NATTS
Carbonyls	DNPH on Silica Gel Traps	HPLC	Eight 3-hr samples every 3rd day	PAMS
Wind Speed/Direction	Continuous monitor	Ultrasonic Sensors	Hourly	SLAMS
Solar	Continuous monitor	Pyranometer	Hourly	SLAMS
Relative Humidity	Continuous monitor	Electronic Sensor	Hourly	SLAMS
Ambient Temperature	Continuous monitor	Electronic Thermistor	Hourly	SLAMS
Barometric Pressure	Continuous monitor	Electronic Sensor	Hourly	SLAMS
Precipitation	Continuous monitor	Tipping Bucket	Hourly	PAMS
Boundary Layer	Continuous monitor	Pulsed Diode Lidar	Hourly	PAMS

O_3 = Ozone
UV = Ultraviolet
CO = Carbon Monoxide
GFC = Gas Filter Correlation
NDIR = Non-Dispersive Infrared
SO_2 = Sulfur Dioxide
NO/NO_2/NOx = Nitric Oxide/Nitrogen Dioxide/Nitrogen Oxides
CAPS = Cavity Attenuated Phase Shift
PAMS = Photochemical Assessment Monitoring Stations
NOy = Total Reactive Oxidized Nitrogen
ICP = Inductively Coupled Plasma
MS = Mass Spectrometry
VOCs = Volatile Organic Compounds
Auto-GC = Automated Gas Chromatography
PAHs = Polycyclic Aromatic Hydrocarbons
PUF = Polyurethane Foam
GC/MS = Gas Chromatography Mass Spectrometry
NATTS = National Air Toxics Trends Station
DNPH = Dinitrophenylhydrazine
HPLC = High Performance Liquid Chromatography

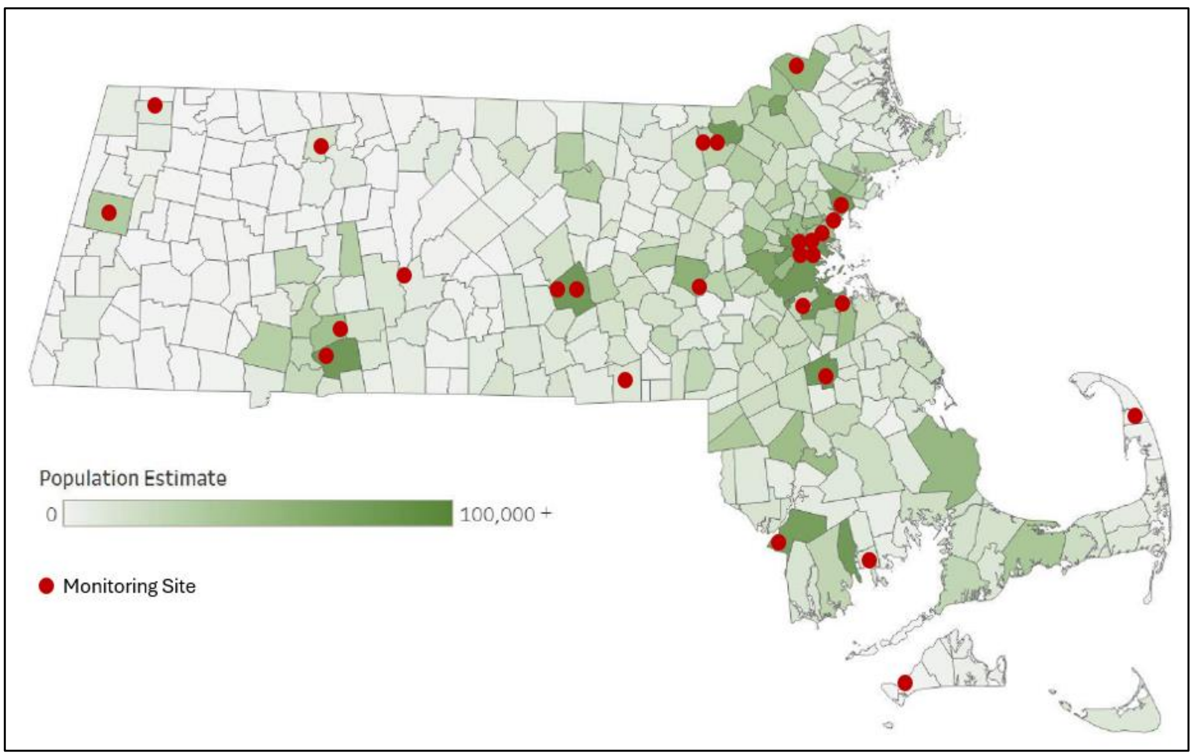
Section 3 – Massachusetts Population

MassDEP believes the air monitoring network is appropriately designed given the demographic, spatial, and health characteristics of the Massachusetts population:

- There have been no major population shifts in Massachusetts in the past 5 years. The shifts that have occurred have moved populations closer to areas with existing monitors (e.g., urban areas).
- Sensitive populations are adequately covered by air monitoring, and pollutant levels are well below NAAQS.
- EJ areas are well covered by air monitors.

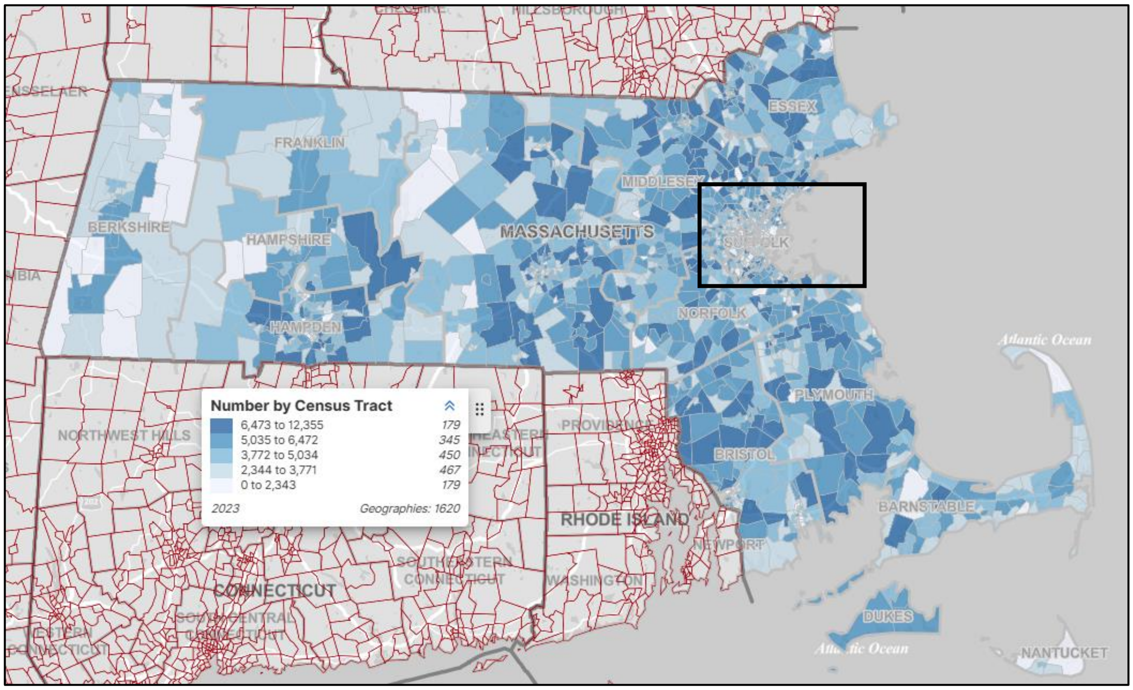
The U.S. Census Bureau estimates that as of 2023, Massachusetts had just over 7 million inhabitants in 351 towns/cities and 14 counties. Most of the population is concentrated in the Boston metropolitan area, with additional concentrations in the Springfield and Worcester areas as shown in Figure 3-1.

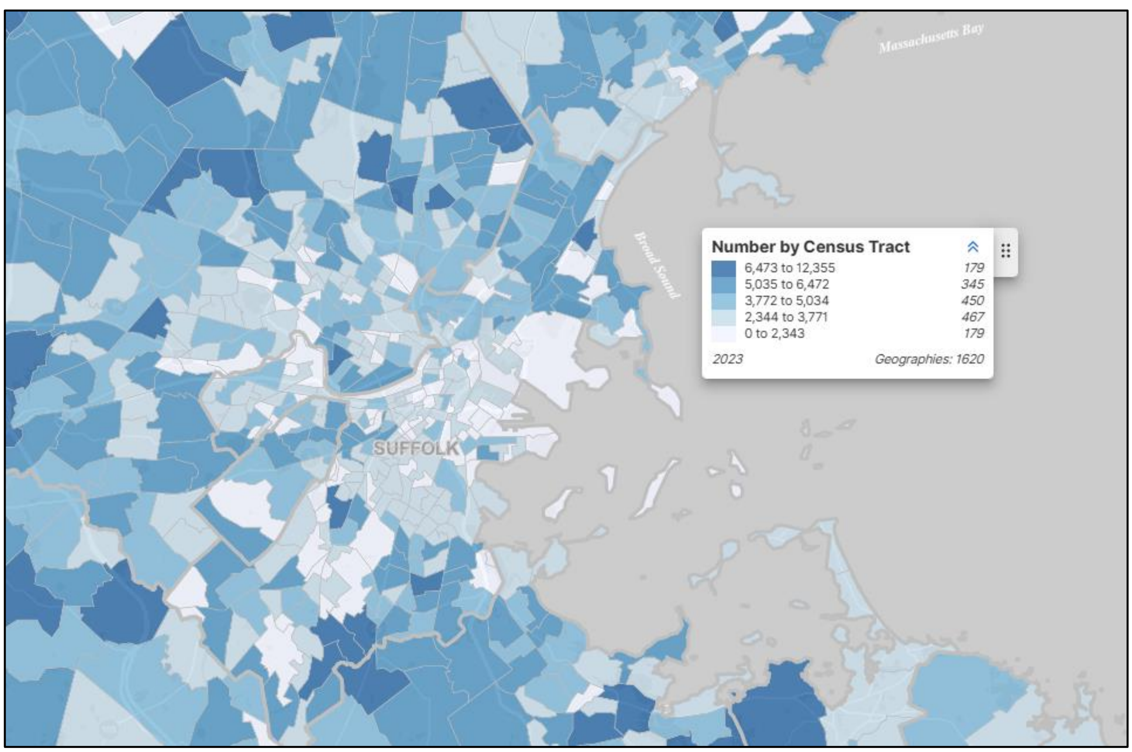
Figure 3-1
2023 Estimated Population of Massachusetts Municipalities with Air Monitoring Stations



US Census - Annual Estimates of the Resident Population for Minor Civil Divisions in Massachusetts: April 1, 2020 to July 1, 2023

Figure 3-1.1
Total Population in 2023 by Census Tract





Source: U.S. Census Bureau, 2019-2023 American Community Survey 5-Year Estimates
https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_B01003&prodType=table

3.1 Population Growth

The U.S. Census Bureau estimates that Massachusetts' population has grown by approximately 4.4% percent between 2015 and 2023, with the largest percent increases in Dukes and Nantucket counties (see Figure 3-2). Three rural areas (Berkshire, Franklin and Hampden counties) experienced minor population decreases. However, because the total growth in all counties has been small, no county's proportional share of the total statewide population changed by more than ±0.4% between 2015 and 2023.

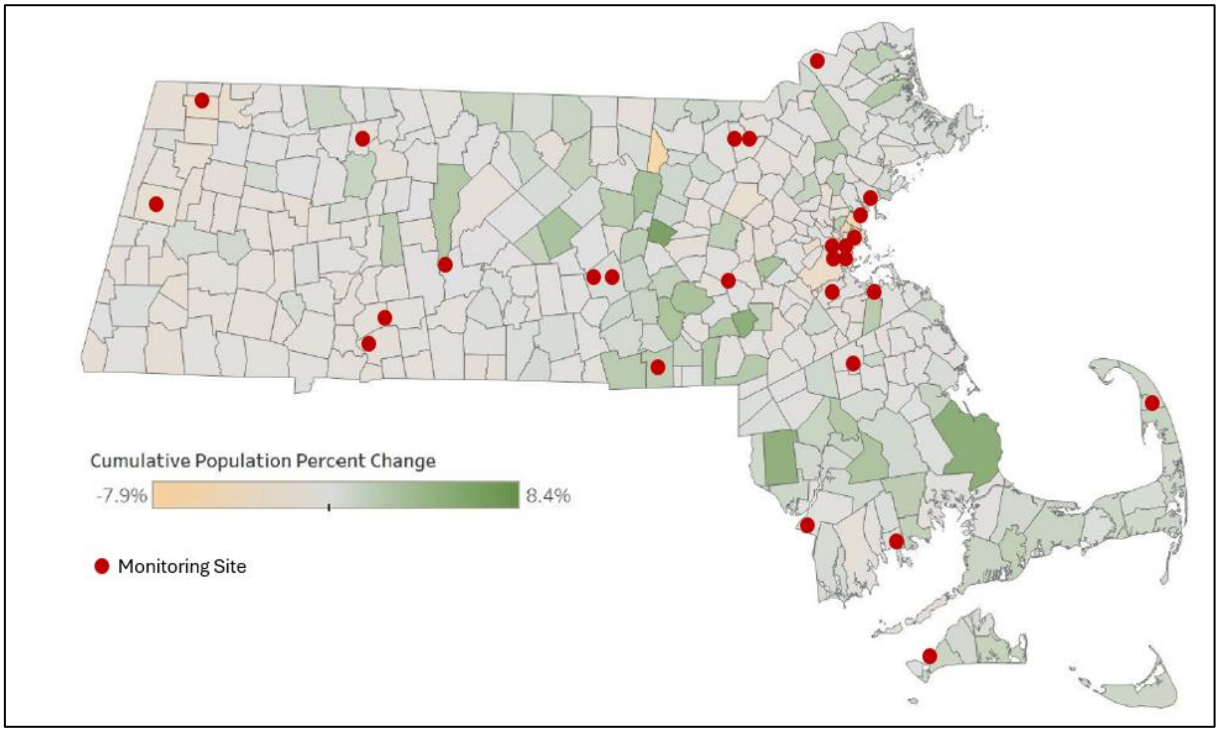
Figure 3-2
Massachusetts Population Change 2015 – 2023

	Population			% of State Population			Change 2015 – 2023	
County	2015	2020	2023	2015	2020	2023	Total	%
Barnstable	214,766	213,505	231,735	3.2%	3.1%	3.3%	16,969	7.9%
Berkshire	129,288	125,927	126,818	1.9%	1.8%	1.8%	-2,470	-1.9%
Bristol	552,763	563,301	581,841	8.2%	8.2%	8.3%	29,078	5.3%
Dukes	17,048	17,430	20,819	0.3%	0.3%	0.3%	3,771	22.1%
Essex	763,849	787,038	810,089	11.4%	11.5%	11.6%	46,240	6.1%
Franklin	71,144	70,529	70,836	1.1%	1.0%	1.0%	-308	-0.4%
Hampden	468,041	466,647	460,291	7.0%	6.8%	6.6%	-7,750	-1.7%
Hampshire	160,759	161,361	162,502	2.4%	2.3%	2.3%	1,743	1.1%
Middlesex	1,556,116	1,605,899	1,623,952	23.2%	23.4%	23.2%	67,836	4.4%
Nantucket	10,556	11,212	14,444	0.2%	0.2%	0.2%	3,888	36.8%
Norfolk	687,721	703,740	727,473	10.3%	10.2%	10.4%	39,752	5.8%
Plymouth	503,681	518,597	535,308	7.5%	7.5%	7.6%	31,627	6.3%
Suffolk	758,919	801,162	768,425	11.3%	11.7%	11.0%	9,506	1.3%
Worcester	810,935	826,655	866,866	12.1%	12.0%	12.4%	55,931	6.9%
Total	6,705,586	6,873,003	7,001,399	100.0%	100.0%	100.0%	295,813	4.4%

Source: U.S. Census Bureau, American Community Survey, Total Population Estimates: January 1, 2015 to December 31, 2023

Figure 3-3 shows population change at the municipal level from 2020 to 2023. The figure shows modest population changes, including slight decreases in the Boston metro area and Western Massachusetts, and scattered increases around the state. Generally, these changes would not indicate a need to reconfigure the network, and areas showing population growth have adequate monitoring coverage.

Figure 3-3
Massachusetts Population Change 2020 – 2023



Source: Annual Estimates of the Resident Population for Minor Civil Divisions in Massachusetts: April 1, 2020 to July 1, 2023 (SUB-MCD-EST2023-POP-25). U.S. Census Bureau, Population Division. May 16, 2024
https://donahue.umass.edu/business-groups/economic-public-policy-research/massachusetts-population-estimates-program/population-estimates-by-massachusetts-geography/by-city-and-town

MassDEP used EPA's Population Served Network Assessment Tool and NetAssess2025 (https://rconnect-public.epa.gov/NetAssess2025/) to calculate the population served by each monitor. These tools compute shapes known as Voronoi or Thiessen polygons that are used as an indicator of the area served by each monitor. A Voronoi polygon is the shape formed by the line connecting the points equidistant between a given monitor and each of the other monitors closest to it. The area within the shape created by the lines surrounding the monitor is geographically closer to that monitor than to any other monitor in the network and is therefore considered an approximation of its coverage area. Note that this is a mathematical construct. Geographic features such as hills or valleys, manmade features such as pollution sources, meteorology, and the development pattern of an area could make the actual area represented by a monitor different from its polygon. Nevertheless, these polygons provide a reasonable starting point for looking at the area served by the monitors.

The network assessment tools calculated populations within each polygon and the results are presented in Figures 3-4.1 through 3-7.2 (see Section 5 maps showing the polygons). Note that 2020 was the latest population data available.

Figure 3-4.1
Change in Population in Voronoi Polygon for Each $PM_{2.5}$ Monitor: 2010 to 2020

Site ID	Site Name	Population Served			% of Total Population Served		
		2010	2020	Growth	2010*	2020	Growth
25-025-0045	Boston - Chinatown	NA	103,115	NA	NA	1%	NA
25-025-0042	Boston - Harrison Ave	183,079	333,497	82%	3%	5%	2%
25-025-0002	Boston - Kenmore	883,390	846,998	-4%	15%	12%	-3%
25-025-0044	Boston - Von Hillern	259,286	166,723	-36%	4%	2%	-2%
25-023-0005	Brockton	717,147	791,667	10%	12%	11%	-1%
25-017-0010	Chelmsford - Near Rd	NA	499,147	NA	NA	7%	NA
25-025-1004	Chelsea	NA	284,313	NA	NA	4%	NA
25-013-0008	Chicopee	248,630	236,256	-5%	4%	3%	-1%
25-005-1004	Fall River	386,913	506,581	31%	6%	7%	1%
25-017-0011	Framingham	NA	478,892	NA	NA	7%	NA
25-011-2005	Greenfield	101,945	101,048	-1%	2%	1%	-1%
25-009-5006	Haverhill - HS	NA	455,774	NA	NA	6%	NA
25-009-2006	Lynn	445,800	443,881	0%	7%	6%	-1%
25-003-6001	North Adams	NA	42,344	NA	NA	1%	NA
25-003-0008	Pittsfield	NA	107,370	NA	NA	2%	NA
25-009-2007	Saugus	NA	117,154	NA	NA	2%	NA
25-013-0018	Springfield	NA	394,961	NA	NA	6%	NA
25-027-0024	Uxbridge	NA	245,049	NA	NA	3%	NA
25-015-4002	Ware	117,547	120,003	2%	2%	2%	0%
25-021-2004	Weymouth	NA	300,383	NA	NA	4%	NA
25-027-0023	Worcester - Summer	440,462	574,127	30%	7%	8%	1%

Source: U.S. Census through NetAssess2025 Ambient Air Monitoring Network Assessment Tool

Figure 3-4.2 2020 $PM_{2.5}$ Voronoi Polygon Demographics and $PM_{2.5}$ Exceedance Probabilities							
		2020 Demographics				$PM_{2.5}$ Monitoring	
Site ID	Site Name	Age <15	Age 65+	Sensitive	Minority	Monitor Type	Probability >35 µg/m³
25-025-0045	Boston - Chinatown	8,835	13,833	22,668	41,019	FEM	<10%
25-025-0042	Boston - Harrison Ave	55,834	52,991	108,825	256,965	FEM/FRM	<10%
25-025-0002	Boston - Kenmore	109,016	122,829	231,845	357,643	FEM/FRM	<10%
25-025-0044	Boston - Von Hillern	24,243	22,594	46,837	102,947	FEM	<10%
25-023-0005	Brockton	123,387	167,933	291,320	232,292	FEM	<10%
25-017-0010	Chelmsford - Near Rd	86,103	82,468	168,571	189,975	FEM	<10%
25-025-1004	Chelsea	46,940	36,482	83,422	245,876	FEM	<10%
25-013-0008	Chicopee	32,241	45,197	77,438	106,717	FEM	<10%
25-005-1004	Fall River	78,894	106,606	185,500	149,648	FEM	<10%
25-017-0011	Framingham	86,664	80,905	167,569	153,566	FEM	<10%
25-011-2005	Greenfield	13,914	22,688	36,602	18,745	FEM/FRM	<10%
25-009-5006	Haverhill - HS	78,599	76,896	155,495	251,817	FEM	<10%
25-009-2006	Lynn	72,931	87,195	160,126	184,266	FEM	<10%
25-003-6001	North Adams	5,850	9,505	15,355	6,338	FEM	<10%
25-003-0008	Pittsfield	14,651	27,077	41,728	21,131	FEM	<10%
25-009-2007	Saugus	18,881	21,451	40,332	40,249	FEM	<10%
25-013-0018	Springfield	67,869	69,086	136,955	227,829	FEM/FRM	<10%
25-027-0024	Uxbridge	42,031	40,530	82,561	63,876	FEM	<10%
25-015-4002	Ware	18,628	23,963	42,591	18,958	FEM	<10%
25-021-2004	Weymouth	46,418	58,787	105,205	93,951	FEM	<10%
25-027-0023	Worcester - Summer	95,535	92,356	187,891	261,589	FEM/FRM	<10%

Source: U.S. Census through NetAssess2025 Ambient Air Monitoring Network Assessment Tool

Notes about Figures 3-4.1 and 3-4.2:

- Changes to the $PM_{2.5}$ network since the 2020 assessment:
  - The Chelsea, Chinatown, Framingham, and Saugus sites were added.
  - A $PM_{2.5}$ monitor was added at the Uxbridge site.
  - The Haverhill and Weymouth sites were moved to new locations within the same municipal boundaries.
- Most sites experienced population differences (gains or losses) since 2010. Only one site experienced a difference in the percentage of total population served greater than 2%: Boston – Kenmore (-3%).
- The Boston – Kenmore and Brockton polygons serve the largest populations. Together these two sites account for 23% of the total population served. North Adams serves the smallest population at less than 1% of the total population served.
- The largest change in total population served and population share is at Boston – Roxbury (+150,418 and +82%).

- Sensitive populations at all sites account for between 22% to 39% of the monitors' populations served. Boston – Chinatown showed the lowest sensitive population share (22%), while Pittsfield showed the highest sensitive population share (39%).
- Chelsea serves the highest minority population by percentage (86%) and Boston – Kenmore serves the largest minority population in total (357,643).
- Exceedance Probabilities for each Census Tract in the Continental U.S. have been calculated for Ozone and $PM_{2.5}$. These values represent the probability of a NAAQS exceedance based on Fused Air Quality Surface Using Downscaling (FAQSD) Files developed by EPA. According to these models, all sites in MassDEP's network have very low (<10%) probabilities of exceeding the 24-hour $PM_{2.5}$ NAAQS of 35 µg/m^3.

Figure 3-5.1
Change in Population in Voronoi Polygon for Each Ozone Monitor: 2010 to 2020

Site ID	Site Name	Population Served			% of Total Population Served		
		2010	2020	Growth	2010*	2020	Growth
25-001-0002	Truro	114,294	132,272	16%	2%	2%	0%
25-005-1004	Fall River	195,043	245,090	26%	3%	4%	1%
25-009-2006	Lynn	530,743	707,413	33%	9%	10%	1%
25-013-0008	Chicopee	544,158	551,801	1%	9%	8%	-1%
25-015-4002	Ware	83,452	81,085	-3%	1%	1%	0%
25-021-3003	Milton - Blue Hill	486,526	439,976	-10%	8%	6%	-2%
25-025-0042	Boston - Harrison Ave	1,372,383	1,439,418	5%	22%	21%	-1%
25-027-0015	Worcester - Airport	474,637	513,067	8%	8%	7%	-1%
25-007-0001	Aquinnah	40,167	68,398	70%	1%	1%	0%
25-017-0009	Chelmsford - EPA	465,395	482,359	4%	8%	7%	-1%
25-027-0024	Uxbridge	446,291	491,759	10%	7%	7%	0%
25-005-1006	Fairhaven	265,898	335,798	26%	4%	5%	1%
25-023-0005	Brockton	501,608	462,527	-8%	8%	7%	-1%
25-011-2005	Greenfield	105,142	102,392	-3%	2%	1%	-1%
25-003-0008	Pittsfield	NA	123,145	NA	NA	2%	NA
25-021-2004	Weymouth	NA	272,946	NA	NA	4%	NA
25-009-5006	Haverhill - HS	NA	474,540	NA	NA	7%	NA

Source: U.S. Census through NetAssess2025 Ambient Air Monitoring Network Assessment Tool

Figure 3-5.2 2020 O_3 Voronoi Polygon Demographics and O_3 Exceedance Probabilities						
		2020 Demographics				O_3 Probability of
Site ID	Site Name	Age <15	Age 65+	Sensitive	Minority	Exceeding 70 ppb
25-001-0002	Truro	14,627	44,997	59,624	26,585	<10%
25-005-1004	Fall River	38,740	49,732	88,472	56,118	<10%
25-009-2006	Lynn	115,688	131,143	246,831	318,582	<10%
25-013-0008	Chicopee	88,060	98,229	186,289	318,256	<10%
25-015-4002	Ware	12,611	16,152	28,763	14,243	<10%
25-021-3003	Milton - Blue Hill	77,731	78,634	156,365	170,491	<10%
25-025-0042	Boston - Harrison Ave	195,856	198,759	394,615	833,518	<10%
25-027-0015	Worcester - Airport	84,574	83,826	168,400	229,103	<10%
25-007-0001	Aquinnah	8,381	19,622	28,003	16,332	<10%
25-017-0009	Chelmsford - EPA	84,271	81,194	165,465	181,848	<10%
25-027-0024	Uxbridge	85,984	79,418	165,402	167,530	<10%
25-005-1006	Fairhaven	51,154	72,691	123,845	96,900	<10%
25-023-0005	Brockton	78,952	79,312	158,264	163,959	<10%
25-011-2005	Greenfield	14,150	22,999	37,149	18,858	<10%
25-003-0008	Pittsfield	16,786	30,829	47,615	23,245	<10%
25-021-2004	Weymouth	43,035	52,167	95,202	75,734	<10%
25-009-5006	Haverhill - HS	82,592	79,283	161,875	258,913	<10%

Source: U.S. Census through NetAssess2025 Ambient Air Monitoring Network Assessment Tool

Notes about Figure 3-5:

- Changes to the ozone network since the 2020 assessment:
  - The Weymouth site was added.
  - The Haverhill site was relocated to Haverhill High School.
  - Informational ozone monitoring was discontinued at the Chelmsford Near Road site.
- The Roxbury polygon is significantly larger than all other sites, representing 21% of the total population served. The Aquinnah, Greenfield, and Ware polygons are the smallest, representing about 1% each. The remainder ranged from about 2% to 10%.
- Six sites (Truro, Fall River, Lynn, Aquinnah, Fairhaven, Uxbridge) experienced double-digit positive growth. Lynn experienced the largest growth by total number (176,670).
- Child populations at all sites account for between 11% to 18% of the monitors' populations served, and senior populations ranged between 14% to 34%. Truro showed the largest sensitive population by percentage at 45%. Boston – Harrison Ave shows the largest total number of sensitive receptors (394,615); however, it was also the smallest percentage of sensitive receptors as a percentage of the total population served at 27%.
- Boston – Harrison Ave shows the largest minority population as a total number (833,518) and was tied with Chicopee for largest minority population by percentage (58%).

- All 17 sites show very low probabilities (<10%) of an exceedance of the ozone NAAQS of 70 ppb.

Figure 3-6.1
Change in Population in Voronoi Polygon for Each NO_2 Monitor: 2010 to 2020

Site ID	Site Name	Population Served			% of Total Population Served		
		2010	2020	Growth	2010	2020	Growth
25-009-2006	Lynn	681,639	808,482	19%	12%	10%	-2%
25-013-0008	Chicopee	331,622	261,364	-21%	6%	3%	-3%
25-015-4002	Ware	262,804	272,659	4%	5%	3%	-2%
25-021-3003	Milton - Blue Hill	1,094,820	643,017	-41%	19%	8%	-11%
25-025-0002	Boston - Kenmore	1,091,887	1,020,567	-7%	19%	13%	-6%
25-025-0042	Boston – Harrison Ave	186,988	206,584	10%	3%	3%	0%
25-027-0023	Worcester - Summer	799,807	955,763	19%	14%	12%	-2%
25-025-0044	Boston - Von Hillern	429,349	302,240	-30%	7%	4%	-3%
25-013-0018	Springfield	NA	394,961	NA	NA	5%	5%
25-017-0010	Chelmsford - Near Rd	NA	834,726	NA	NA	10%	10%
25-003-0008	Pittsfield	NA	1,407,240	NA	NA	18%	18%
25-021-2004	Weymouth	NA	850,058	NA	NA	11%	11%

Source: U.S. Census through NetAssess2025 Ambient Air Monitoring Network Assessment Tool

Figure 3-6.2
2020 NO_2 Voronoi Polygon Demographics

Site ID	Site Name	2020 Demographics			
		Age < 15	Age 65+	Sensitive	Minority
25-009-2006	Lynn	129,442	157,469	286,911	304,682
25-013-0008	Chicopee	35,501	51,215	86,716	111,534
25-015-4002	Ware	40,957	56,614	97,571	41,820
25-021-3003	Milton - Blue Hill	113,573	110,496	224,069	285,954
25-025-0002	Boston - Kenmore	133,878	146,214	280,092	458,385
25-025-0042	Boston - Harrison Ave	34,456	28,785	63,241	189,043
25-027-0023	Worcester – Summer	161,076	155,918	316,994	378,883
25-025-0044	Boston - Von Hillern	42,307	37,526	79,833	229,787
25-013-0018	Springfield	67,869	69,086	136,955	227,829
25-017-0010	Chelmsford - Near Rd	147,923	136,589	284,512	437,159
25-003-0008	Pittsfield	218,352	283,919	502,271	383,445
25-021-2004	Weymouth	125,370	193,641	319,011	191,033

Source: U.S. Census through NetAssess2025 Ambient Air Monitoring Network Assessment Tool

Notes about Figure 3-6:

- Changes to the NO_2 network since the 2020 assessment:
  - The Weymouth site was added.
  - An NO_2 monitor was added to the Pittsfield site.

- Child populations at all sites account for between 13% to 18% of the populations served, and senior populations ranged between 12% to 23%. Weymouth shows the largest sensitive population by percentage at 38%; however, Pittsfield shows the largest sensitive population by total number (502,271).
- Boston – Harrison Ave shows the largest population of minorities by percentage (92%); however, Boston – Kenmore shows the largest by total number (458,385).
- The population share for individual monitors may not be as significant for NO_2 as traffic counts and congestion, since NO_2 is primarily a mobile source pollutant in Massachusetts, which limits the utility of the polygon analysis for NO_2.

Figure 3-7.1
Change in Population in Voronoi Polygon for Each SO_2 Monitor: 2010 to 2020

Site ID	Site Name	Population Served			% Total Population Served		
		2010	2020	Growth	2010	2020	Growth
25-005-1004	Fall River	720,610	943,872	31%	13%	14%	1%
25-015-4002	Ware	223,576	249,798	12%	4%	4%	0%
25-025-0002	Boston - Kenmore	1,845,482	2,008,060	9%	34%	29%	-5%
25-025-0042	Boston - Harrison Ave	1,181,913	1,399,449	18%	22%	20%	-2%
25-027-0023	Worcester - Summer	833,068	940,206	13%	15%	14%	-1%
25-013-0018	Springfield	607,176	1,375,968	127%	11%	20%	9%

Source: U.S. Census through NetAssess2025 Ambient Air Monitoring Network Assessment Tool

Figure 3-7.2
2020 SO_2 Voronoi Polygon Demographics

Site ID	Site Name	2020 Demographics			
		Age < 15	Age 65+	Sensitive	Minority
25-005-1004	Fall River	138,361	216,975	355,336	236,862
25-015-4002	Ware	34,470	48,425	82,895	50,880
25-025-0002	Boston - Kenmore	304,481	319,708	624,189	899,929
25-025-0042	Boston - Harrison Ave	223,858	237,462	461,320	711,467
25-027-0023	Worcester - Summer	157,797	153,988	311,785	365,969
25-013-0018	Springfield	223,856	249,646	473,502	747,903

Source: U.S. Census through NetAssess2025 Ambient Air Monitoring Network Assessment Tool

Notes about Figure 3-7:

- There are no changes to the SO_2 network since the 2020 assessment.
- Springfield shows a significant change in population (+127%) compared to 2010. This may be due to changes in Connecticut's monitoring network. According to the NetAssess2025 tool, the Springfield polygon covers a large portion of Connecticut, including portions of Hartford.

- Child populations at all sites account for between 14% to 17% of the populations served, and senior populations ranged between 16% to 23%. Boston - Kenmore shows the largest sensitive population by total number (624,189); however, all show sensitive populations in the range of 31% to 38% of populations served.
- Springfield and Boston – Harrison Ave show the largest population of minorities by percentage (54% and 51%); however, Boston – Kenmore shows the largest by total number (899,929).
- The population share for individual monitors may not be as significant for SO_2 as the location of large stationary sources since SO_2 is primarily a point source pollutant, which limits the utility of the polygon analysis.

Since Massachusetts' population distribution has remained largely stable since 2010 and no significant shifts are expected in the future, MassDEP does not believe that it needs to change its network design based on population distribution.

3.2 Sensitive Populations

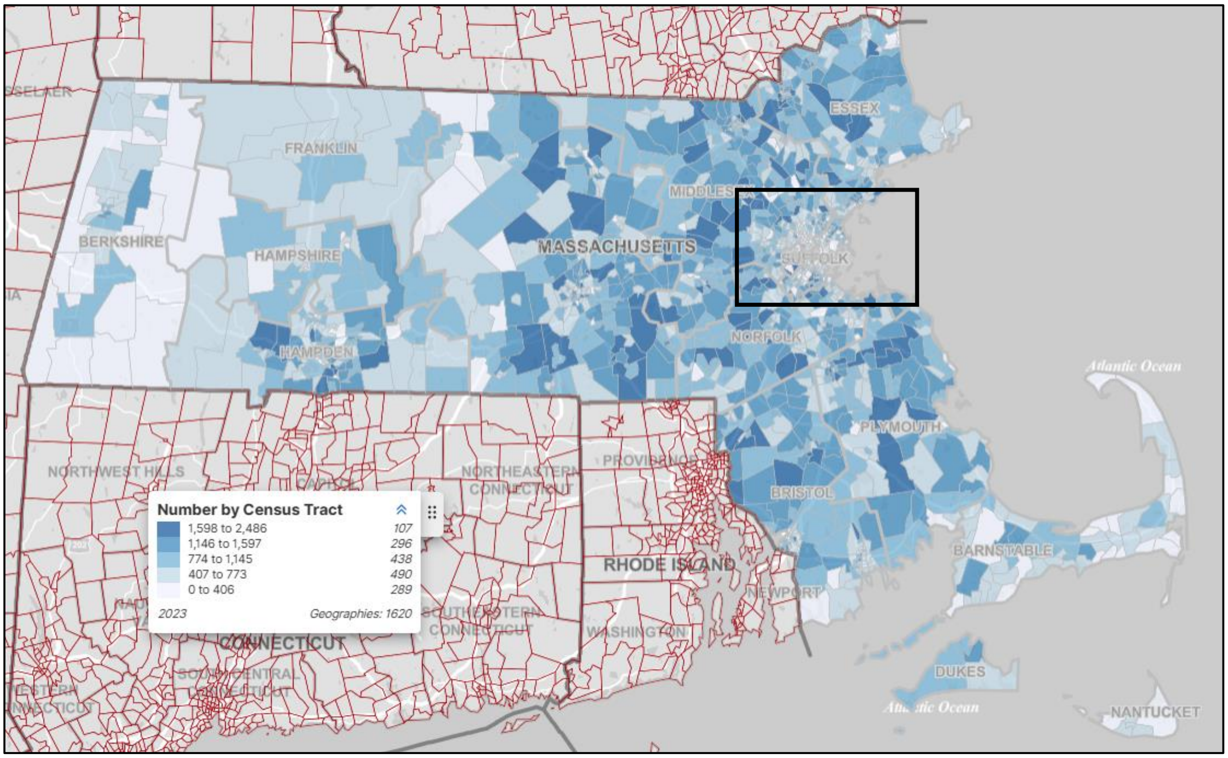
Children

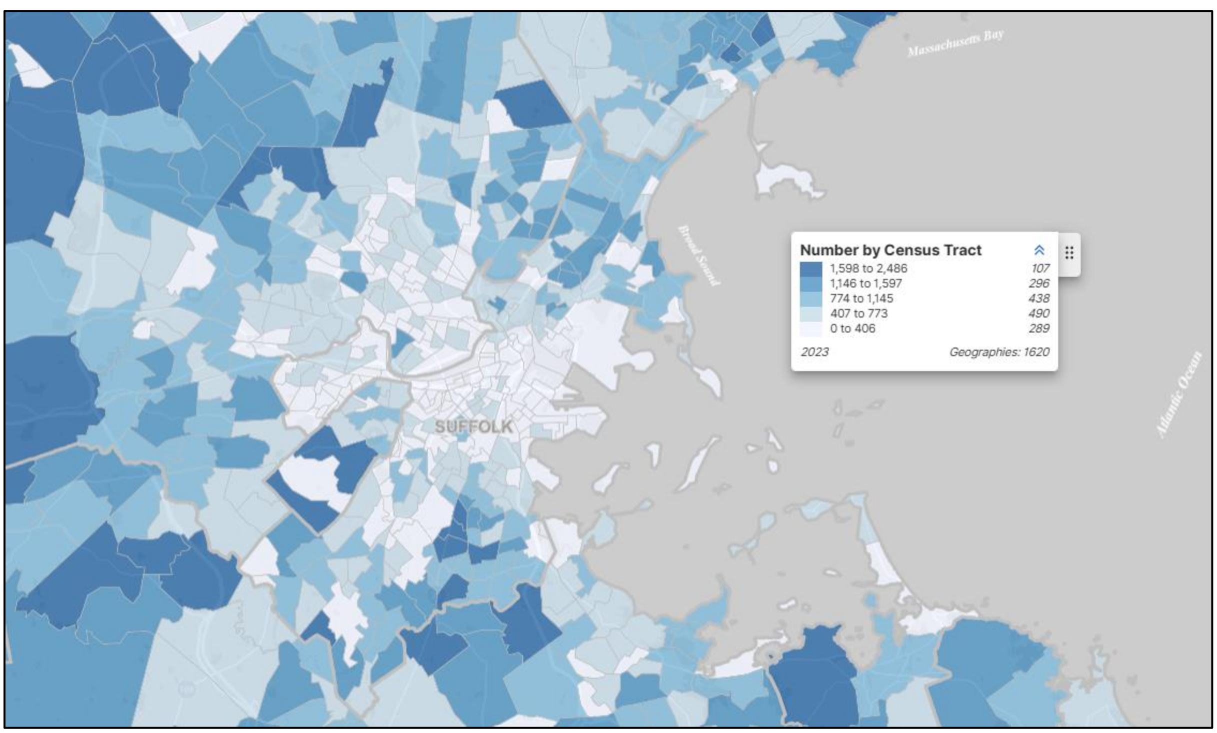
The U.S. Census estimates that in 2023 there were 1,341,439 persons under the age of 18 years in Massachusetts comprising 19.2% of the population (down from about 21% in 2013). Figure 3-8 shows the distribution of children by census tract for the state and Boston area. This distribution of children closely matches that of the general population. Figure 3-9 shows asthma prevalence in children throughout the state. Because the state is well covered by ozone and $PM_{2.5}$ monitors, the monitoring network provides good coverage for where children live and where pediatric asthma prevalence may be higher.

Elderly

The U.S. Census estimates that in 2023 there were 1,292,884 persons 65 years or older in Massachusetts comprising about 18.5% of the population. Figure 3-10 shows the distribution of elders by census tract for the state and Boston area. This distribution closely matches that of the general population as shown in Figure 3-1.1. Because the state is well covered by ozone and $PM_{2.5}$ monitors, the monitoring network provides good coverage for where persons 65 years or older live.

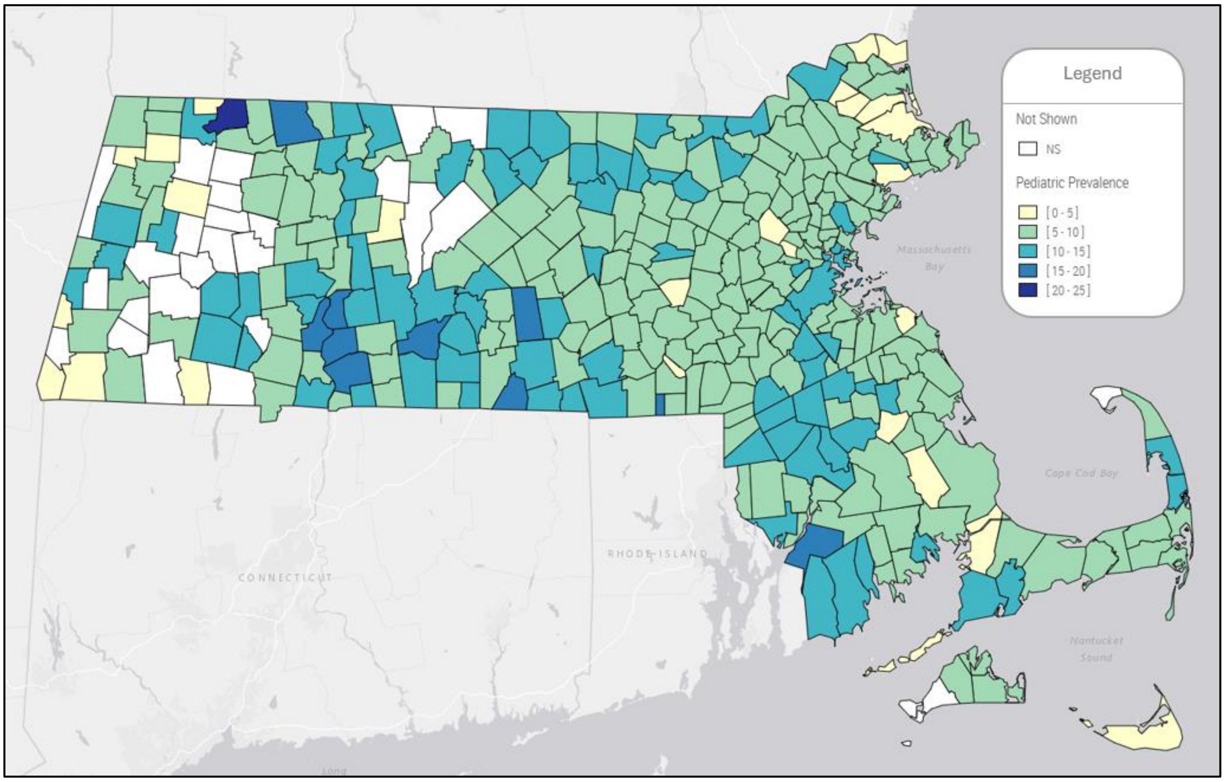
Figure 3-8
Children Under 18 Years in 2023 by Census Tract





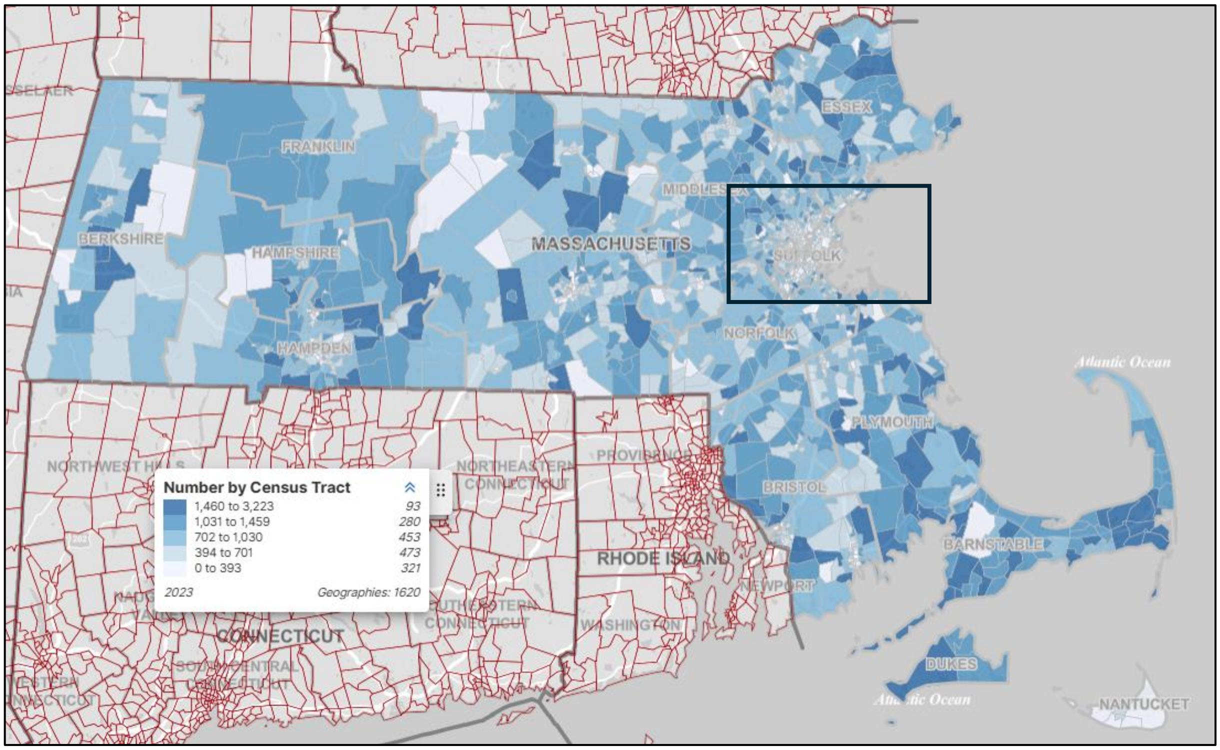
Source: U.S. Census Bureau, 2019-2023 American Community Survey 5-Year Estimates

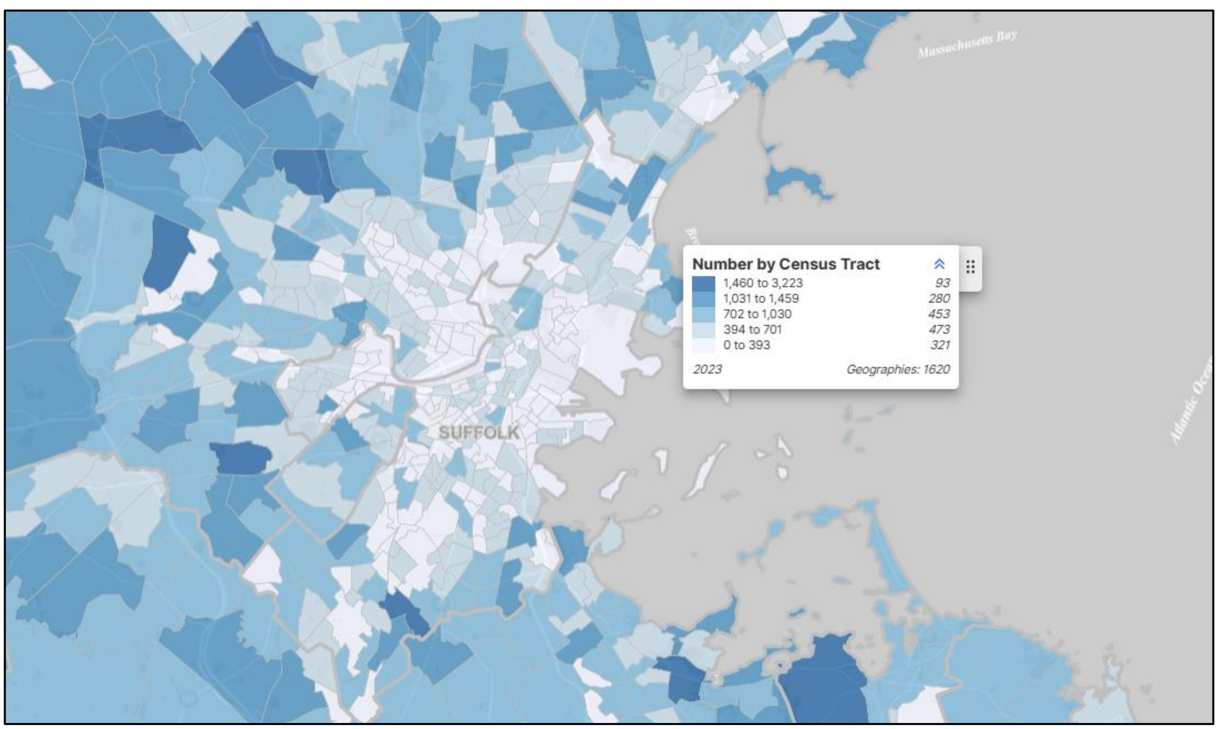
Figure 3-9
Pediatric Asthma Prevalence per 100 Students School Years 2023-2024



Source: Massachusetts Environmental Public Health Tracking system
https://matracking.ehs.state.ma.us/Health-Data/Asthma/index.html

Figure 3-10
Persons 65 Years and Over in 2023 by Census Tract





Source: U.S. Census Bureau, 2019-2023 American Community Survey 5-Year Estimates

Environmental Justice (EJ) Populations

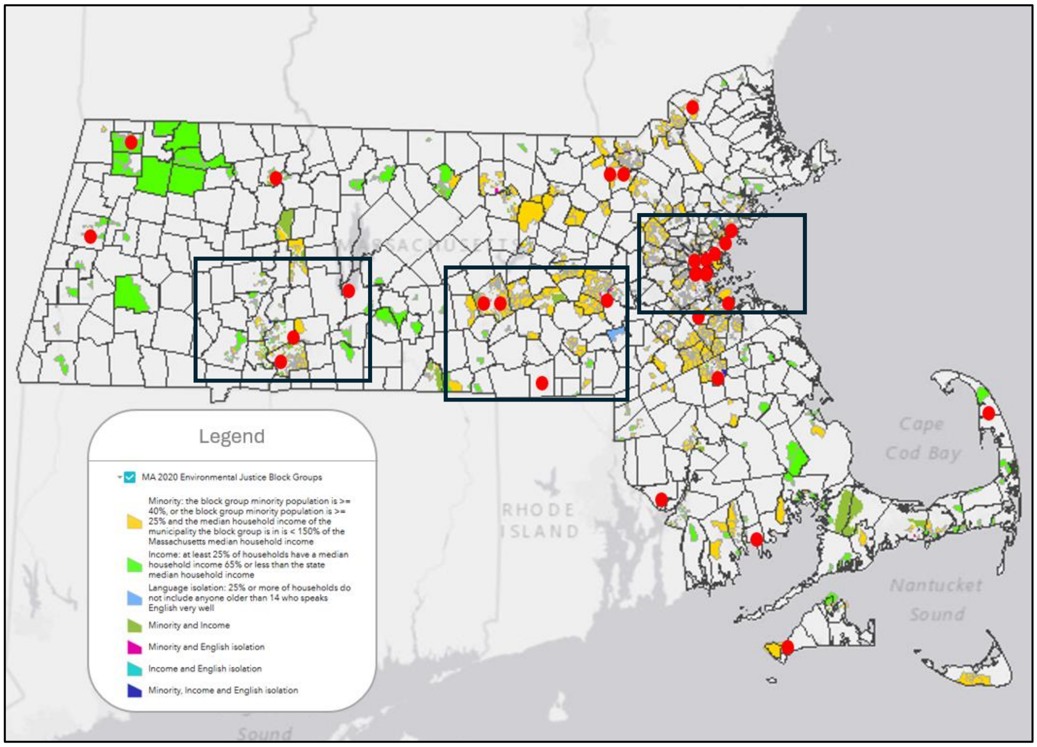
Figure 3-14 shows EJ populations with monitoring stations overlaid. In Massachusetts a community is identified as an EJ population if any of the following are true:

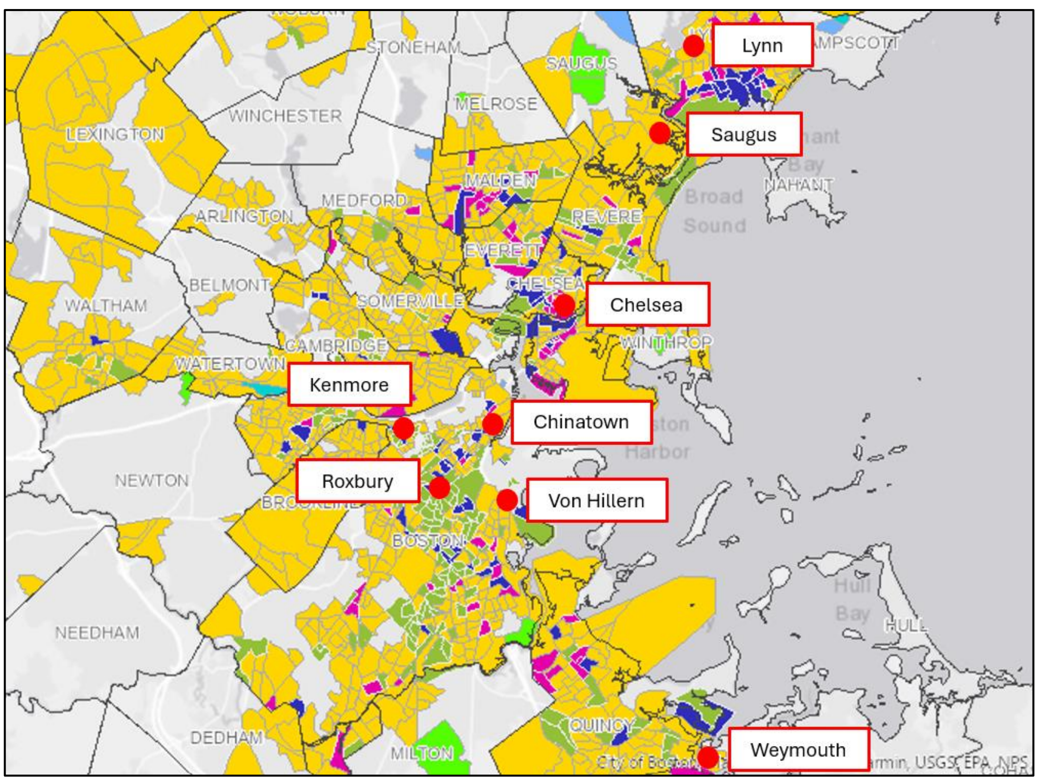
- Block group whose annual median household income is equal to or less than 65 percent of the statewide median; or
- 25% or more of the residents identify as a race other than white; or
- 25% or more of households have no one over the age of 14 who speaks English only or very well.

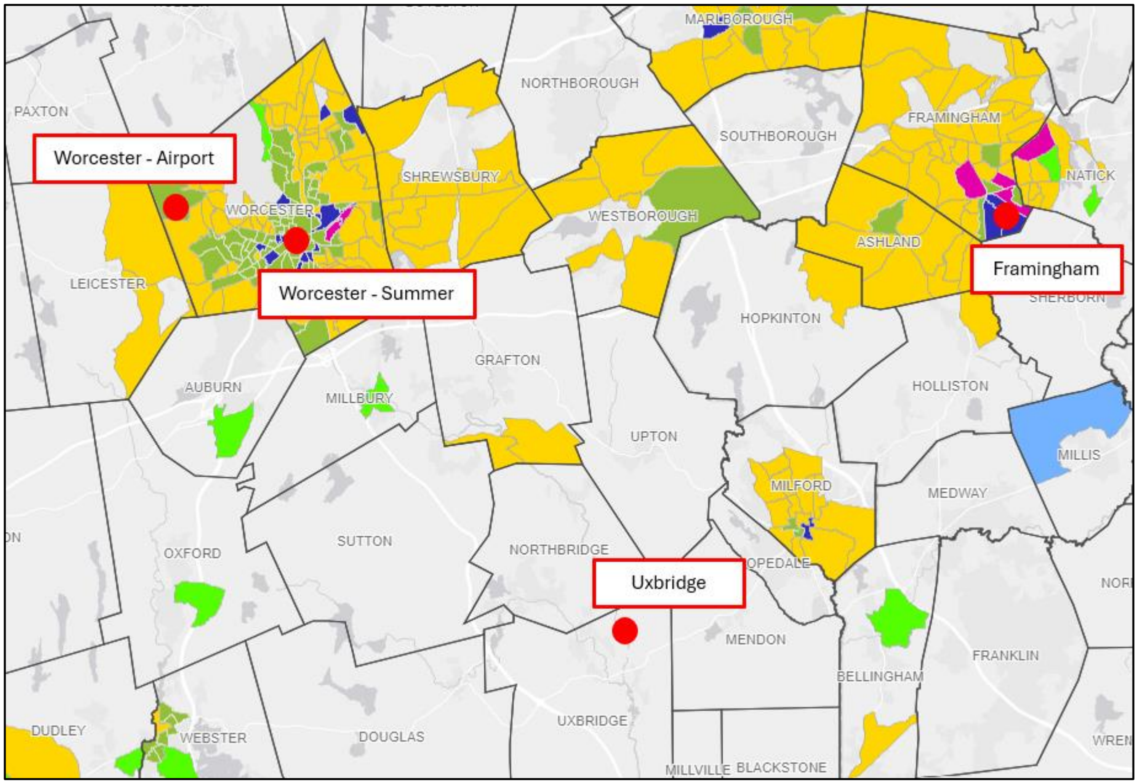
Based on the location of pollutant-specific monitors (as described in Section VI below), the following observations can be made:

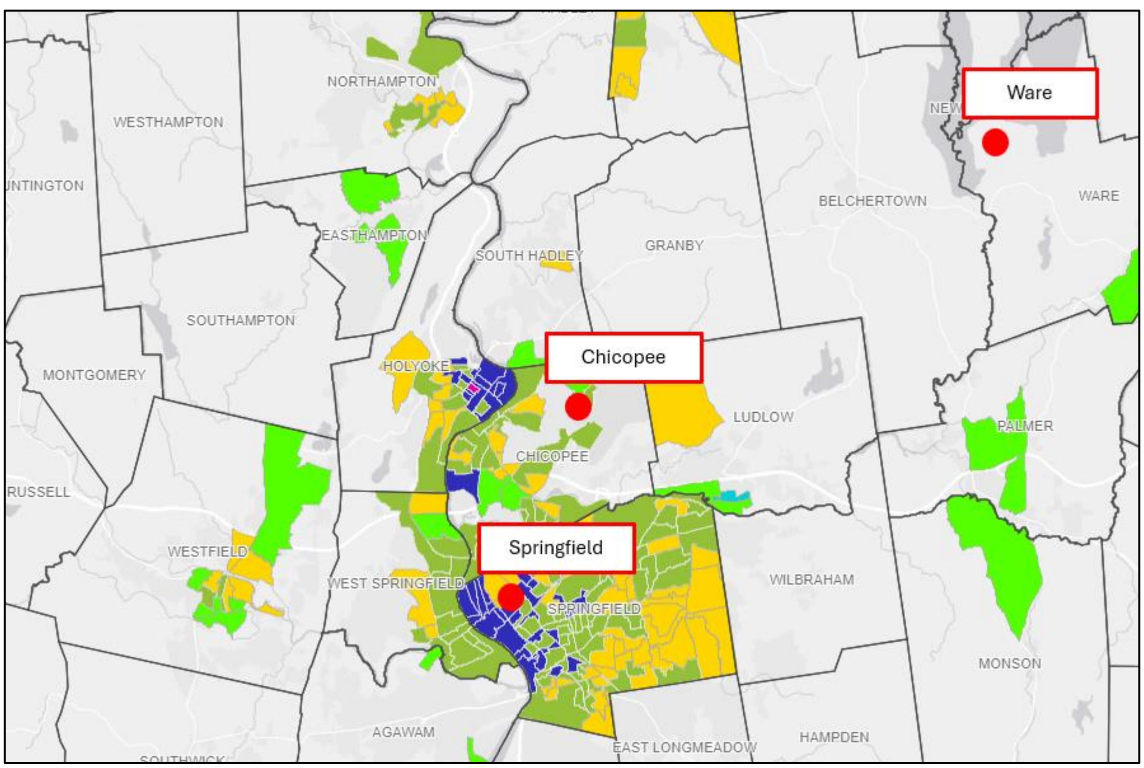
- $PM_{2.5}$ – Most of the larger clusters of urban EJ populations are adequately covered by $PM_{2.5}$ monitors. Urban EJ populations without $PM_{2.5}$ monitors (e.g., Leominster/Fitchburg) generally would be expected to experience levels similar to other urban areas. Likewise, rural EJ populations in Western Massachusetts would be expected to experience levels similar to rural monitors in North Adams, Greenfield and Pittsfield. Importantly, $PM_{2.5}$ levels are well below the NAAQS statewide.
- Ozone – The state is adequately covered by ozone monitors, and levels do not vary dramatically over small distances.
- NO_2 – The near-road monitors at Chelmsford – Near Road and Boston – Von Hillern are designed to measure a maximum exposure level, and therefore generally would cover other areas of the state.
- SO_2 – The last coal-fired power station in Massachusetts, Brayton Point in Somerset, discontinued operations in 2017. SO_2 values throughout the state have remained very low for several years.
- CO – CO levels are so very low and have not been a concern for many years.

Figure 3-11
Massachusetts EJ Populations 2022 – Income, Race, Language









Source: MassGIS Environmental Justice Viewer
https://mass-eoeea.maps.arcgis.com/apps/MapSeries/index.html?appid=535e4419dc0545be980545a0eeaf9b53

Section 4 – Air Quality Summary

MassDEP believes that emissions trends in Massachusetts do not suggest a need to change the distribution of monitors throughout the state for the following reasons:

- The decline in emissions has been uniform across the State;
- The number of new major point sources is limited and those that are permitted are well controlled;
- Existing point sources are emitting less;
- The monitoring network is designed to characterize highest concentrations and general background concentrations and population exposures rather than the impacts of individual sources; and
- There has been no significant change in population or distribution of vehicle miles travelled across the state and therefore limited change in the distribution of area and mobile source emissions across the state.

Ozone and $PM_{2.5}$ continue to be important pollutants to monitor and MassDEP maintains an extensive ozone and $PM_{2.5}$ monitoring network. Several ozone monitors are located in the southern and eastern part of the state where ozone transport entering the state is most likely to occur. MassDEP monitors $PM_{2.5}$ and black carbon to characterize wood smoke emissions. Continuous and filter-based $PM_{2.5}$ monitors are located throughout the state. Black carbon monitors are located at Boston – Roxbury, Boston – Von Hillern, Chelmsford – Near Road, Framingham, Greenfield, North Adams, Pittsfield, Saugus, and Springfield.

4.1 National Ambient Air Quality Standards

Figure 4-1 shows the NAAQS for the six criteria pollutants: ozone; nitrogen dioxide; particulate matter (PM_{10} and $PM_{2.5}$); carbon monoxide; sulfur dioxide; and lead. EPA has classified Massachusetts as “attainment / unclassified” for all the NAAQS except for the 2024 $PM_{2.5}$ primary NAAQS for which EPA has not yet classified areas. Massachusetts has recommended that EPA classify all of Massachusetts as “attainment” for the 2024 $PM_{2.5}$ primary NAAQS.

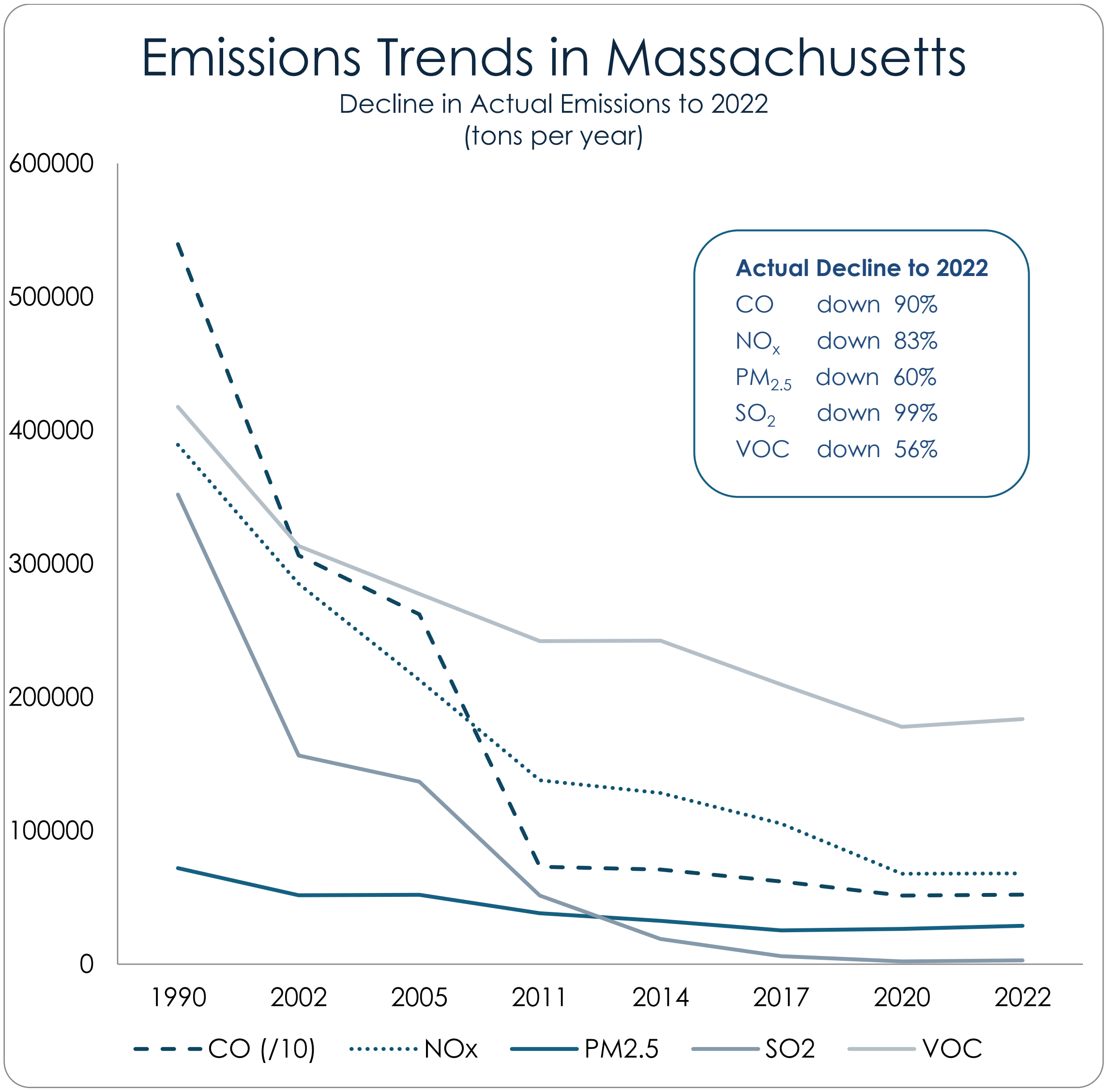
Figure 4-1 National Ambient Air Quality Standards					
Pollutant		**Primary/ Secondary**	**Averaging Time**	**Level**	**Form**
Carbon Monoxide		primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead		primary and secondary	3 month ave	0.15 µg/m³	Not to be exceeded
Nitrogen Dioxide		primary	1 hour	100 ppb	98th percentile of 1 hour daily maximum concentrations, averaged over 3 years
		primary and secondary	1 year	53 ppb	Annual mean
Ozone		primary and secondary	8 hours	0.070 ppm	Annual fourth-highest daily maximum 8 hour concentration, averaged over 3 years
Particle Pollution	$PM_{2.5}$	primary	1 year	9 µg/m³	Annual mean, averaged over 3 years
		secondary	1 year	15 µg/m³	Annual mean, averaged over 3 years
		primary and secondary	24 hours	35 µg/m³	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24 hours	150 µg/m³	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide		primary	1 hour	75 ppb	99th percentile of 1 hour daily maximum concentrations, averaged over 3 years
		secondary	1 year	10 ppb	Annual mean, averaged over 3 years

µg/m³ = micrograms per cubic meter
ppm = parts per million
ppb = parts per billion

4.2 Emissions Inventory Summary

Reductions in air pollution emissions since 1990 have led to significant improvements in air quality in Massachusetts. Figure 4-2 shows emissions reductions based on Massachusetts emissions inventory data from 1990 to 2022 (the most recent published inventory).

Figure 4-2
Emissions Trends in Massachusetts



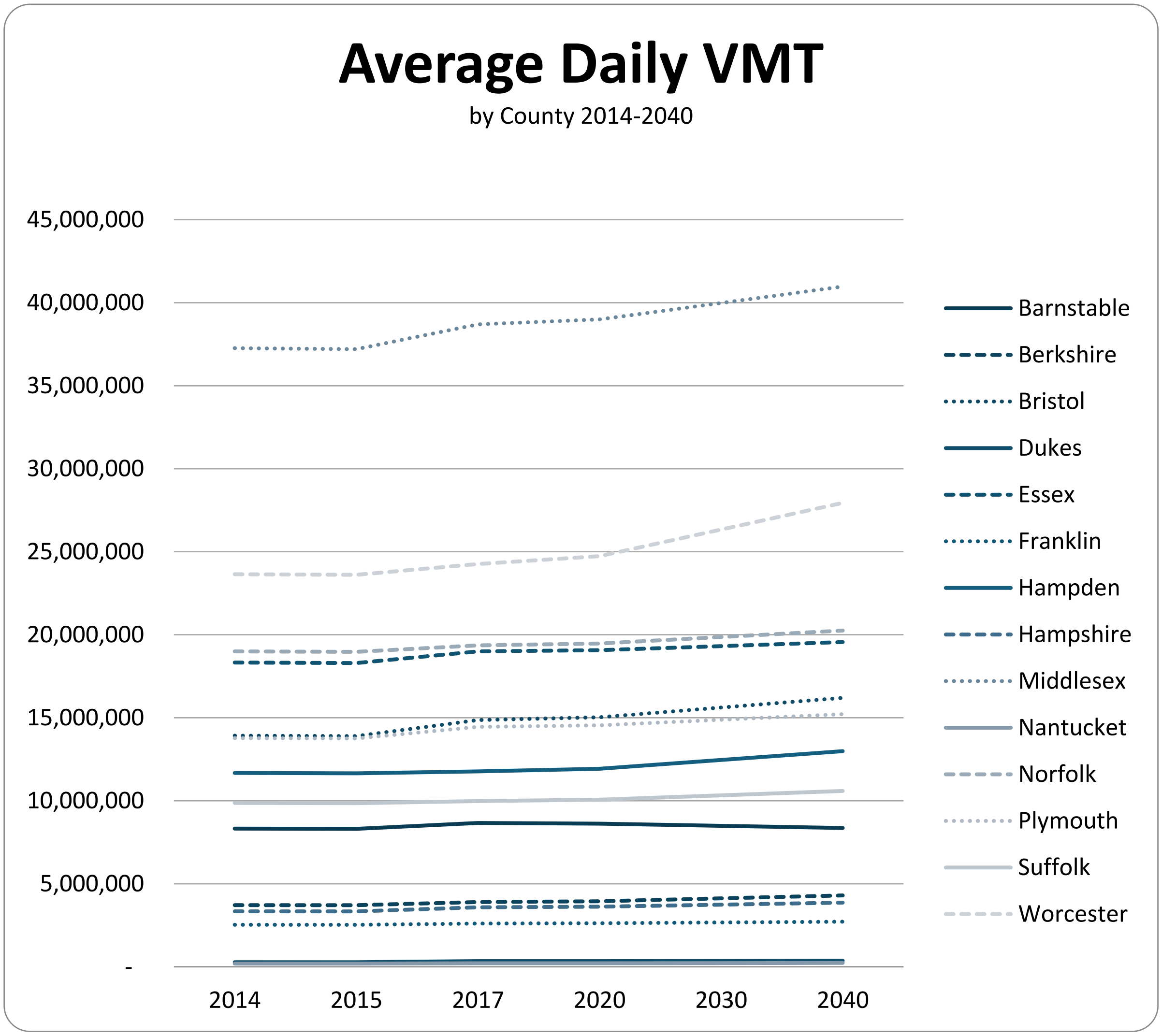
Source: EPA NEI v.1.0 - EMP data retrieval tool: https://www.epa.gov/air-emissions-modeling/2022v1-emissions-modeling-platform
Note: CO tons divided by 10 for ease of display with the other pollutants.

Vehicles make up one of the largest sources of VOC and NOx emissions. Vehicle miles travelled (VMT) indicate the relative distribution and magnitude of those emissions. In the past, as VMT increased, emissions increased. Today, due to new cleaner vehicles in the fleet, VMT does not always result in increased emissions.

Figure 4-3 shows there has been little change in the distribution of VMT across the state, and projections from the Massachusetts Department of Transportation (MassDOT) indicate this general distribution is expected to remain constant into the future. The one exception is

Worcester County, where VMT is expected to rise gradually at a higher rate than other areas of the state. This change in VMT in Worcester County is not deemed significant for the purpose of designing the monitoring network.

Figure 4-3
Average Daily VMT



Source: Highway Performance Monitoring System (HPMS), MassDOT Traffic Counting Program Data, Massachusetts Statewide Travel Demand Model, MassDOT Planning staff calculations.

4.3 Distribution of Emission Reductions

Figure 4-4 shows that emissions reductions have been relatively uniform across the state.

Figure 4-4 Emissions Reduction by Pollutant and County 1990 – 2022								
County	Pollutant	1990*	2005	2011	2014	2020	2022	% Change 1990-2022
Barnstable	CO	213,453	210,206	45,066	43,054	33,954	35,358	-83%
Barnstable	NOx	18,652	12,723	7,961	6,684	3,424	3,575	-81%
Barnstable	$PM_{2.5}$	3,603	3,346	1,480	1,300	987	1,332	-63%
Barnstable	SO_2	63,372	28,276	1,305	1,338	57	587	-99%
Barnstable	VOC	19,681	15,975	13,741	13,760	7,993	8,593	-56%
Berkshire	CO	98,671	27,745	30,405	21,407	15,117	16,029	-84%
Berkshire	NOx	10,665	6,105	4,240	2,554	1,487	1,550	-85%
Berkshire	$PM_{2.5}$	4,315	2,393	2,495	1,517	1,447	1,366	-68%
Berkshire	SO_2	10,629	2,521	700	295	38	67	-99%
Berkshire	VOC	14,161	7,869	13,209	11,602	10,462	10,881	-23%
Bristol	CO	447,624	160,148	51,768	56,075	37,390	38,332	-91%
Bristol	NOx	62,226	23,756	12,007	17,294	4,570	4,621	-93%
Bristol	$PM_{2.5}$	5,223	5,843	2,758	2,914	1,900	2,060	-61%
Bristol	SO_2	103,652	41,578	20,436	2,576	96	101	-100%
Bristol	VOC	32,154	19,159	17,435	17,902	13,179	13,666	-57%
Dukes	CO	25,104	20,948	12,062	7,917	5,645	5,616	-78%
Dukes	NOx	696	2,119	2,552	1,052	743	802	15%
Dukes	$PM_{2.5}$	532	738	733	248	152	211	-60%
Dukes	SO_2	229	313	525	76	10	14	-94%
Dukes	VOC	4,248	2,460	3,829	3,287	1,272	1,490	-65%
Essex	CO	606,854	233,286	81,069	76,577	58,704	57,258	-91%
Essex	NOx	48,276	21,906	15,750	17,160	9,384	8,648	-82%
Essex	$PM_{2.5}$	6,114	4,525	4,036	2,993	2,016	2,343	-62%
Essex	SO_2	56,349	17,201	6,233	2,898	267	218	-100%
Essex	VOC	50,166	26,192	21,989	21,994	15,808	16,188	-68%
Franklin	CO	131,409	53,340	22,399	15,798	11,674	11,484	-91%
Franklin	NOx	6,726	3,971	2,731	1,586	1,229	1,033	-85%
Franklin	$PM_{2.5}$	2,914	2,324	2,082	1,306	1,422	1,278	-56%
Franklin	SO_2	2,370	1,029	552	177	30	36	-98%
Franklin	VOC	12,687	30,042	13,411	12,233	9,697	10,035	-21%
Hampden	CO	403,137	166,954	58,111	43,678	33,580	34,010	-92%
Hampden	NOx	26,049	10,861	10,364	7,591	4,716	4,563	-82%
Hampden	$PM_{2.5}$	4,830	3,858	3,290	2,498	2,157	2,373	-51%
Hampden	SO_2	20,242	9,710	2,410	1,630	142	145	-99%
Hampden	VOC	25,328	16,192	19,263	17,535	14,261	14,695	-42%
Hampshire	CO	155,653	63,832	24,164	18,341	13,730	13,879	-91%
Hampshire	NOx	7,683	4,337	3,462	2,257	1,334	1,260	-84%
Hampshire	$PM_{2.5}$	2,905	2,498	2,156	1,577	1,361	1,421	-51%
Hampshire	SO_2	3,248	1,526	584	280	49	45	-99%
Hampshire	VOC	12,788	6,382	11,200	10,428	9,099	9,504	-26%

Middlesex	CO	1,194,565	581,188	138,996	157,576	111,605	109,616	-91%
Middlesex	NOx	62,563	43,608	24,426	24,592	13,140	12,582	-80%
Middlesex	$PM_{2.5}$	12,491	7,418	4,912	5,816	4,766	5,059	-60%
Middlesex	SO_2	36,758	15,249	5,255	2,651	227	228	-99%
Middlesex	VOC	87,722	54,218	38,238	41,334	30,209	30,638	-65%
Nantucket	CO	16,927	15,134	6,885	5,769	4,229	4,213	-75%
Nantucket	NOx	2,325	644	1135	620	390	428	-82%
Nantucket	$PM_{2.5}$	302	611	265	134	90	173	-43%
Nantucket	SO_2	625	99	270	42	3	5	-99%
Nantucket	VOC	2,612	1,632	1,713	1,833	692	625	-76%
Norfolk	CO	620,449	375,218	66,541	66,009	47,326	48,230	-92%
Norfolk	NOx	27,280	25,053	12,262	10,779	5,648	5,719	-79%
Norfolk	$PM_{2.5}$	5,560	3,899	2,069	2,009	2,020	2,282	-59%
Norfolk	SO_2	10,548	4,270	2,718	1,203	182	158	-98%
Norfolk	VOC	42,215	27,741	18,609	18,898	13,581	14,165	-66%
Plymouth	CO	391,226	168,608	55,080	56,503	42,834	44,097	-89%
Plymouth	NOx	18,899	11,060	9,910	9,706	5,575	5,773	-69%
Plymouth	$PM_{2.5}$	6,851	4,147	2,540	2,266	1,755	1,986	-71%
Plymouth	SO_2	7,606	2,723	2,460	1,254	448	434	-94%
Plymouth	VOC	36,613	16,980	20,238	19,970	13,504	14,261	-61%
Suffolk	CO	388,528	178,554	44,850	47,654	29,576	31,953	-92%
Suffolk	NOx	59,772	18,719	14,017	11,710	7,074	8,603	-86%
Suffolk	$PM_{2.5}$	6,075	2,403	1,974	1,710	1,553	1,692	-72%
Suffolk	SO_2	21,869	5,367	4,362	2,594	152	339	-98%
Suffolk	VOC	25,017	18,613	11,493	14,132	8,998	8,952	-64%
Worcester	CO	701631	366,744	92,710	93,251	68,578	70,662	-90%
Worcester	NOx	37,342	28,065	16,973	14,636	9,031	8,891	-76%
Worcester	$PM_{2.5}$	10,254	7,941	7,388	6,178	4,798	5,171	-50%
Worcester	SO_2	14,381	6,837	3,550	1,886	381	472	-97%
Worcester	VOC	52,203	34,030	37,742	37,536	29,101	29,936	-43%
Statewide	CO	5,395,231	2,621,905	730,106	709,609	513,942	520,737	-90%
Statewide	NOx	389,154	212,927	137,790	128,221	67,745	68,048	-83%
Statewide	$PM_{2.5}$	71,969	51,944	38,178	32,466	26,424	28,745	-60%
Statewide	SO_2	351,878	136,699	51,360	18,900	2,082	2,849	-99%
Statewide	VOC	417,595	277,485	242,110	242,444	177,856	183,627	-56%

Section 5 – Pollutant Network Status

Section 5 summarizes the status of the ambient air quality monitoring for each of the following pollutants:

- Particulate matter (including speciation and air toxics)
- Ozone (including PAMS monitoring)
- Carbon monoxide
- Lead
- Sulfur dioxide
- Nitrogen dioxide (including NOx, other oxides of nitrogen)

The following topics are covered for each of these pollutants:

- Monitor locations/descriptions/purposes
- Coverage area
- Monitoring data
- Technological issues
- Adequacy of the Monitoring Network including, for ozone and $PM_{2.5}$, Correlations, New Sites Analysis, and Removal Bias Data
- Analysis results

Section 5 also assesses the Meteorological Network and describes Quality Assurance and Quality Control (QA/QC) activities.

5.1 Particulate Matter (PM)

5.1.1 Network Description

MassDEP operates PM monitors at 21 locations across the Commonwealth. The National Park Service and Wampanoag Tribe operate PM monitors at two additional locations for the Interagency Monitoring of Protected Visual Environments (IMPROVE) program. At least one monitor is located in each county except for Norfolk and Nantucket. The PM network consists of:

- PM_{10} at 5 sites:
  - Continuous FEM PM_{10} mass monitors at all five locations.

- Collocated low-volume samplers at the National Core (NCore)/National Air Toxics Trends Stations (NATTS) site (Boston-Harrison Avenue). Filters from this site are analyzed for toxic elements as part of the NATTS air monitoring program and for lead as required by the NCore program.

- $PM_{2.5}$ at 21 sites:
  - Twenty-one FEM sites, five of which are collocated with FRM samplers. All of MassDEP's continuous $PM_{2.5}$ monitors meet FEM requirements and are designated as primary monitors for determining compliance with the $PM_{2.5}$ NAAQS. FEMs provide the hourly $PM_{2.5}$ data that appears on MassDEP's website. FRM samplers are for QA purposes only.
  - Five FRM $PM_{2.5}$ sites. The NCore site FRM is on a 1-in-3 day schedule and the remaining four sites are on a 1-in-6 day schedule.
  - Two IMPROVE samplers operated by the National Park Service and Wampanoag Tribe are on a 1-in-3 day schedule.

- $PM_{0.1}$ at 4 sites:
  - Four ultrafine ($PM_{0.1}$) sites. Continuous condensation particle counters (CPCs) at all four locations.

- PMcoarse (PM_{10} – $PM_{2.5}$) at 5 sites:
  - Continuous PM mass monitors at all five locations including the NCore site at Boston-Harrison Avenue.

- Speciated $PM_{2.5}$ at 4 sites:
  - Two speciation sampler sites (Boston-Harrison Avenue and Chicopee). The speciated $PM_{2.5}$ program is designed to determine some of the chemical constituents (elements, sulfates, nitrates, carbon species) that are contained in $PM_{2.5}$, which can provide information about the sources of the PM.
  - Two IMPROVE sampling sites (Truro and Aquinnah – Martha's Vineyard) that provide speciated $PM_{2.5}$ data. The IMPROVE program measures, at rural locations, parameters that are similar to those measured by the speciation program. The data are used to evaluate the role of fine particulates and their constituents in the degradation of visibility.

Figure 5-1 lists the particulate matter sites, their location, type of monitoring and purpose of the monitoring.

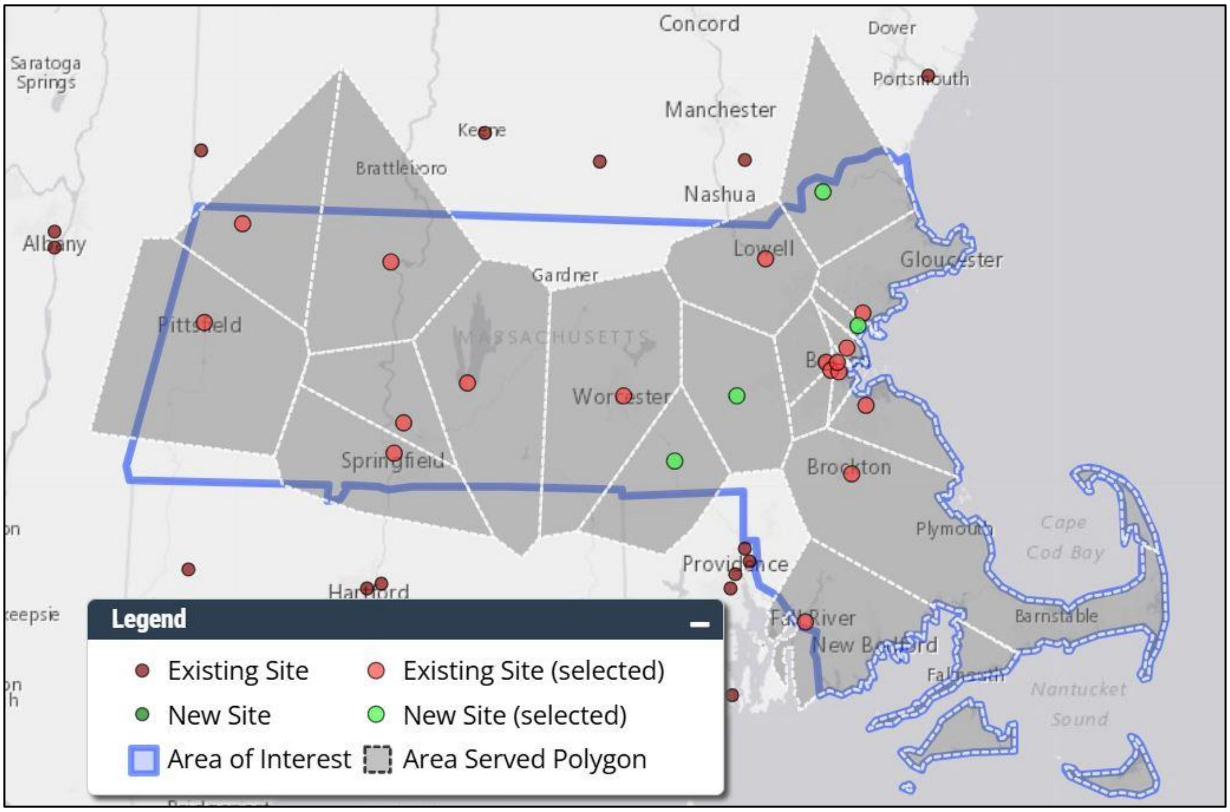
Figure 5-1 $PM_{2.5}$ Monitoring Sites					
Site ID	**Site Name**	**Scale**	**Reason for the Monitor**	**MSA / MiSA**	**PM Type**
25-025-0045	Boston - Chinatown	Neighborhood	Population Exposure	Boston-Cambridge-Newton MSA	FEM
25-025-0002	Boston - Kenmore	Neighborhood/Micro	Highest Concentration; Population Exposure	Boston-Cambridge-Newton MSA	FEM and FRM
25-025-0042	Boston - Harrison Ave	Neighborhood	Population Exposure	Boston-Cambridge-Newton MSA	FEM and FRM
25-025-0044	Boston - Von Hillern	Middle	Population Exposure; Highest Concentration	Boston-Cambridge-Newton MSA	FEM and FRM
25-023-0005	Brockton	Urban/Neighborhood	Population Exposure	Boston-Cambridge-Newton MSA	FEM
25-017-0010	Chelmsford - Near Rd	Middle	Population Exposure	Boston-Cambridge-Newton MSA	FEM
25-025-1004	Chelsea	Neighborhood	Population Exposure	Boston-Cambridge-Newton MSA	FEM
25-013-0008	Chicopee	Urban	Population Exposure	Springfield MSA	FEM
25-005-1004	Fall River	Neighborhood	Population Exposure	Providence-Warwick MSA	FEM
25-017-0011	Framingham	Urban	Population Exposure	Boston-Cambridge-Newton MSA	FEM
25-011-2005	Greenfield	Regional/Neighborhood	Population Exposure	Greenfield Town MiSA	FEM and FRM
25-009-5006	Haverhill - HS	Regional/Neighborhood	Population Exposure	Boston-Cambridge-Newton MSA	FEM
25-009-2006	Lynn	Urban/Neighborhood	PAMS - Max Precursor O_3; Population Exposure	Boston-Cambridge-Newton MSA	FEM
25-003-6001	North Adams	Neighborhood	Population Exposure	Pittsfield MSA	FEM
25-003-0008	Pittsfield	Regional/Neighborhood	Population Exposure	Pittsfield MSA	FEM
25-009-2007	Saugus	Urban	Population Exposure	Boston-Cambridge-Newton MSA	FEM
25-013-0018	Springfield	Urban	Highest Concentration; Population Exposure	Springfield MSA	FEM and FRM
25-027-0024	Uxbridge	Regional	Ozone Transport; Population Exposure	Worcester MSA	FEM
25-015-4002	Ware	Urban	Maximum O_3; Background other pollutants	Springfield MSA	FEM
25-021-2005	Weymouth	Neighborhood	Population Exposure	Boston-Cambridge-Newton MSA	FEM
25-027-0023	Worcester - Summer St	Urban/Middle	Population Exposure	Worcester MSA	FEM

MSA = Metropolitan Statistical Area
MiSA = Micropolitan Statistical Area

5.1.2 Area Served

Figure 5-2 shows the area served by each $PM_{2.5}$ monitor as defined by Voroni polygons. These polygons were developed using EPA's NetAssess tool. The polygons show that the state is well covered by monitors in Massachusetts or in neighboring states.

Figure 5-2
Area Served – $PM_{2.5}$ FEM sites



Source: NetAssess2025 Ambient Air Monitoring Network Assessment Tool

Notes: Co-located $PM_{2.5}$ monitors are treated as a single location. Four sites in Haverhill, Saugus, Framingham, and Uxbridge were established after the NetAssess2025 tool was compiled and were manually added using functions in the NetAssess2025 tool.

5.1.3 Monitoring Data

2024 PM_{10} Data Summary

Figure 5-3 shows a summary of 2024 PM_{10} data. All values are well below applicable NAAQS. The Uxbridge and Saugus PM_{10} monitors were deployed in 2025; therefore, no 2024 data is available.

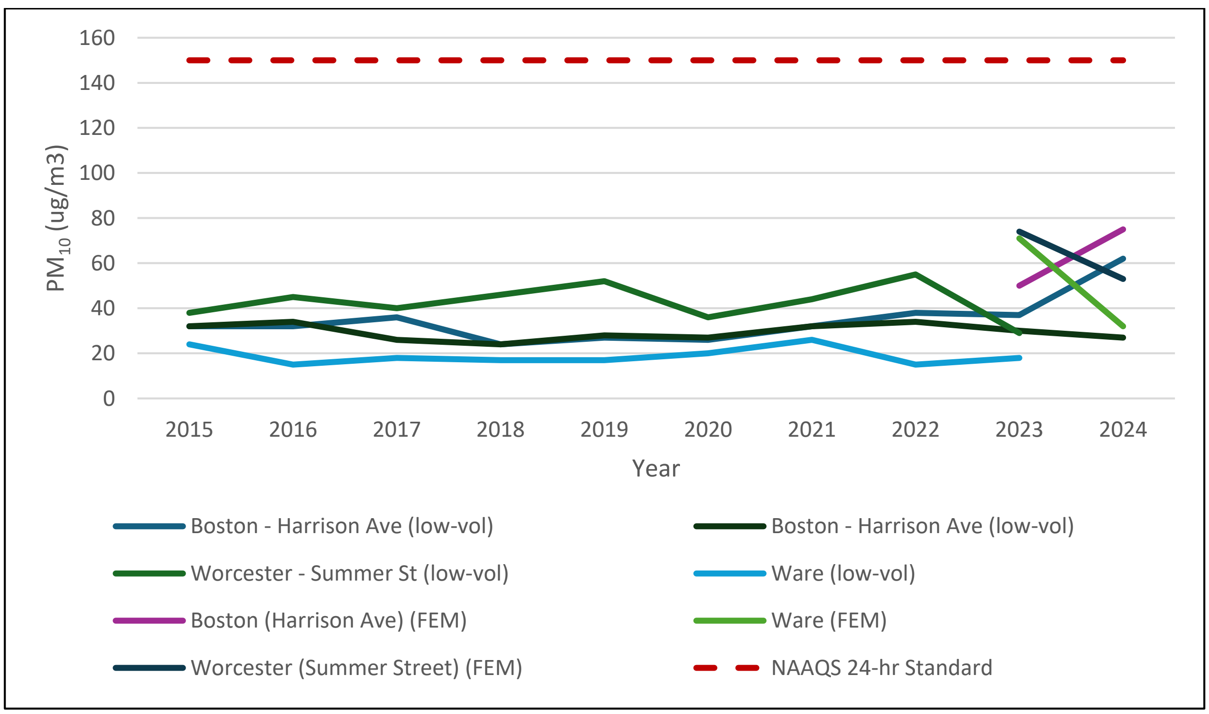
Figure 5-3 2024 PM_{10} FRM Annual Data Summary (µg/m^3)								
City	County	Address	1ST MAX 24-HR	2ND MAX 24-HR	3RD MAX 24-HR	4TH MAX 24-HR	DAYS MAX >STD	ARITH MEAN
Boston	Suffolk	Harrison Avenue	75	72	50	48	0	12.7
Ware	Hampshire	Skyline Drive	32	31	30	28	0	7.8
Worcester	Worcester	Summer St	53	52	51	42	0	11.8

Primary and Secondary NAAQS: 24-hour = 150 µg/m^3
1st, 2nd, 3rd, 4th 24-HR MAX = First, Second, Third and Fourth highest 24-hour values for the year
ARITH MEAN = Annual mean

PM_{10} Trends

Figure 5-4 shows trends for each PM_{10} monitor relative to the 24-hour standard of 150 µg/m^3. In 2023, MassDEP replaced low-volume PM_{10} samplers with continuous PM_{10} mass monitors. Low-volume PM_{10} data prior to 2023 is also displayed in the figure below.

Figure 5-4
PM_{10} Trends 2015-2024
24-Hour Calendar Year Maximum



$PM_{2.5}$ 2024 Data Summary

Figure 5-5 shows a summary of the 2024 FEM $PM_{2.5}$ data. All values are well below applicable NAAQS. The Framingham, Uxbridge and Saugus $PM_{2.5}$ monitors were deployed in 2025; therefore, no 2024 data is available. The notably high values at the Lynn site resulted from a nearby wildfire event.

Figure 5-5
2024 $PM_{2.5}$ FEM 24-Hour Data Summary (µg/m^3)

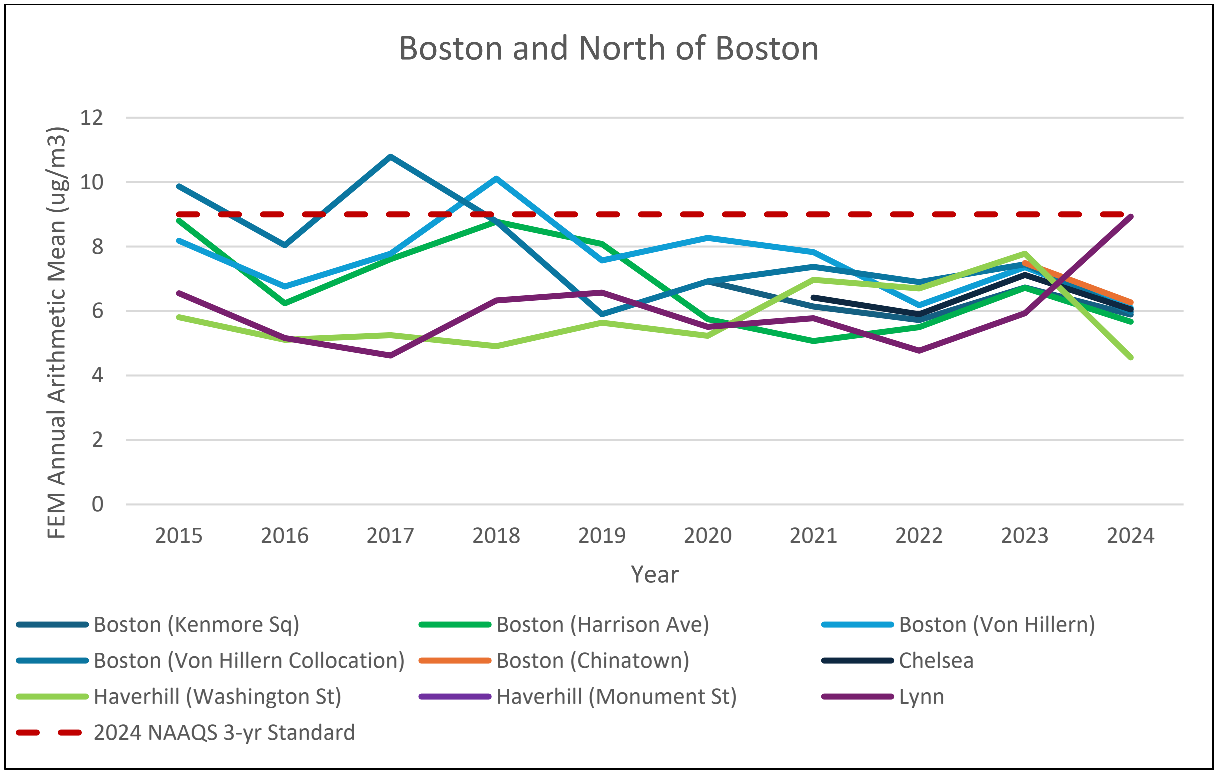
City	County	Address	1ST MAX 24-HR	2ND MAX 24-HR	3RD MAX 24-HR	4TH MAX 24-HR	98TH Percentile 24-HR	ARITH MEAN
Boston	Suffolk	Kenmore Sq	22.1	21.6	21.5	20.6	16.0	5.89
Boston	Suffolk	Harrison Ave	22.4	22.3	20.9	19.9	15.4	5.67
Boston	Suffolk	Von Hillern St	23.4	23.1	21.6	20.9	17.0	6.10
Boston	Suffolk	Von Hillern St*	23.1	22.8	21.5	21.0	16.5	5.97
Boston	Suffolk	Kneeland St	22.6	22.2	20.9	20.9	16.1	6.27
Brockton	Plymouth	Clinton St	22.7	21.8	21.3	20.2	16.6	5.57
Chelmsford	Middlesex	Manning Road	22.5	21.3	19.8	19.7	15.5	5.33
Chelsea	Suffolk	Willow St	22.2	21.7	21.3	21.2	18.4	6.05
Chicopee	Hampden	Anderson Road	20.1	19.6	19.6	16.3	14.5	4.94
Fall River	Bristol	Globe Street	21.1	20.8	18.7	17.5	13.0	5.09
Greenfield	Franklin	Barr Avenue	32.1	21.6	21.4	19.6	15.8	5.70
Haverhill	Essex	Monument St	20.4	19.7	19.5	18.8	19.5	5.90
Lynn	Essex	Parkland Ave	**833.8**	**321.9**	**71.6**	**63.5**	19.5	8.93
North Adams	Berkshire	Holden Street	21.3	21.2	20.5	18.7	16.6	5.79
Pittsfield	Berkshire	Silver Lake Blvd	20.3	20.2	19.8	19.4	14.6	5.27
Springfield	Hampden	Liberty St	21.9	21.5	21.3	18.8	16.8	5.91
Ware	Hampshire	Skyline Drive	21.9	21.4	20.9	16.0	12.5	4.26
Weymouth	Norfolk	Monatiquot St	20.6	20.4	19.6	18.4	14.3	5.09
Worcester	Worcester	Summer St	22.2	21.4	21.2	18.0	15.3	5.39

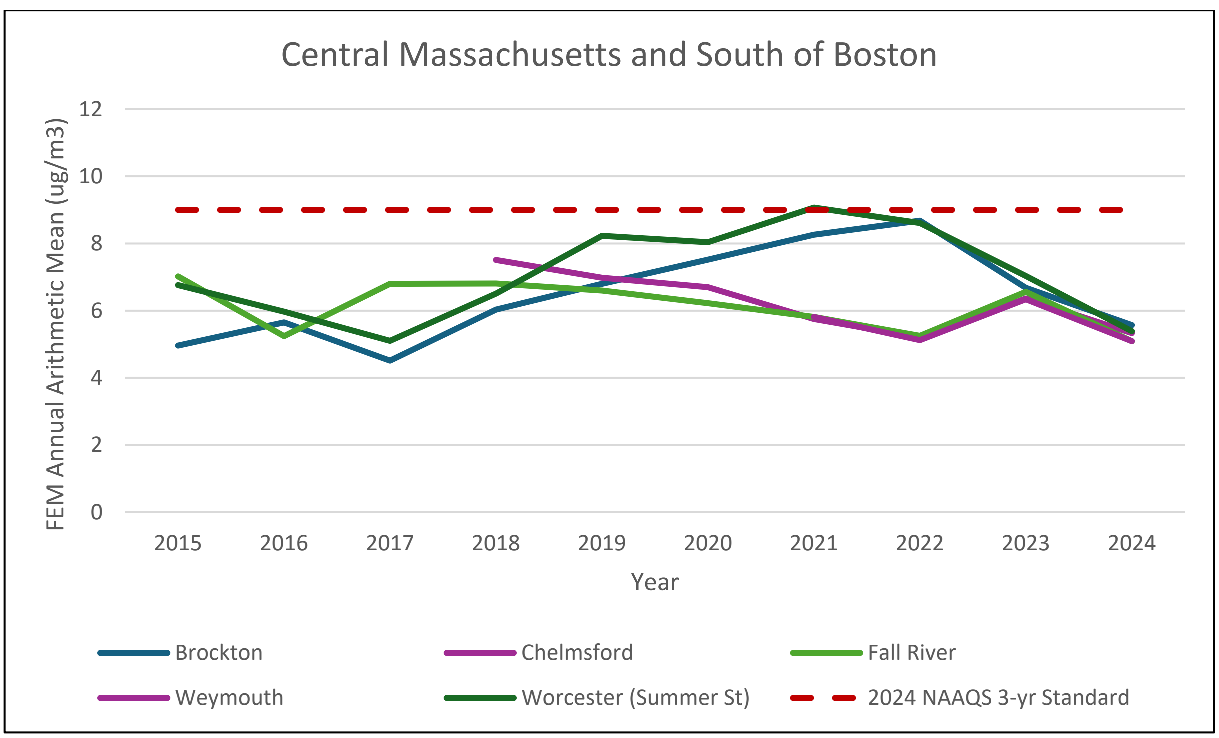
Primary NAAQS: Annual Mean = 9.0 µg/m^3
Secondary NAAQS: Annual Mean = 15.0 µg/m^3
Primary and Secondary NAAQS: 24-hour (98th percentile) = 35 µg/m^3
* = Collocated monitors
1st, 2nd, 3rd, 4th 24-HR MAX = First, Second, Third, and Fourth highest 24-hour values for the year
98th Percentile 24-HR = 98th Percentile value for the year
ARITH MEAN = Annual mean

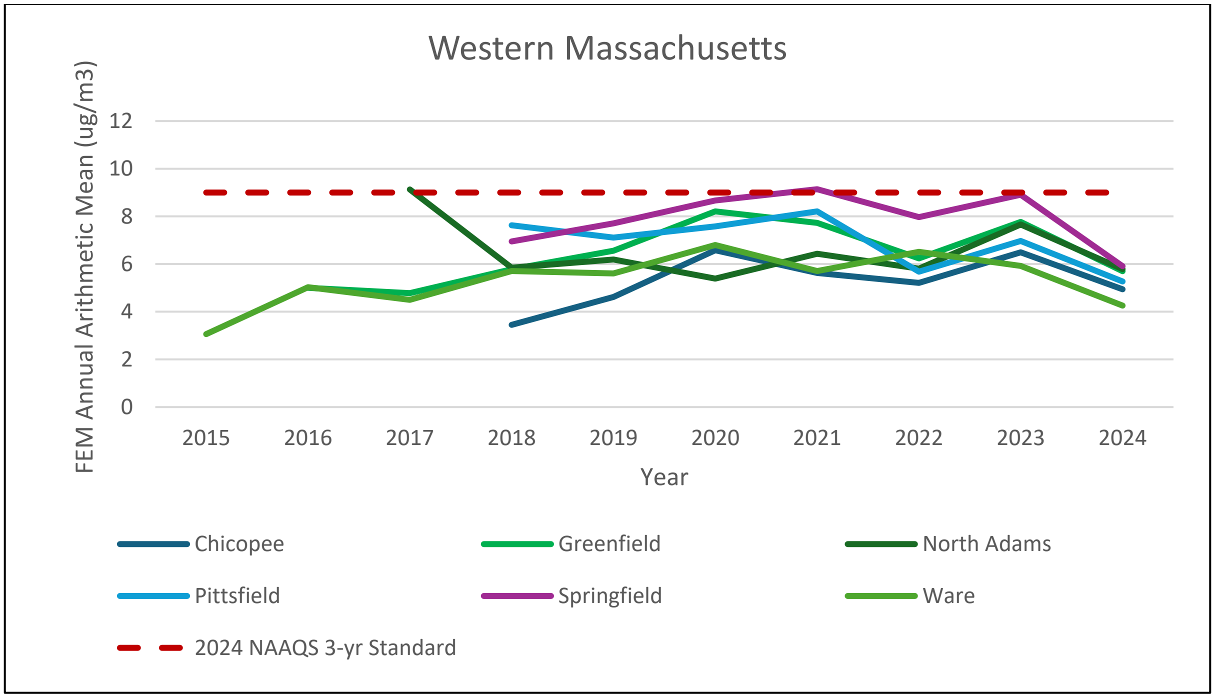
$PM_{2.5}$ Trends

Figure 5-6 shows trends for each FRM $PM_{2.5}$ monitor relative to the annual standard of 9 µg/m^3.

Figure 5-6
$PM_{2.5}$ Annual Arithmetic Mean Trends







$PM_{2.5}$ Design Values

The design value is a statistic that describes the air quality measured by a monitor relative to the NAAQS in order to classify attainment and nonattainment areas, assess progress towards meeting the NAAQS, and develop control strategies. Design values are defined in EPA guidance and are based on the NAAQS in 40 CFR Part 50. They often require multiple years of data that help to ensure a stable indicator. EPA computes and publishes design values for each monitor annually.

The annual $PM_{2.5}$ design value is computed at each site by averaging the daily samples taken each quarter, averaging these quarterly averages to obtain an annual average, and then averaging three years of annual averages. The 24-hour $PM_{2.5}$ design value is computed at each site by determining the 98^{th} percentile of the daily samples collected each year for three years, and then averaging these three numbers. Because design values are computed over a 3-year time period they are more stable than the measurements recorded in any one year.

Five sites include collocated FRM and FEM instruments; however, at all sites the FEM is considered the primary source of data for NAAQS compliance. Design values are calculated using data from the primary monitor.

Figure 5-7 shows the most recent design values for each $PM_{2.5}$ FRM monitor. All design values are well below applicable NAAQS. The Framingham, Uxbridge and Saugus $PM_{2.5}$ monitors were deployed in 2025; therefore, design values are not available.

Figure 5-7 FEM $PM_{2.5}$ 2024 Design Values				
			2021-2024 Design Values	
City	County	Address	24 Hour Standard 35 µg/m³	Annual Standard 9 µg/m³
Boston	Suffolk	Kenmore Sq	16	6.1
Boston	Suffolk	Harrison Ave	16	6.0
Boston	Suffolk	Von Hillern St	17	6.5
Boston	Suffolk	Kneeland St*	20	6.9
Brockton	Plymouth	Clinton St	19	7.0
Chelmsford	Middlesex	Manning Road	15	5.6
Chelsea	Suffolk	Willow St	18	6.4
Chicopee	Hampden	Anderson Road	17	5.5
Fall River	Bristol	Globe Street	17	5.6
Greenfield	Franklin	Barr Avenue	21	6.7
Haverhill	Essex	Monument St**	18	6.6
Lynn	Essex	Parkland Ave	17	6.5
North Adams	Berkshire	Holden Street	19	6.4
Pittsfield	Berkshire	Silver Lake Blvd	17	6.0
Springfield	Hampden	Liberty St	20	7.6
Ware	Hampshire	Skyline Drive	16	5.6
Weymouth	Norfolk	Monatiquot St	16	5.5
Worcester	Worcester	Summer St	18	7.0

* = Incomplete data set (less than 3 years) for comparison to NAAQS.
** = The Haverhill design value is derived by combining data from the previous Washington Street location with the current Monument Street location

5.1.4 Monitoring Technology

PM_{10}

MassDEP operates FEM designated, continuous PM mass monitors that use scattered light spectrometry for PM_{10} measurement. The instrument employs broadband spectroscopy using 90° white-light scattering with a polychromatic light-emitting diode (LED). The monitor operates at a total flow rate of 16.67 LPM with 5.0 LPM entering the measurement cell and the remaining 11.67 LPM discarded as bypass flow.

The instrument is an optical aerosol spectrometer that converts optical measurements to mass measurements by determining sampled particle size via scattered light at the single particle level according to Lorenz-Mie Theory. In brief, the sampling head draws a representative sample of ambient aerosol at a flow rate of 16.67 LPM. The flow is split with 5.0 LPM direct to the monitor and 11.7 lpm discarded as bypass flow. The aspirated particles in the 5.0 lpm flow are then dried (i.e., brought below 35% RH) with the Aerosol Sample Conditioner (ASC) and moved into the optical particle sensor where scattered light intensity is measured to determine particle size diameter. The particles move separately into the T-aperture through an optically differentiated measurement volume that is homogeneously illuminated with polychromatic light. The polychromatic light source, an LED, combined with a 90° scattered light detection, achieves a precise and unambiguous calibration curve in the Mie range, resulting in a large size resolution.

Each particle generates a scattered light impulse that is detected at an 85° to 95° angle where amplitude (height) and signal length are measured; the amplitude of the scattered light impulse is directly related to the particle size diameter. The T-aperture and simultaneous signal length measurements eliminate border zone error, which is characterized by the partial illumination of particles at the border of the measurement range.

$PM_{2.5}$

MassDEP operates FEM designated, continuous PM mass monitors that use scattered light spectrometry for $PM_{2.5}$ measurement. The instrument employs broadband spectroscopy using 90° white-light scattering with a polychromatic LED. There is one pump in the T640 which operates at a flow rate of 5.0 LPM.

The instrument is an optical aerosol spectrometer that converts optical measurements to mass measurements by determining sampled particle size via scattered light at the single particle level according to Lorenz-Mie Theory. In brief, the sampling head draws a representative sample of ambient aerosol at a flow rate of 5.0 LPM. The aspirated particles are then dried (i.e., brought below 35% RH) with the ASC and moved into the optical particle sensor where scattered light intensity is measured to determine particle size diameter. The particles move separately into the T-aperture through an optically differentiated measurement volume that is homogeneously illuminated with polychromatic light. The polychromatic light source, an LED, combined with a 90° scattered light detection, achieves a precise and unambiguous calibration curve in the Mie range, resulting in a large size resolution.

Each particle generates a scattered light impulse that is detected at an 85° to 95° angle where amplitude (height) and signal length are measured; the amplitude of the scattered light impulse is directly related to the particle size diameter. The T-aperture and simultaneous signal length measurements eliminate border zone error, which is characterized by the partial illumination of particles at the border of the measurement range.

$PM_{0.1}$

MassDEP operates four continuous monitors for measuring $PM_{0.1}$ particle counts near high traffic roadways. The monitor draws in an air sample and counts the number of particles in that sample to provide a particle concentration value that is displayed as the number of particles detected per cubic centimeter of sampled air.

The monitor utilizes a laminar-flow, water-based condensation growth technique. Particles which are too small (nanometer scale) to scatter enough light to be detected by conventional optics are grown to a larger size by condensing water on them. The air sample is continuously drawn through the inlet via an external pump and a portion of the flow is sent to the exhaust as transport flow. The stream of aerosol particles is uninterrupted and follows a laminar flow path from the sample inlet to the optical detector. In the conditioner, the aerosol sample stream is saturated with water vapor and then temperature-equilibrated. The sample passes to a growth tube where the wetted walls (composed of a porous medium) are heated to raise the vapor pressure. The high diffusivity of the water vapor allows the vapor to reach the center of the sample stream at a faster rate than the thermal diffusivity of the vapor can equilibrate to the higher temperatures near the walls—creating a supersaturated condition along the radius of the flow stream. These unstable conditions facilitate water condensation on the sample particles. Particles that are larger than the detection limit pass up the growth tube. The enlarged particles are passed through a laser beam and create a large light pulse. Every particle pulse event is detected and counted. In this technique, particle concentration is measured by counting each particle in the air stream.

PM_{coarse} (PM_{10} – $PM_{2.5}$)

MassDEP reports PM_{coarse} concentrations at all sites with PM_{10} measurements. The FEM designated, continuous PM mass monitors automatically calculate a PM_{coarse} concentration based on PM_{10} and $PM_{2.5}$ measurements using scattered light spectrometry.

Speciation

MassDEP has been collecting $PM_{2.5}$ samples for speciation at the Boston – Harrison Avenue air monitoring station since 2000 and in Chicopee since 2001. Speciation is the analysis of PM collected on Teflon, nylon and quartz filters simultaneously to determine the chemical composition of the PM collected. 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 and nitrates, and carbon (total and organic).

5.1.5 Adequacy of the Network

EPA Requirements

As demonstrated in Figure 5-8, the PM network meets or exceeds federal requirements for PM_{10}, $PM_{2.5}$, and speciation.

Figure 5-8
$PM_{2.5}$ Monitor Siting Requirements, including Speciation

	MSA Population	Most Recent 3-Year Design Value ≥85% of any $PM_{2.5}$ NAAQS	Most Recent 3-Year Design Value <85% of any $PM_{2.5}$ NAAQS or No Design Value
EPA Requirements for Number of $PM_{2.5}$ Monitors	>1,000,000	3	2
	500,000–1,000,000	2	1
	50,000–<500,000	1	0

MSA	2023 Population	3 Year Design Values (showing highest value in MSA): 24 Hour - 35 µg/m3		Annual - 9 µg/m3		> 85% of any NAAQS?	Monitors Needed	Monitors in Network
		Value	% of STD	Value	% of STD			
Boston-Cambridge-Newton MSA	4,919,179	19	54%	7.0	78%	NO	2	12
Barnstable MSA	231,735	NA	NA	NA	NA	NA	0	0
Providence-Warwick MSA	1,677,803*	17	49%	5.6	62%	NO	1	1
Worcester MSA	866,866	18	51%	7.0	78%	NO	1	2
Springfield MSA	460,291	17	49%	5.6	62%	NO	1	3
Pittsfield MSA	126,818	19	54%	6.4	71%	NO	0	2

* The Massachusetts population in the MSA is 581,841. The remainder of the population resides in Rhode Island.

Additional $PM_{2.5}$ Monitor Requirements	MSA: Boston-Cambridge-Newton MSA	Worcester MSA	Springfield MSA
At least one monitoring station is to be sited at neighborhood or larger scale in an area of expected maximum concentration.	Boston-Von Hillern	Summer Street	Liberty Street
For CBSAs with a population of 1,000,000 or more persons, at least one $PM_{2.5}$ monitor is to be collocated at a near-road NO_2 station.	Boston-Von Hillern Chelmsford-Near Road	N/A	N/A
For areas with additional required SLAMS, a monitoring station is to be sited in an at-risk community with poor air quality, particularly where there are anticipated effects from sources in the area (e.g., a major industrial area, point source(s), port, rail yard, airport, or other transportation facility or corridor).	Boston-Kenmore Boston-Harrison Ave Boston-Von Hillern	Summer Street	Liberty Street Chicopee Westover
The State, or where appropriate, local agencies must operate continuous $PM_{2.5}$ analyzers equal to at least one-half (round up) the minimum required sites listed in Table D–5 of Appendix D. At least one required continuous analyzer in each MSA must be collocated with one of the required FRM/FEM monitors, unless at least one of the required FRM/FEM monitors is itself a continuous FEM monitor in which case no collocation requirement applies.	12 Continuous 3 Collocated	2 Continuous 0 Collocated	3 Continuous 1 Collocated
Each State shall install and operate at least one $PM_{2.5}$ site to monitor regional background and at least one $PM_{2.5}$ site to monitor regional transport.	1 Continuous (Ware)		
Each State shall continue to conduct chemical speciation monitoring and analyses at sites designated to be part of the $PM_{2.5}$ Speciation Trends Network (STN). The selection and modification of these STN sites must be approved by the Administrator. Chemical speciation sites shall include analysis for elements, selected anions and cations, and carbon.	Boston-Harrison Ave	N/A	Chicopee

Exceedance Probability, Correlations, Removal Bias

EPA recommends three analytical approaches for identifying potentially underserved areas and redundant sites.

1. Identifying potential new sites based on the likelihood of the site exceeding a standard.
2. Evaluating the correlation between site measurements to find redundancies.
3. Estimating the removal bias – the difference between the measured concentrations at a site and those that would be estimated for that site based on data from surrounding sites.

NetAssess2025 is an online tool that provides these analyses. NetAssess2025 was used to implement these approaches for this report. The reference is provided below.

NetAssess2025 v1.1 Ambient Air Monitoring Network Assessment Tool. The latest data in this version is from 2020. https://rconnect-public.epa.gov/NetAssess2025/

Exceedance Probability

NetAssess2025 provides a probability map to help determine where new monitors may be needed. The method is explained in the excerpt below from the NetAssess2025 documentation.

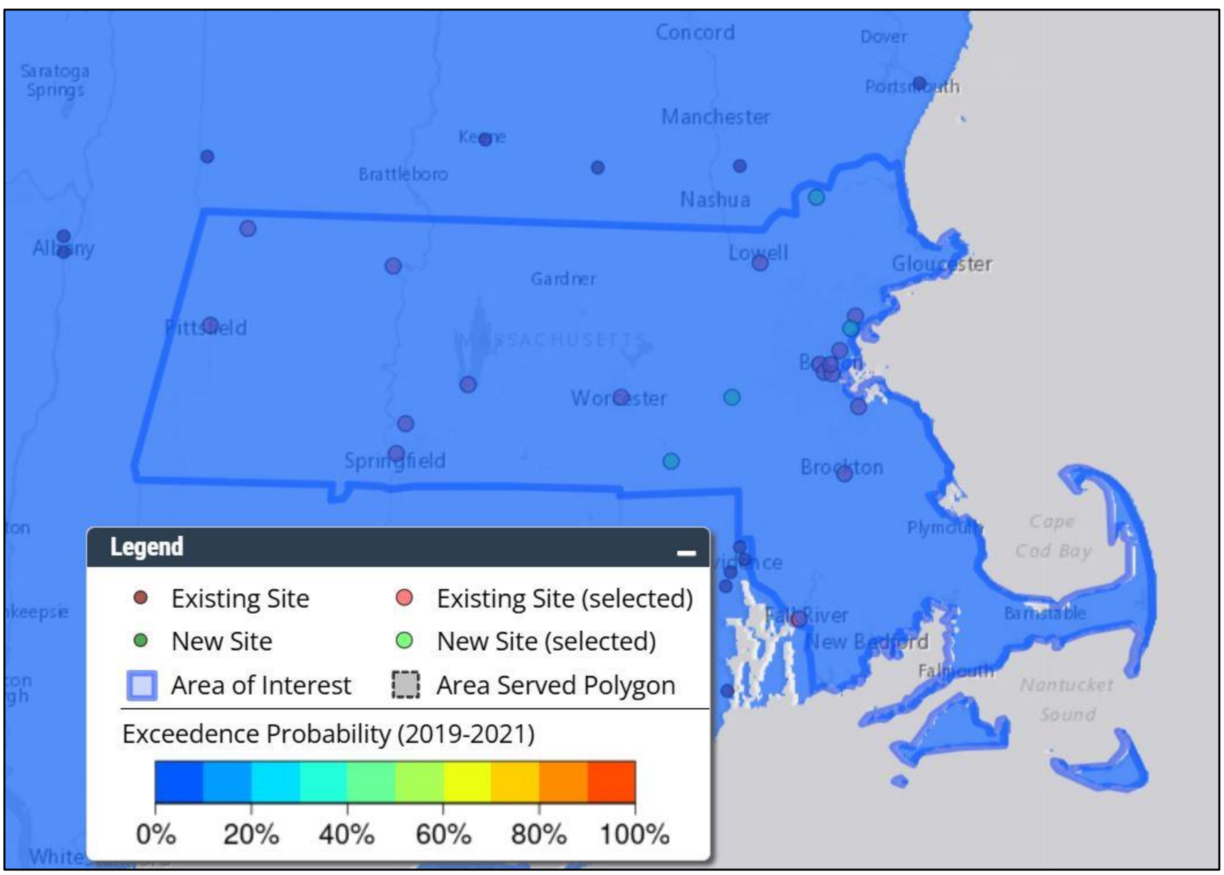
> Exceedance Probabilities – One objective of the network assessment is to determine if new sites are needed. In order to make that decision, it is helpful to have some estimation of the extreme pollution levels in areas where no monitors currently exist. NetAssess2025 provides ozone and $PM_{2.5}$ maps of the contiguous US that can be used to make spatial comparisons regarding the probability of daily values exceeding a certain threshold.
>
> Surface Probability Maps – To clarify, these maps do not show the probability of violating the National Ambient Air Quality Standards (NAAQS). They provide information about the spatial distribution of the highest daily values for a pollutant (not, for example, the probability of the 4th highest daily 8-hour ozone maximum exceeding a threshold).
>
> These maps are intended to be used as a spatial comparison and not for probability estimates for a single geographic point or area. The probability estimates alone should not be used to justify a new monitor. The maps should be used in conjunction with existing monitoring data. If a monitor has historically measured high values, then the probability map gives an indication of areas where you would expect to observe similar

extreme values. This information, along with demographic and emissions data, could be used in a weight of evidence approach for proposing new monitor locations.

Data – The surface probability maps were created by using EPA/CDC downscaler data. Downscaler data are daily estimates of ground level ozone and $PM_{2.5}$ for every census tract in the continental US. These are statistical estimates from “fusing” photochemical modeling data and ambient monitoring data using Bayesian space-time methods. For more details on how the data were generated, see the meta data document on the EPA website.

Figure 5-9 shows the probability of exceeding the 35 µg/m^3 $PM_{2.5}$ NAAQS. The spatial comparison map indicates all areas of the state have a low probability of daily values exceeding the $PM_{2.5}$ threshold. No areas of high or moderate probability were indicated.

Figure 5-9
Probability of Exceeding the $PM_{2.5}$ 35 µg/m^3 Daily NAAQS



Source: NetAssess2025 Ambient Air Monitoring Network Assessment Tool

Site Correlation Analysis

The NetAssess2025 tool was used to provide correlations between monitors. The Correlation Matrix tool calculates and displays the correlation, relative difference, and distance between pairs of sites within a user selected set of air monitoring sites. The correlation matrix graphic displays information about how concentrations at monitors within your Area of Interest compare to one another. Each monitor comparison is represented by a square in the chart.

The blue squares in the bottom-left corner show the correlation between each pair of monitors, with text indicating the number of days used in the calculation. The red squares in the top-right corner show the mean absolute difference in concentrations between each pair of monitors, with text indicating the distance in kilometers between each pair of monitors. The numbers along the diagonal indicate the most recent design value for each monitor.

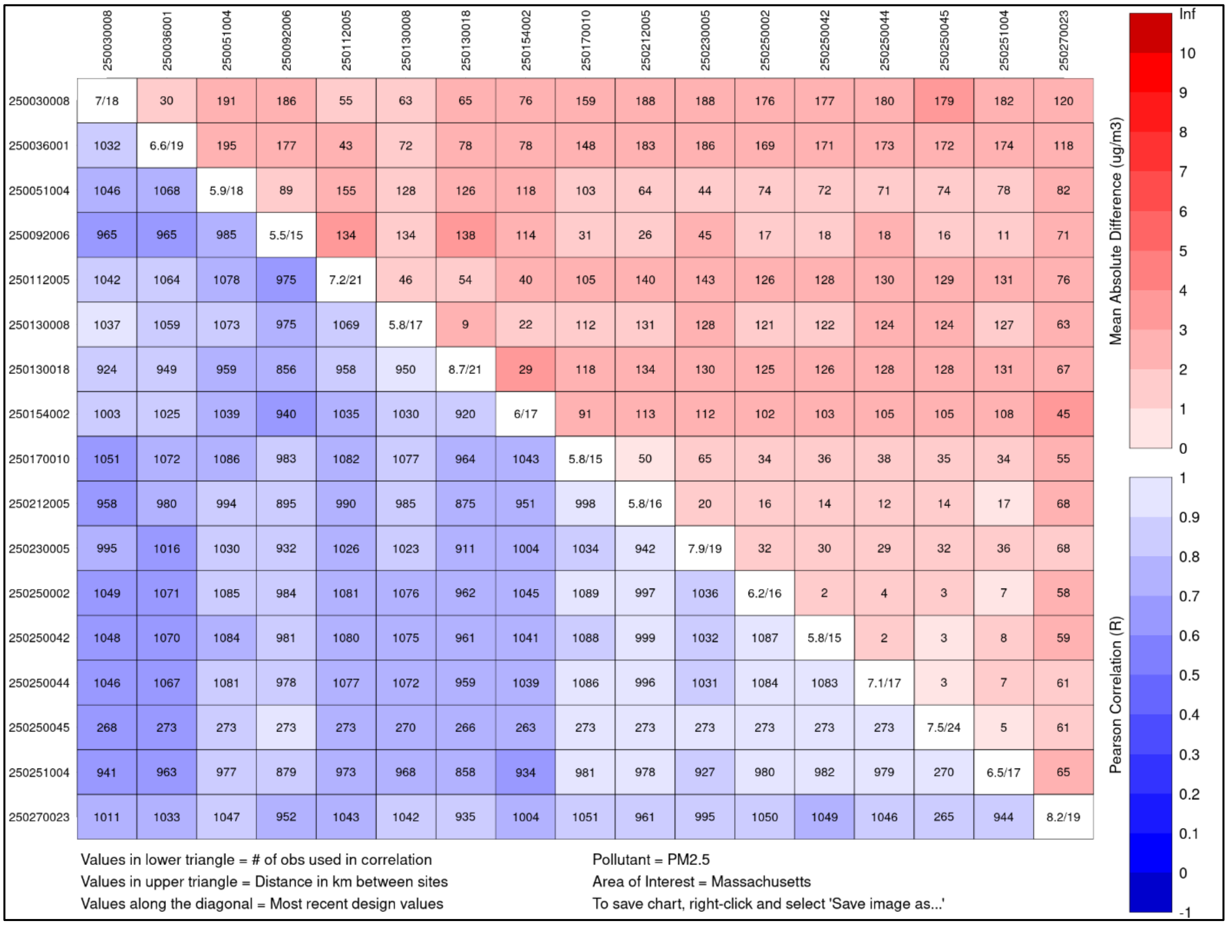
The purpose of this tool is to provide a means of determining possible redundant sites that could be removed. Possible redundant sites would exhibit fairly high correlations consistently across all their pairings and would have low average relative difference despite the distance. Usually, it is expected that correlation between sites will decrease as distance increases. However, for a regional air pollutant such as ozone, sites in the same air shed can have very similar concentrations and be highly correlated. More unique sites would exhibit the opposite characteristics. They would not be very well correlated with other sites and their relative difference would be higher than other site to site pairs.

The Correlation Matrix tool generates a graphical display that summarizes the correlation, relative difference and distance between pairs of monitoring sites. The correlation between two sites quantitatively describes the degree of relatedness between the measurements made at two sites. That relatedness could be caused by various influences including a common source affecting both sites to pollutant transport caused meteorology. The correlation, however, may indicate whether a pair of sites is related, but it does not indicate if one site consistently measures pollutant concentrations at levels substantially higher or lower than the other.

The average relative difference between the two sites is an indicator of the overall measurement similarity between the two sites. Site pairs with a lower average relative difference are more similar to each other than pairs with a larger difference. Both the correlation and the relative difference between sites are influenced by the distance by which site pairs are separated. Usually, sites with a larger distance between them will generally be more poorly correlated and have large differences in the corresponding pollutant concentrations.

Figure 5-10 shows the correlation between the measured air quality at each PM2.5 monitoring site based on FRM and FEM data.

Figure 5-10
Correlation Matrix for FEM $PM_{2.5}$ Monitors



	250030008	250036001	250051004	250092006	250112005	250130008	250130018	250154002	250170010	250212005	250230005	250250002	250250042	250250044	250250045	250251004	250270023
250030008	7/18	30	191	186	55	63	65	76	159	188	188	176	177	180	179	182	120
250036001	1032	6.6/19	195	177	43	72	78	78	148	183	186	169	171	173	172	174	118
250051004	1046	1068	5.9/18	89	155	128	126	118	103	64	44	74	72	71	74	78	82
250092006	965	965	985	5.5/15	134	134	138	114	31	26	45	17	18	18	16	11	71
250112005	1042	1064	1078	975	7.2/21	46	54	40	105	140	143	126	128	130	129	131	76
250130008	1037	1059	1073	975	1069	5.8/17	9	22	112	131	128	121	122	124	124	127	63
250130018	924	949	959	856	958	950	8.7/21	29	118	134	130	125	126	128	128	131	67
250154002	1003	1025	1039	940	1035	1030	920	6/17	91	113	112	102	103	105	105	108	45
250170010	1051	1072	1086	983	1082	1077	964	1043	5.8/15	50	65	34	36	38	35	34	55
250212005	958	980	994	895	990	985	875	951	998	5.8/16	20	16	14	12	14	17	68
250230005	995	1016	1030	932	1026	1023	911	1004	1034	942	7.9/19	32	30	29	32	36	68
250250002	1049	1071	1085	984	1081	1076	962	1045	1089	997	1036	6.2/16	2	4	3	7	58
250250042	1048	1070	1084	981	1080	1075	961	1041	1088	999	1032	1087	5.8/15	2	3	8	59
250250044	1046	1067	1081	978	1077	1072	959	1039	1086	996	1031	1084	1083	7.1/17	3	7	61
250250045	268	273	273	273	273	270	266	263	273	273	273	273	273	273	7.5/24	5	61
250251004	941	963	977	879	973	968	858	934	981	978	927	980	982	979	270	6.5/17	65
250270023	1011	1033	1047	952	1043	1042	935	1004	1051	961	995	1050	1049	1046	265	944	8.2/19

Source: NetAssess2025 Ambient Air Monitoring Network Assessment Tool

Seven monitor pairs exhibit correlations greater than 0.95 and all correlations are greater than 0.6. The seven pairs exhibiting correlations greater than 0.95 are shown in Figure 5-11. All seven are located in the greater Boston area, which is the state's largest urban population center. Although the high correlation values indicate possible redundancies, these sites are located in areas of interest and should be retained.

Figure 5-11 Correlation Over 0.95 for FRM and FEM $PM_{2.5}$ Monitors					
Site 1	Site 2	Correlation	Distance (km)	n	Mean Difference
25-009-2006 - Lynn	25-025-0045 - Chinatown	0.9617	16	273	1.3938
25-021-2005 - Weymouth	25-025-0045 - Chinatown	0.9739	14	273	1.0458
25-021-2005 - Weymouth	25-025-1004 - Chelsea	0.9589	17	978	0.9656
25-025-0002 - Kenmore	25-025-0045 - Chinatown	0.9543	3	273	1.0432
25-025-0042 - Roxbury	25-025-0045 - Chinatown	0.9695	3	273	0.9106
25-025-0044 - Von Hillern	25-025-0045 - Chinatown	0.9722	3	273	0.9443
25-025-0045 - Chinatown	25-025-1004 - Chelsea	0.9670	5	270	0.9078

Source: NetAssess2025 Ambient Air Monitoring Network Assessment Tool
n = Number of observations used in correlation
km = kilometers

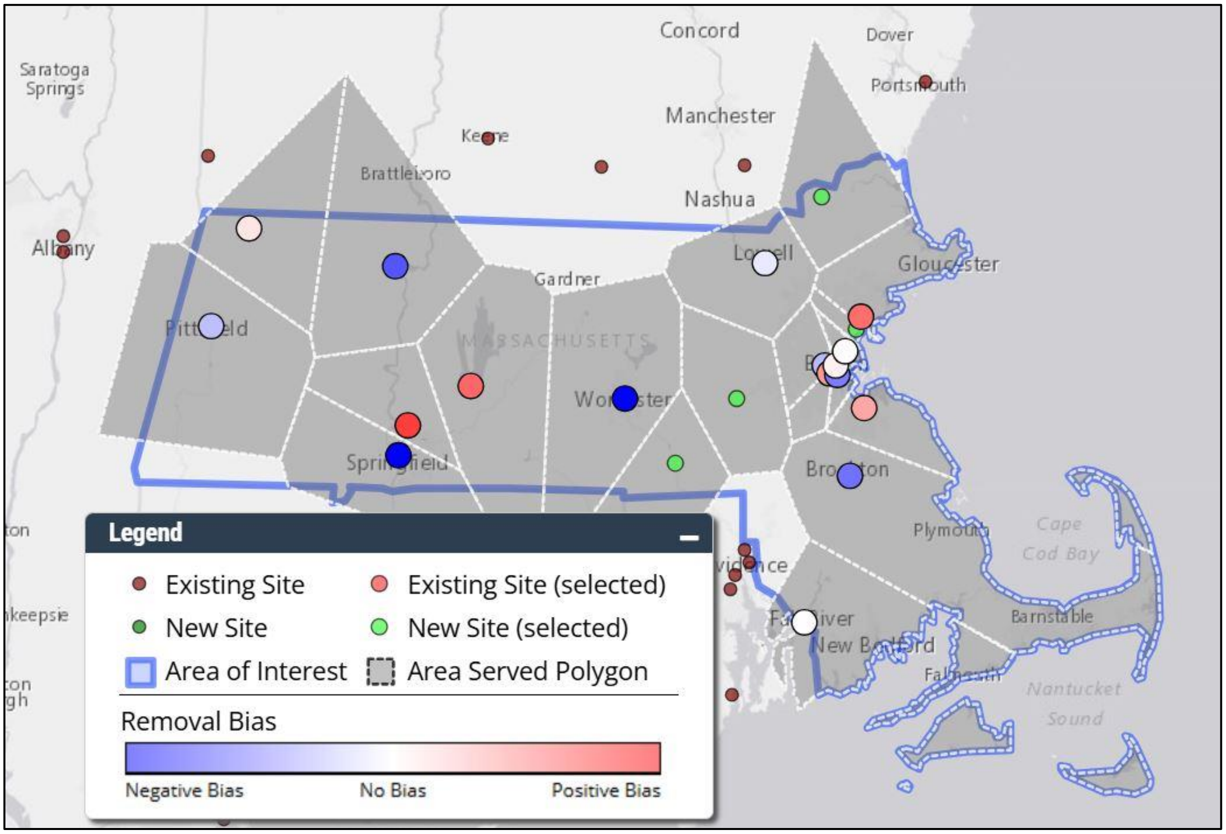
Removal Bias Analysis

Removal bias was calculated among all the $PM_{2.5}$ monitors within the state. Removal bias was calculated with NetAssess2025, which explains the process in its documentation as follows:

> The removal bias tool is meant to aid in determining redundant sites. The bias estimation uses the nearest neighbors to each site to estimate the concentration at the location of the site if the site had never existed. This is done using the Voronoi Neighborhood Averaging algorithm with inverse distance squared weighting. The squared distance allows for higher weighting on concentrations at sites located closer to the site being examined. The bias was calculated for each day at each site by taking the difference between the predicted value from the interpolation and the measured concentration. A positive average bias would mean that if the site being examined was removed, the neighboring sites would indicate that the estimated concentration would be larger than the measured concentration. Likewise, a negative average bias would suggest that the estimated concentration at the location of the site is smaller than the actual measured concentration.

If the bias is small, that may indicate that the monitor is redundant and could be removed. Removal bias results are displayed in Figures 5-12 and 5-13. Since removal bias includes measured concentrations in its calculation, only sites with a full year of measured concentrations in 2024 are included in Figure 5-13; therefore, the Haverhill - HS, Framingham, Uxbridge and Saugus $PM_{2.5}$ monitors are excluded.

Figure 5-12
Removal Bias for FRM and FEM $PM_{2.5}$ Monitors



Source: NetAssess2025 Ambient Air Monitoring Network Assessment Tool

Figure 5-13
Removal Bias for $PM_{2.5}$ Monitors

Site ID	Site Name	Mean Removal Bias	Min Removal Bias	Max Removal Bias	Removal Bias Standard Deviation	Neighbors Included
25-025-0045	Boston - Chinatown	0.13	-2.7	4.2	1.13	4
25-025-0002	Boston - Kenmore	-0.58	-9.2	6.4	1.48	7
25-025-0042	Boston - Harrison Ave	0.88	-7.2	9.7	1.55	6
25-025-0044	Boston - Von Hillern	-1.1	-14.2	6.7	1.75	4
25-023-0005	Brockton	-1.2	-10.2	4.9	1.67	6
25-017-0010	Chelmsford - Near Rd	-0.2	-8.9	18.5	1.18	5
25-025-1004	Chelsea	0	-10.6	5.5	1.12	5
25-013-0008	Chicopee	-0.55	-19.9	5.3	1.9	7
25-005-1004	Fall River	1.22	-30.9	8.6	1.78	6
25-011-2005	Greenfield	1.63	-9.7	23.4	2	4

25-009-2006	Lynn	-1.43	-22.2	10.6	2.08	5
25-003-6001	North Adams	-0.02	-14.5	5.3	1.85	7
25-003-0008	Pittsfield	0.23	-11.5	5.9	1.77	4
25-013-0018	Springfield	-2.15	-28	10.2	2.08	6
25-015-4002	Ware	1.28	-6.4	13.3	2.33	8
25-021-2005	Weymouth	0.75	-4.6	4.7	1.07	8
25-027-0023	Worcester - Summer St	-2.14	-19.2	4.3	2.26	7

Source: NetAssess2025 Ambient Air Monitoring Network Assessment Tool

As shown in Figure 5-13, mean removal bias ranged from -2.15 to 1.63. Chelsea exhibited a zero value, and North Adams (-0.02) exhibited a value close to zero. Although redundancies may be indicated by these low values, these sites are located in areas of interest and should be retained.

5.1.5 Analysis Results

MassDEP's $PM_{2.5}$ monitoring network meets EPA monitoring requirements and objectives and provides good coverage for the state. Monitored $PM_{2.5}$ levels are below the NAAQS and additional monitors are not needed at this time. However, given the health impacts of $PM_{2.5}$, MassDEP is evaluating opportunities to enhance $PM_{2.5}$ monitoring in vulnerable communities.

5.2 Ozone

5.2.1 Network Description

MassDEP operates 16 ozone monitoring sites in 15 municipalities across the state. There is at least one state-operated ozone monitor located in each county except Dukes (Martha's Vineyard) and Nantucket. However, the Wampanoag Tribe of Gay Head (Aquinnah) operates an ozone monitor in Dukes County.

Figure 5-14
Ozone Monitoring Sites, Location, Scale and Purpose

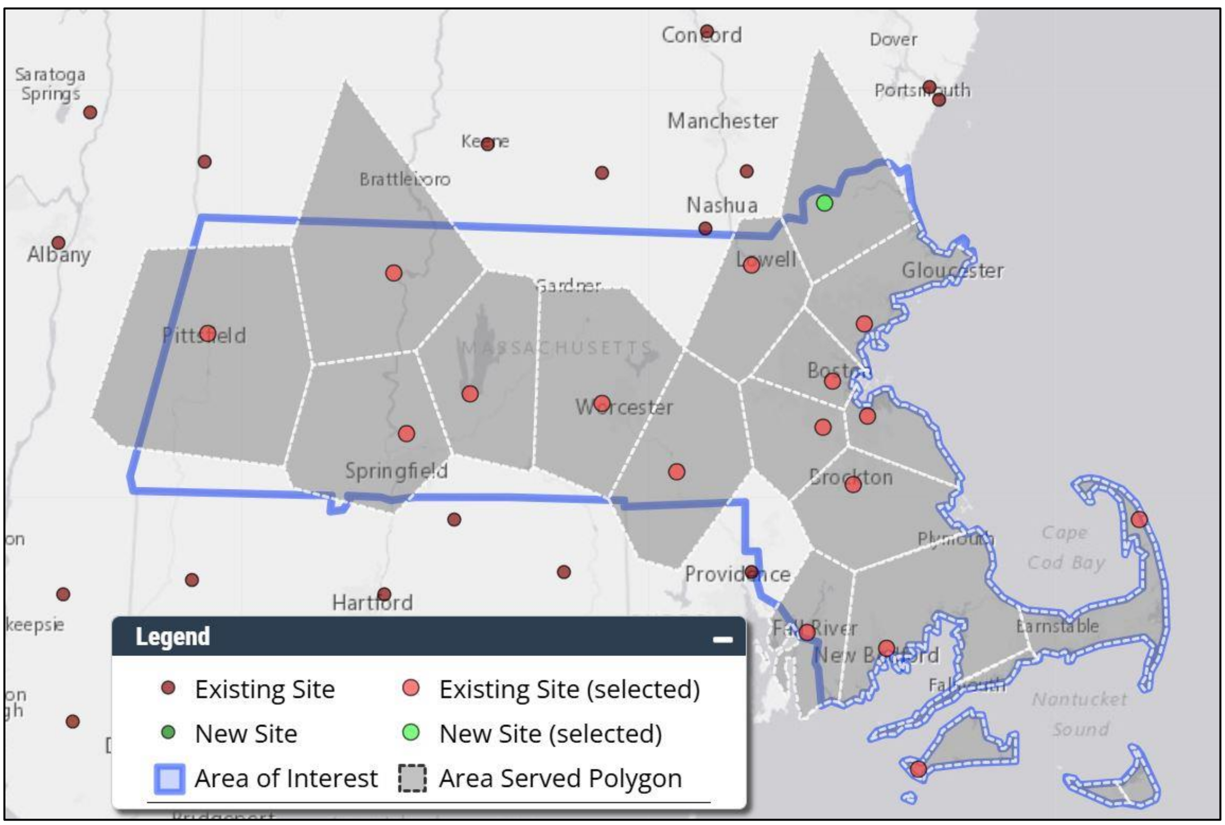
Site ID	Site Name	Scale	Reason for Monitor	MSA/MiSA
25-025-0042	Boston - Harrison Ave	Neighborhood	Population Exposure	Boston-Cambridge-Newton MSA
25-023-0005	Brockton	Urban	Population Exposure	Boston-Cambridge-Newton MSA
25-017-0009	Chelmsford - EPA	Neighborhood	Population Exposure	Boston-Cambridge-Newton MSA
25-013-0008	Chicopee	Urban	Population Exposure	Springfield MSA
25-005-1006	Fairhaven	Regional	Population Exposure	Providence-Warwick MSA
25-005-1004	Fall River	Neighborhood	Population Exposure	Providence-Warwick MSA
25-011-2005	Greenfield	Regional	Population Exposure	Greenfield Town MiSA
25-009-5006	Haverhill - HS	Regional	Population Exposure	Boston-Cambridge-Newton MSA
25-009-2006	Lynn	Urban	PAMS - Max Precursor O_3; Population Exposure	Boston-Cambridge-Newton MSA
25-021-3003	Milton - Blue Hill	Regional	Upwind Background $PM_{2.5}$; Maximum O_3	Boston-Cambridge-Newton MSA
25-003-0008	Pittsfield	Regional	Population Exposure	Pittsfield MSA

25-001-0002	Truro	Regional	General Background	Barnstable MSA
25-027-0024	Uxbridge	Regional	O_3 Transport; Population Exposure	Worcester MSA
25-015-4002	Ware	Urban	Max. O_3 Conc.; Background for other pollutants	Springfield MSA
25-021-2005	Weymouth	Neighborhood	Population Exposure	Boston-Cambridge-Newton MSA
25-027-0015	Worcester - Airport	Urban	Population Exposure	Worcester MSA
25-007-0001	Aquinnah	Regional	Regional	Providence-Warwick MSA

5.2.2 Areas Served

Figure 5-15 shows the area served by each ozone monitor as defined by Voronoi polygons. These polygons were developed using NetAssess2025. The polygons show that the state is well covered by monitors in Massachusetts or in neighboring states.

Figure 5-15
Area Served – Ozone sites



Source: NetAssess2025 Ambient Air Monitoring Network Assessment Tool

Notes: The Haverhill site was established after the NetAssess2025 tool was compiled and was manually added using functions in the NetAssess2025 tool.

5.2.3 Monitoring Data

2024 Ozone Data Summary

Figure 5-16 shows a summary of 2024 ozone season data (March 1 – September 30).

Figure 5-16
2024 O_3 Monitoring Data Summary (ppm)

City	County	Address	1ST MAX 8-HR	2ND MAX 8-HR	3RD MAX 8-HR	4TH MAX 8-HR	8-HR MAX>0.070 STD
Aquinnah (Tribal)	Dukes	Herring Creek Dr	0.073	0.063	0.062	0.061	1
Boston	Suffolk	Harrison Avenue	0.061	0.059	0.059	0.058	0
Brockton	Plymouth	Clinton Street	0.069	0.066	0.066	0.064	0
Chelmsford	Middlesex	Technology Drive	0.068	0.063	0.062	0.061	0
Chicopee	Hampden	Anderson Road	0.076	0.073	0.069	0.068	2
Fairhaven	Bristol	School Street	0.070	0.068	0.063	0.063	0
Fall River	Bristol	Globe Street	0.073	0.071	0.070	0.066	2
Greenfield	Franklin	Barr Avenue	0.068	0.068	0.063	0.061	0
Haverhill - HS	Essex	Monument Street	0.066	0.056	0.054	0.053	0
Lynn	Essex	Parkland Avenue	0.076	0.068	0.066	0.066	1
Milton	Norfolk	Canton Avenue	0.066	0.066	0.065	0.065	0
Pittsfield	Berkshire	Silver Lake Blvd	0.069	0.067	0.066	0.066	0
Truro	Barnstable	Collins Road	0.071	0.062	0.062	0.060	1
Uxbridge	Worcester	E. Hartford Ave	0.066	0.062	0.062	0.061	0
Ware	Hampshire	Skyline Drive	0.074	0.073	0.070	0.063	2
Worcester	Worcester	Airport Drive	0.067	0.066	0.066	0.066	0

NAAQS: 8-hour = 0.070 ppm

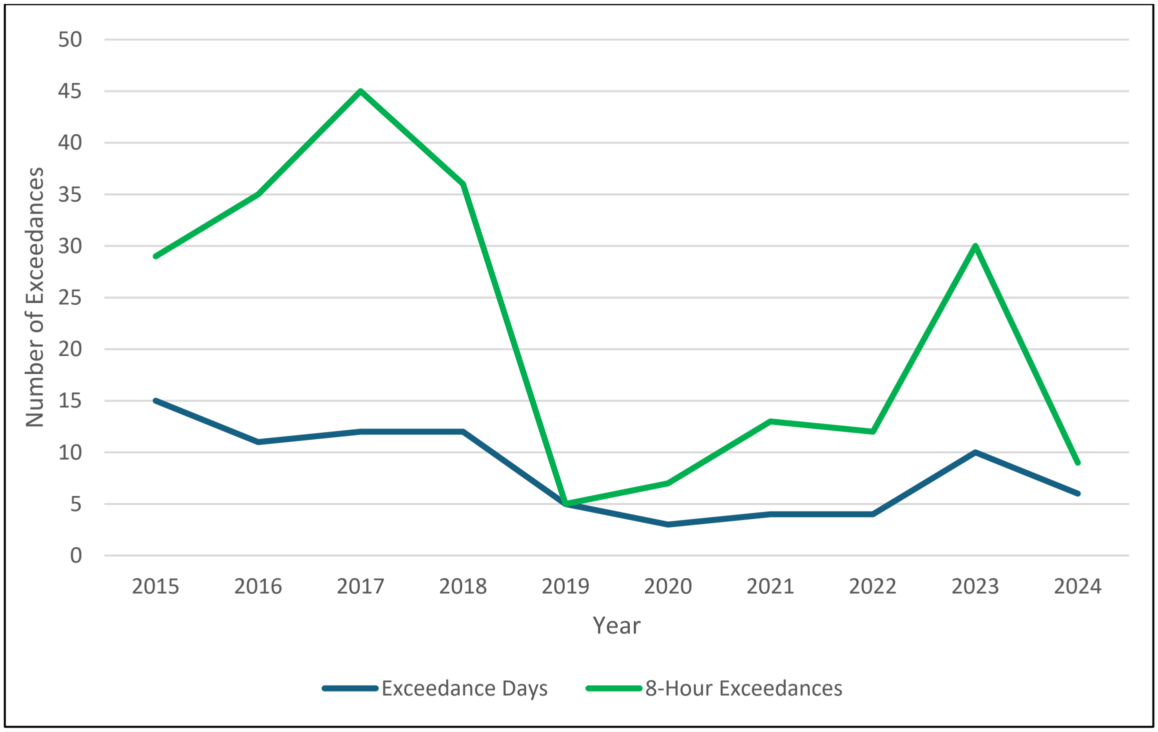
1^{st}, 2^{nd}, 3^{rd}, 4^{th} MAX 8-HR = Maximum 8-hour Value for the 1^{st}, 2^{nd}, 3^{rd} and 4^{th} Highest Day
8-HR MAX > 0.070 STD = Number of Measured Daily 8-hr Maximum Values Greater Than the 0.070 ppm 8-hr Standard

Note: The Lynn 1st Max occurred outside of ozone season during a local brush fire event.

8-hour Ozone Exceedance Trends

Figure 5-17 shows the trends of 8-hour ozone exceedances for each monitor based on the 2015 8-hour standard.

Figure 5-17
8-hour Ozone Exceedance Trends 2015 – 2024
Based on the 0.070 ppm 8-hour Standard



Ozone Design Values

The 2015 8-hour NAAQS for ozone is 0.070 parts per million (ppm). The design value is the 3-year average of the annual fourth-highest daily maximum 8-hour ozone concentration. Figure 5-18 shows ozone design values based on 2021-2024 monitored data. All design values are below the 8-hour 0.070 ppm ozone standard.

Figure 5-18
Ozone Monitor 2024 Design Values (ppm)

City	County	Address	Design Value 2022-2024
Aquinnah (Tribal)	Dukes	Herring Creek Drive	0.066
Boston	Suffolk	Harrison Avenue	0.063
Brockton	Plymouth	Clinton Street	0.064
Chelmsford	Middlesex	Technology Drive	0.062
Chicopee	Hampden	Anderson Road	0.066
Fairhaven	Bristol	School Street	0.063
Fall River	Bristol	Globe Street	0.065
Greenfield	Franklin	Barr Avenue	0.061
Haverhill - HS	Essex	Washington Street	0.059*
Lynn	Essex	Parkland Avenue	0.068

Milton	Norfolk	Canton Avenue	0.067
Pittsfield	Berkshire	Silver Lake Blvd	0.064
Truro	Barnstable	Collins Road	0.062
Uxbridge	Worcester	E. Hartford Ave	0.060
Ware	Hampshire	Skyline Drive	0.063
Weymouth	Norfolk	Monatiquot Street	0.065
Worcester	Worcester	Airport Drive	0.059

* The Haverhill design value was derived by combining data from the previous Washington Street location with the current Monument Street location.

5.2.4 Photochemical Assessment Monitoring Station (PAMS) Monitoring

Ground-level ozone is unique because it is not emitted directly into the atmosphere from a stack or a tailpipe. Instead, it forms in the atmosphere from the photochemical reactions of other pollutants such as volatile organic compounds (VOCs) and nitrogen oxides (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.

PAMS is a special designation for enhanced monitoring stations that 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. This data makes it possible to assess ozone attainment progress independent of the meteorological variation that occurs between years.

In addition to the standard NAAQS pollutants (ozone, NO2, etc.) that are measured at other sites, other ozone precursors such as VOCs, including hydrocarbons and carbonyl compounds (e.g., aldehydes), are measured at PAMS stations on either an hourly basis or at regular intervals during June, July and August. NOx (total oxides of nitrogen) measurements (including NOx, NO and NO_2) and NOy (total reactive oxides of nitrogen) are also required at PAMS sites. NOy characterizes atmospheric nitrogen reactions better than traditional NOx measurements. The target carbonyl compounds (formaldehyde and acetaldehyde), which have been measured as indicators of photochemical reactions, have received renewed attention regarding their air toxics relevance.

Meteorology is a critical component of ozone formation. Each PAMS site has a full complement of meteorological sensors including wind speed, wind direction, temperature, relative humidity, barometric pressure, solar radiation, precipitation and atmospheric mixing heights.

Although Massachusetts is currently in attainment with the ozone NAAQS, MassDEP continues to operate one PAMS site in Lynn (25-009-2006). The benefits of continued PAMS monitoring in

Lynn include obtaining spatial and temporal trends. MassDEP is in the ozone transport region (OTR) and has collected PAMS data for over 25 years. Continued PAMS measurements can be compared with regional and historic data to demonstrate trends in ozone precursor pollutants as they move through the heavily populated northeast corridor.

When the ozone and PAMS sites were originally established, MassDEP worked closely with EPA to ensure that the proper analyses were done to ensure that each site met the network design requirements. Since population and pollution sources have not significantly changed since the mid-1990s, MassDEP is confident that the ozone sites and the PAMS site still meet the appropriate design criteria.

MassDEP continues to participate in regional and national discussions designed to make sure the PAMS and ozone networks are both efficient and relevant. MassDEP believes the current configuration is sufficient for air pollution forecasting and ozone SIP development and implementation.

Figure 5-19
Location and Description of the PAMS Site

Site ID	Site Name	Reason for Monitor	Date Established	Pollutant Measurements	Meteorological Measurements
25-009-2006	Lynn	PAMS - Max. Precursor; Population Exposure	1/1/1992	O_3, NO, NO_2, NO_X, NO_Y, $PM_{2.5}$, VOCs, Carbonyls	WS, WD, TEMP, RH, BP, SOLAR, PRECIP, ABL

WS = wind speed
WD = wind direction
TEMP = temperature
RH = relative humidity
BP = barometric pressure
SOLAR = solar radiation
PRECIP = precipitation
ABL = atmospheric boundary layer

5.2.5 Monitoring Technology

Ozone

MassDEP uses continuous ultraviolet (UV) light photometry to monitor ambient ozone concentrations. This is the Federal Automated Equivalent Method and there is no reason to change this equipment, although there is current research into the reintroduction of chemiluminescence method.

PAMS

MassDEP operates an Automated Gas Chromatograph (Auto-GCs) with a flame ionization detector (FID) to measure ozone precursor target hydrocarbon VOCs (volatile organic compounds) at the Lynn PAMS site. This instrument completes an hourly sample collection and analysis cycle to measure target VOCs.

5.2.6 Adequacy of the Monitoring Network

EPA Requirements

As demonstrated in Figure 5-20, MassDEP's ozone monitoring network meets minimum EPA requirements.

Figure 5-20
Minimum Ozone Monitoring Requirements

MSA	2023 Population	Design Value (max for MSA)	≥85% of Std?	Monitors Required	Monitors in Network	Maximum Concentration Site
Boston-Cambridge-Newton	4,919,179	0.068	Yes	3	8	Lynn
Barnstable	231,735	0.062	Yes	1	1	Truro
Providence-Warwick	1,677,803	0.065	Yes	2	2	Fall River
Worcester	866,866	0.060	Yes	2	2	Uxbridge
Springfield	622,793	0.066	Yes	2	3	Chicopee
Greenfield	70,836	0.061	Yes	1	1	Greenfield
Pittsfield	126,818	0.064	Yes	1	1	Pittsfield

Note: Springfield includes Amherst Town-Northampton

Design Criteria:

If the Design value is ≥85% of the standard:

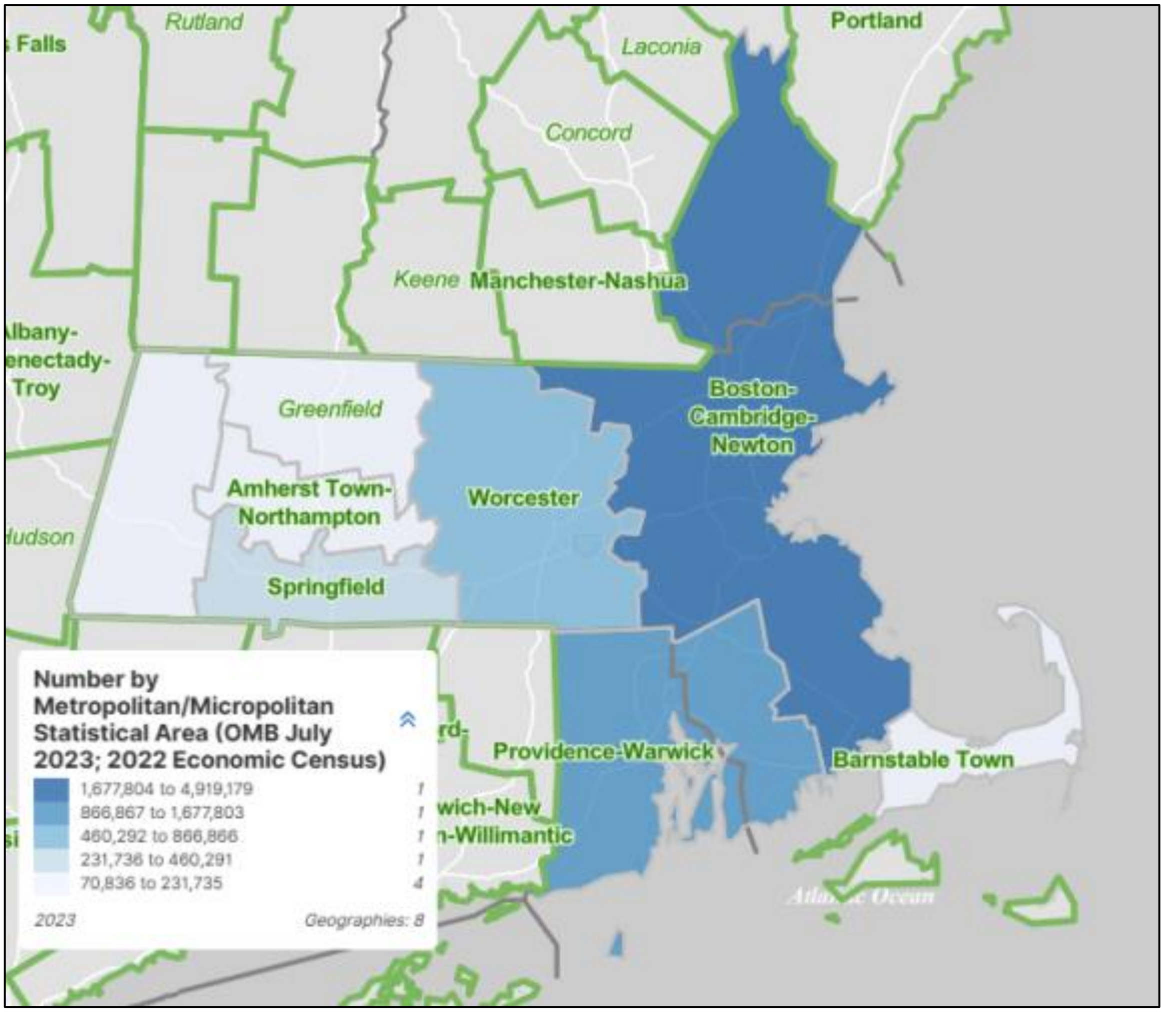
- MSAs with a population of > 10 million require 4 monitors
- MSAs with a population of 4 - 10 million require 3 monitors
- MSAs with a population of 350,000 - < 4 million require 2 monitors
- MSAs with a population of 50,000 - 349,999 require 1 monitor

If the Design value is <85% of the standard:

- MSAs with a population of > 10 million require 2 monitors
- MSAs with a population of 4 - 10 million require 1 monitor
- MSAs with a population of 350,000 - < 4 million require 1 monitor
- MSAs with a population of 50,000 - 349,999 require 0 monitor

Figure 5-23 shows population estimates for Massachusetts with the highest concentration of the state's population in the Boston-Cambridge-Newton Metro Area.

Figure 5-21
Metro/Micro Statistical Areas in Massachusetts



Source: U.S. Census Bureau, 2023 American Community Survey 1-Year Estimates

Exceedance Probability, Correlations, Removal Bias

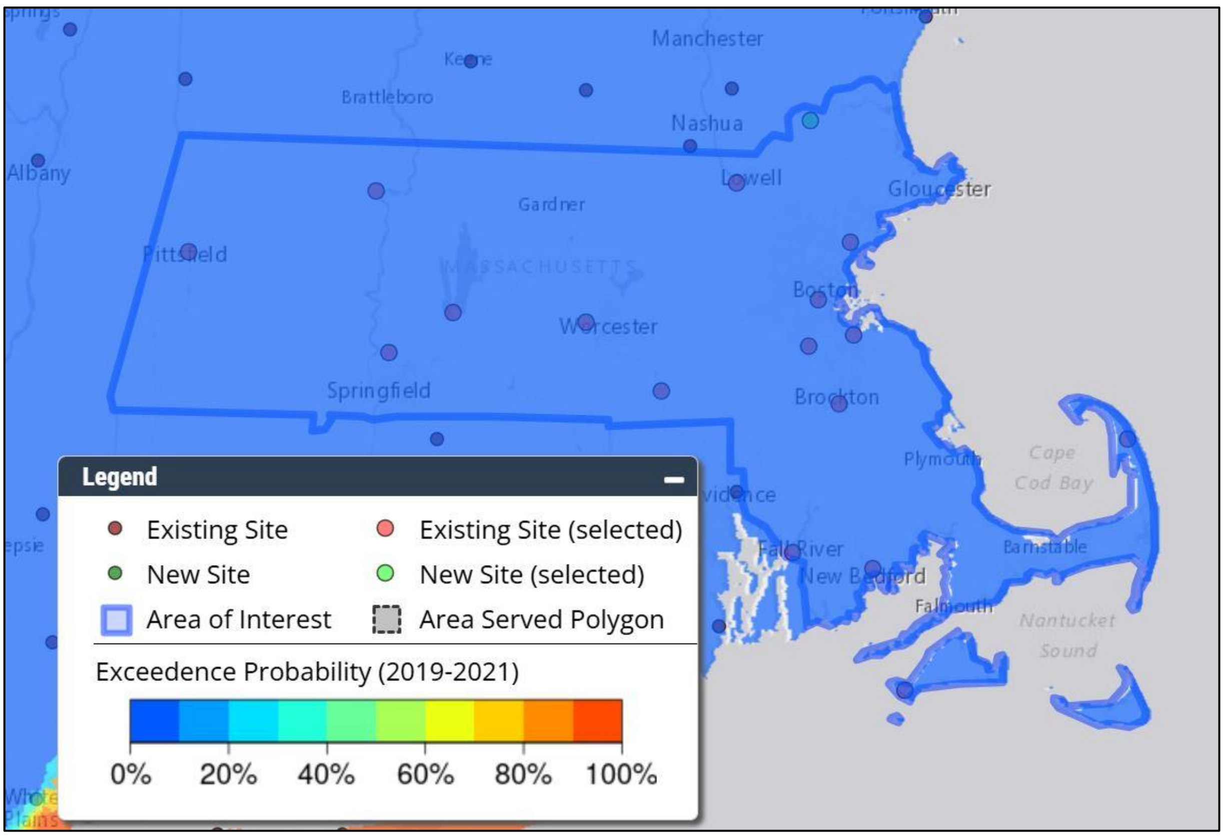
EPA recommends three analytical approaches for identifying potentially underserved areas and redundant sites in the ozone monitoring network. MassDEP used NetAssess2025 to conduct these analyses.

Exceedance Probability

NetAssess2025 provides a probability map to help determine where new monitors may need to be located.

Figure 5-24 shows the probability of exceeding the existing 70 ppb NAAQS. The spatial comparison map indicates all areas of the state have a low probability of daily values exceeding the ozone threshold. No areas of high or moderate probability were indicated.

Figure 5-24
Probability of Exceeding the O_3 70 ppb NAAQS



Source: NetAssess2025 Ambient Air Monitoring Network Assessment Tool

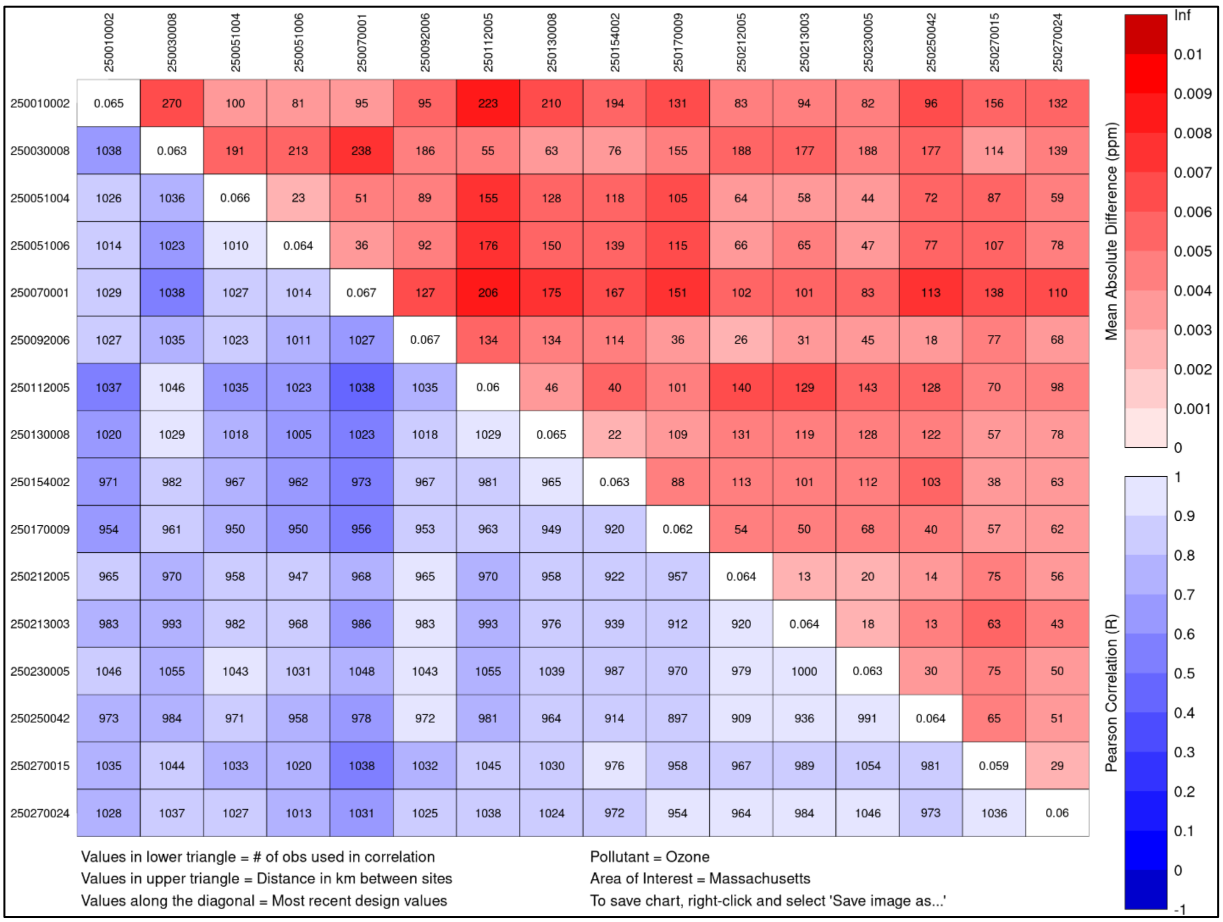
Site Correlation Analysis

The NetAssess2025 tool was used to provide correlations between ozone monitors. The Correlation Matrix tool uses daily summary pollutant concentration data for ozone and fine particles. For ozone, the correlation matrix tool calculates a Pearson Correlation (r) for all valid

8-hour average ozone concentration pairs. If a site has more than one monitor collecting ozone data, the daily maximum 8-hour ozone concentration is the average of all valid results for that site on that date.

Figure 5-25 shows the correlation between ozone measurements at monitoring sites in Massachusetts.

Figure 5-25
Correlation Between Ozone Monitors in Massachusetts



	250010002	250030008	250051004	250051006	250070001	250092006	250112005	250130008	250154002	250170009	250212005	250213003	250230005	250250042	250270015	250270024
250010002	0.065	270	100	81	95	95	223	210	194	131	83	94	82	96	156	132
250030008	1038	0.063	191	213	238	186	55	63	76	155	188	177	188	177	114	139
250051004	1026	1036	0.066	23	51	89	155	128	118	105	64	58	44	72	87	59
250051006	1014	1023	1010	0.064	36	92	176	150	139	115	66	65	47	77	107	78
250070001	1029	1038	1027	1014	0.067	127	206	175	167	151	102	101	83	113	138	110
250092006	1027	1035	1023	1011	1027	0.067	134	134	114	36	26	31	45	18	77	68
250112005	1037	1046	1035	1023	1038	1035	0.06	46	40	101	140	129	143	128	70	98
250130008	1020	1029	1018	1005	1023	1018	1029	0.065	22	109	131	119	128	122	57	78
250154002	971	982	967	962	973	967	981	965	0.063	88	113	101	112	103	38	63
250170009	954	961	950	950	956	953	963	949	920	0.062	54	50	68	40	57	62
250212005	965	970	958	947	968	965	970	958	922	957	0.064	13	20	14	75	56
250213003	983	993	982	968	986	983	993	976	939	912	920	0.064	18	13	63	43
250230005	1046	1055	1043	1031	1048	1043	1055	1039	987	970	979	1000	0.063	30	75	50
250250042	973	984	971	958	978	972	981	964	914	897	909	936	991	0.064	65	51
250270015	1035	1044	1033	1020	1038	1032	1045	1030	976	958	967	989	1054	981	0.059	29
250270024	1028	1037	1027	1013	1031	1025	1038	1024	972	954	964	984	1046	973	1036	0.06

Source: NetAssess2025 Ambient Air Monitoring Network Assessment Tool

Overall, the ozone monitors are highly correlated with an average correlation value of 0.80 and an average mean difference value of 0.005. Figure 5-26 shows highly correlated sites with correlation values greater than 0.90, mean difference less than 0.005 and distance less than 50 km (~31 miles).

The Brockton (25-023-0005) and Milton (25-021-3003) sites appear most frequently in Figure 5-26, with each pairing to another site five times including one pairing between the two sites themselves. The Lynn (25-009-2006), Boston – Harrison Ave (25-025-0042) and Weymouth (25-021-2005) sites each pair to another site four times, including pairings with themselves and the Brockton and Milton sites. No other site appears in Figure 5-26 more than three times.

Figure 5-26
Highly Correlated Ozone Monitors in Massachusetts

Site 1	Site 2	Correlation	Distance (km)	n	Mean Difference
25-005-1004 - Fall River	25-005-1006 - Fairhaven	0.9369	23	1010	0.0027
25-005-1004 - Fall River	25-023-0005 - Brockton	0.9111	44	1043	0.0032
25-009-2006 - Lynn	25-021-3003 - Milton	0.9001	31	983	0.0037
25-009-2006 - Lynn	25-023-0005 - Brockton	0.9189	45	1043	0.0030
25-009-2006 - Lynn	25-021-2005 - Weymouth	0.9456	26	965	0.0026
25-009-2006 - Lynn	25-025-0042 - Boston Harrison Ave	0.9536	18	972	0.0030
25-011-2005 - Greenfield	25-013-0008 - Chicopee	0.9336	46	1029	0.0038
25-013-0008 - Chicopee	25-015-4002 - Ware	0.9280	22	965	0.0029
25-015-4002 - Ware	25-027-0015 - Worcester Airport	0.9155	38	976	0.0031
25-021-2005 - Weymouth	25-021-3003 - Milton	0.9337	13	920	0.0028
25-021-2005 - Weymouth	25-023-0005 - Brockton	0.9612	20	979	0.0021
25-021-2005 - Weymouth	25-025-0042 - Boston Harrison Ave	0.9603	14	909	0.0034
25-021-3003 - Milton	25-023-0005 - Brockton	0.9429	18	1000	0.0028
25-021-3003 - Milton	25-025-0042 - Boston Harrison Ave	0.9178	13	936	0.0045
25-021-3003 - Milton	25-027-0024 - Uxbridge	0.9016	43	984	0.0040
25-023-0005 - Brockton	25-025-0042 - Boston Harrison Ave	0.9297	30	991	0.0036
25-027-0015 - Worcester Airport	25-027-0024 - Uxbridge	0.9264	29	1036	0.0027

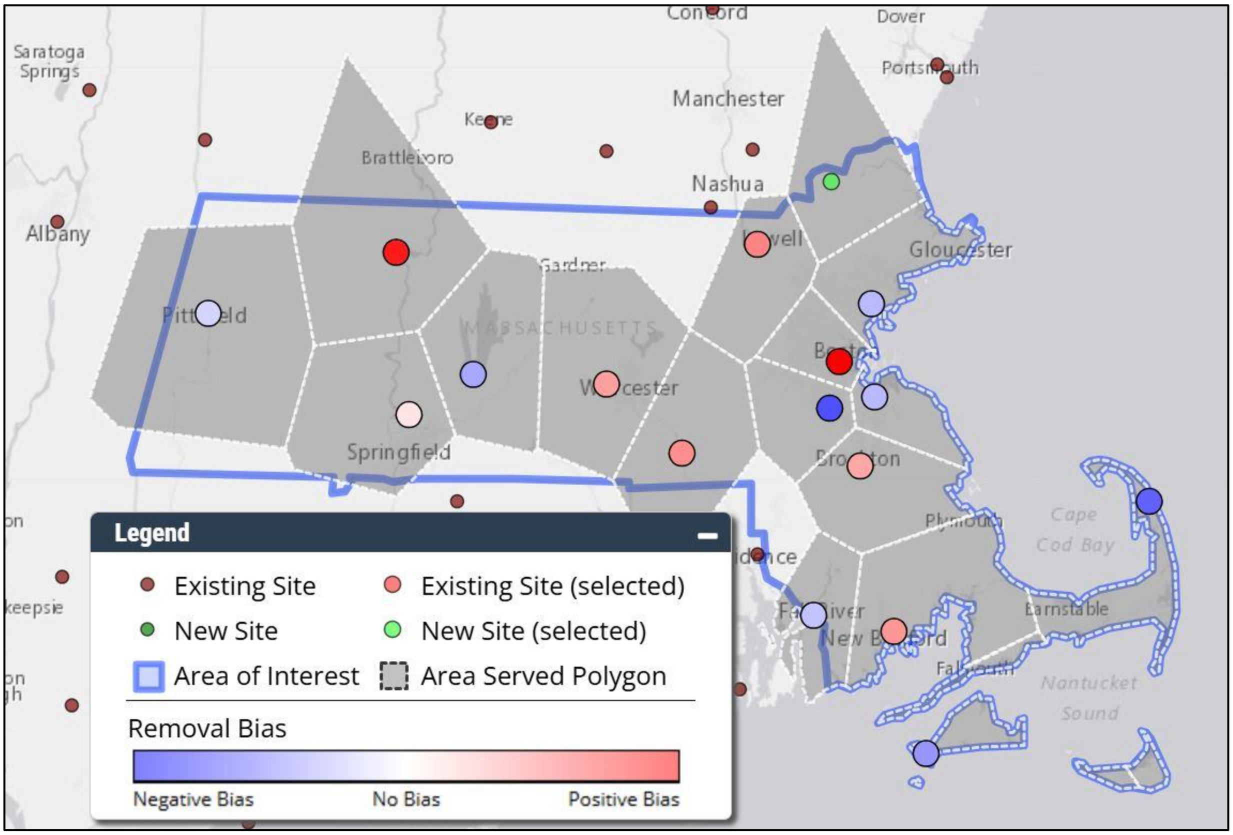
n = Number of observations used in correlation
km = kilometers

Source: NetAssess2025 Ambient Air Monitoring Network Assessment Tool

Removal Bias Analysis

Removal bias was calculated with NetAssess2025. Figures 5-27 and 5-28 show the removal bias that would result from eliminating each ozone monitor individually. Since removal bias includes measured concentrations in its calculation, only sites with a full year of measured concentrations in 2024 are included in Figure 5-27; therefore, the Haverhill - HS ozone monitor is excluded.

Figure 5-27
Removal Bias for Ozone Monitors



Source: NetAssess2025 Ambient Air Monitoring Network Assessment Tool

Figure 5-28
Removal Bias Statistics for Ozone Monitors

Site ID	Site Name	Mean Removal Bias	Min Removal Bias	Max Removal Bias	Removal Bias Standard Deviation	Neighbors Included
25-007-0001	Aquinnah (Tribal)	-0.0012	-0.024	0.021	0.0044	9
25-025-0042	Boston	0.0029	-0.006	0.021	0.0029	4
25-023-0005	Brockton	0.0010	-0.009	0.015	0.0021	6
25-017-0009	Chelmsford	0.0014	-0.008	0.012	0.0027	6
25-013-0008	Chicopee	0.0003	-0.013	0.019	0.0029	6
25-005-1006	Fairhaven	0.0012	-0.010	0.015	0.0027	4
25-005-1004	Fall River	-0.0007	-0.014	0.012	0.0027	5
25-011-2005	Greenfield	0.0026	-0.010	0.032	0.0036	5
25-009-2006	Lynn	-0.0008	-0.013	0.008	0.0028	7
25-021-3003	Milton	-0.0020	-0.016	0.010	0.0033	6

25-003-0008	Pittsfield	-0.0005	-0.008	0.017	0.0026	6
25-001-0002	Truro	-0.0018	-0.016	0.019	0.0039	14
25-027-0024	Uxbridge	0.0013	-0.006	0.015	0.0024	7
25-015-4002	Ware	-0.0010	-0.018	0.009	0.0031	7
25-021-2005	Weymouth	-0.0008	-0.009	0.012	0.0024	5
25-027-0015	Worcester	0.0011	-0.015	0.016	0.0030	5

Source: NetAssess2025 Ambient Air Monitoring Network Assessment Tool

The mean removal bias is generally very small, but the distance between the minimum and maximum is substantial. Therefore, removing any one monitor would not introduce significant bias on average, but would introduce the potential for relatively large errors (imprecision). This analysis therefore does not point to any particular monitor as redundant and a good candidate for removal.

5.2.7 Analysis Results

MassDEP's ozone monitoring network meets EPA monitoring requirements and objectives and provides good coverage for the state, and there is no need for additional ozone or PAMS monitors at this time. While it is possible that some ozone monitors could be eliminated, MassDEP measures other pollutants at most ozone monitoring sites, providing additional benefits.

5.3 Carbon Monoxide (CO)

5.3.1 Network Description

MassDEP currently operates three carbon monoxide (CO) monitors in Suffolk and Worcester Counties. The network consists of trace-level instruments that measure from 0 to 5 parts per million. Trace-level monitors are used at locations where CO levels are expected to be less than 2 parts per million. Values around the state have been consistently low for quite some time. Figure 5-29 lists the location, purpose, description and EPA scale of each of the CO monitoring stations.

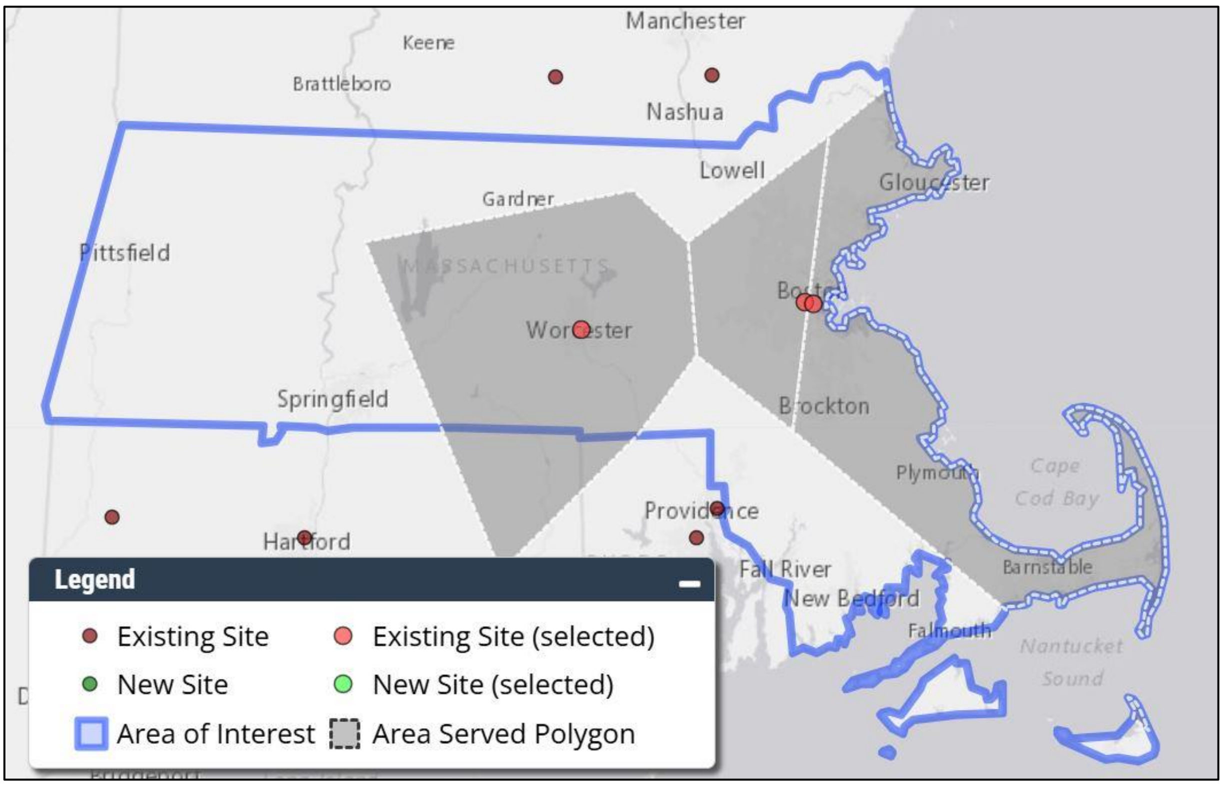
Figure 5-29
CO Monitoring Network Description

Site ID	Site Name	Scale	Reason for Monitor	MSA/MiSA
25-025-0044	Boston - Von Hillern	Middle	Population Exposure; Max. Concentration; Near Road	Boston-Cambridge-Newton MSA
25-025-0042	Boston - Harrison Ave	Neighborhood	Population Exposure	Boston-Cambridge-Newton MSA
25-027-0023	Worcester - Summer St	Middle	Population Exposure	Worcester MSA

5.3.2 CO Monitor Areas Served

Figure 5-30 shows the area served by each CO monitor as defined by Voronoi polygons. These polygons were developed using NetAssess2025. Due to the very low levels of CO monitored, CO has become much less of a concern for EPA and states, and MassDEP has worked with EPA to gradually reduce its CO monitoring network.

Figure 5-30
Area Served – CO sites



Source: NetAssess2025 Ambient Air Monitoring Network Assessment Tool

5.3.3 Monitoring Data

2024 Data Summary

Figure 5-31 summarizes 2024 CO data. All values are well below the applicable NAAQS.

Figure 5-31 2024 CO Monitoring Data Summary (ppm)						
City	County	Address	1ST MAX 1-HR	2ND MAX 1-HR	1ST MAX 8-HR	2ND MAX 8-HR
Boston	Suffolk	Harrison Avenue	1.584	1.438	1.3	1.0
Boston	Suffolk	Von Hillern Street	1.777	1.646	1.3	0.9
Worcester	Worcester	Summer Street	1.412	1.254	1.0	0.9

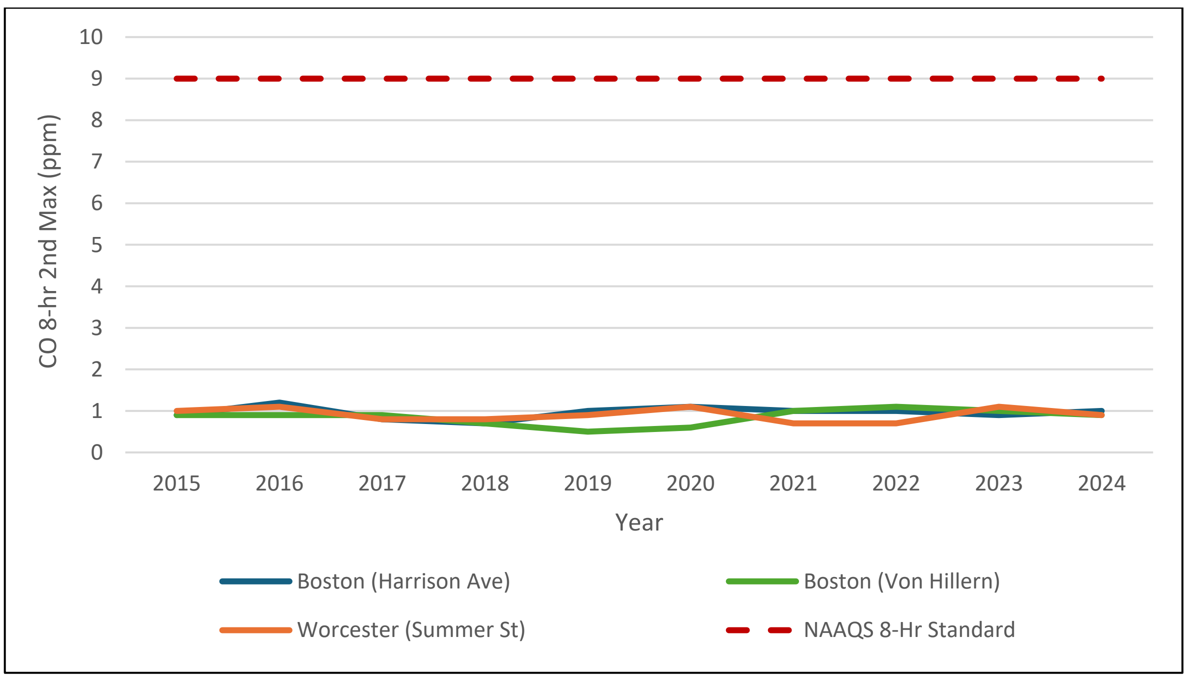
Primary NAAQS:
- 8-hour = 9 ppm
- 1-hour = 35 ppm

1st, 2nd MAX 1-HR = First and Second highest 1-hour value
1st, 2nd MAX 8-HR = First and Second highest 8-hour value

CO Trends

Figure 5-33 shows the trend of each CO monitor relative to the 8-hour standard of 9 ppm.

Figure 5-33
Carbon Monoxide Trends 2015-2024
2nd Maximum 8-hour Values



CO Design Values

There are no design values for CO, but only values not to be exceeded. The 8-hour NAAQS for CO is 9 parts per million (ppm) not to be exceeded more than once per year. The 1-hour NAAQS for CO is 35 ppm not to be exceeded more than once per year. Figure 5-32 shows that Massachusetts is consistently well below both the 8-hour and 1-hour CO standards.

Figure 5-32 2024 Summary Values for CO (ppm)				
			2022 – 2024 Maximum Value	
City	County	Address	1 Hour (35 ppm)	8 Hour (9 ppm)
Boston	Suffolk	Harrison Avenue	1.533	1.167
Boston	Suffolk	Von Hillern Street	2.775	1.367
Worcester	Worcester	Summer Street	1.534	1.000

5.3.4 Monitoring Technology

MassDEP uses infrared red (IR) absorption analyzers to monitor low concentration range (trace level) CO. There is no reason to change to another measurement technology at this time.

5.3.5 Adequacy of the Monitoring Network

EPA Requirements

MassDEP has sited its CO monitors in compliance with EPA requirements, guidance and approval. Near-road sites in CBSAs having a population of 1,000,000 or more are required to collocate one CO monitor with one NO_2 monitor. MassDEP's Boston – Von Hillern site fulfills this requirement.

In addition, continued operation of existing CO sites using FRM or FEM monitors is required until discontinuation is approved by EPA. The Boston-Harrison Avenue and Worcester - Summer Street monitors represent urban background, and Boston-Von Hillern monitors near-road concentrations.

5.3.6 Analysis Results

MassDEP's CO monitoring network meets EPA monitoring requirements and objectives and provides adequate coverage for the state given the very low levels of CO monitored, and no additional monitors are needed.

5.4 Sulfur Dioxide (SO_2)

5.4.1 Network Description

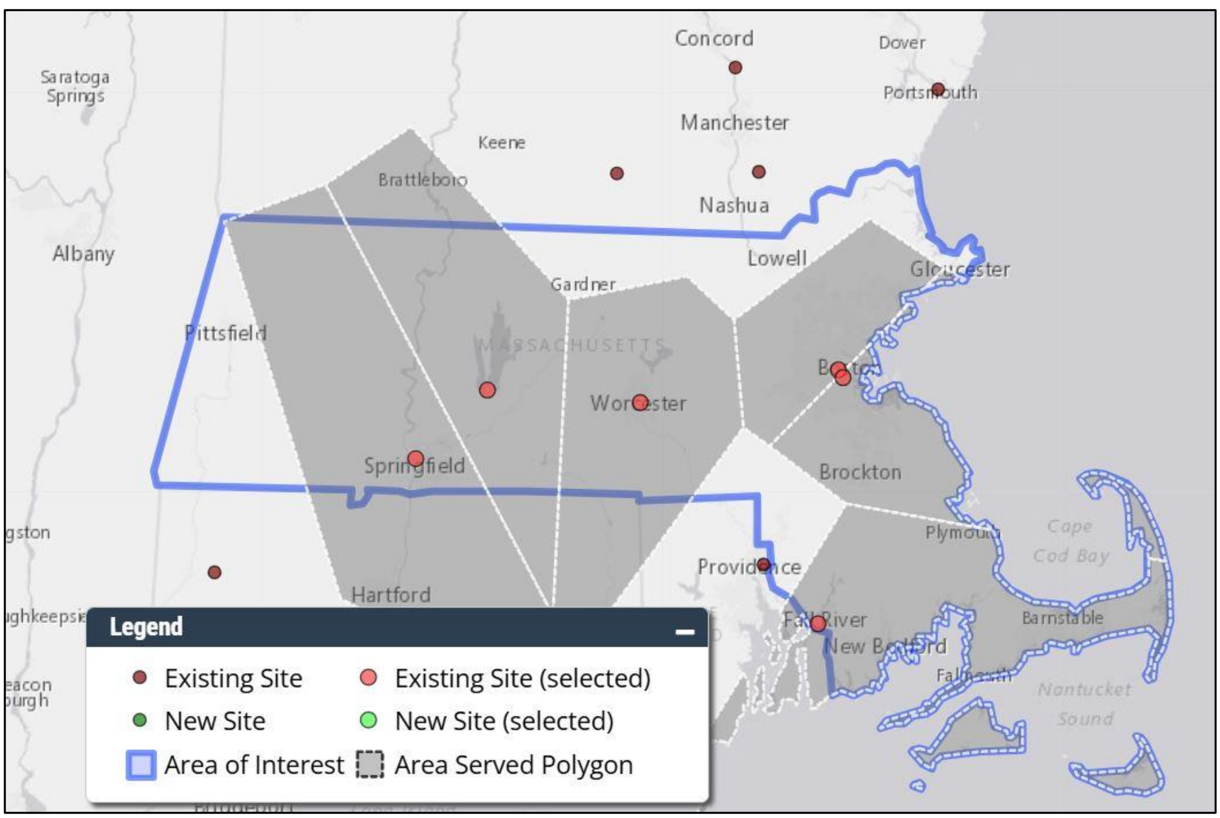
MassDEP currently operates six SO_2 monitors in Suffolk, Worcester, Bristol, Hampden and Hampshire Counties. Similar to CO, SO_2 concentrations have decreased so significantly that trace instruments are used for monitoring. Figure 5-34 lists the location, purpose and description of the SO_2 monitoring stations and their EPA scales for SO_2 monitoring purposes.

Figure 5-34 SO_2 Monitoring Network Description				
Site ID	**Site Name**	**Scale**	**Reason for Monitor**	**MSA/MiSA**
25-025-0002	Boston - Kenmore	Neighborhood	Population Exposure	Boston-Cambridge-Newton MSA
25-025-0042	Boston - Harrison Ave	Neighborhood	Population Exposure	Boston-Cambridge-Newton MSA
25-005-1004	Fall River	Neighborhood	Population Exposure	Providence-Warwick MSA
25-013-0018	Springfield	Urban	Population Exposure	Springfield MSA
25-015-4002	Ware	Urban	Population Exposure	Springfield MSA
25-027-0023	Worcester - Summer St	Urban	Population Exposure	Worcester MSA

5.4.2 Area Served

Figure 5-35 shows the area served by each SO_2 monitor as defined by Voronoi polygons. These polygons were developed using NetAssess2025. The SO_2 monitoring network provides adequate coverage for the state given the low levels monitored. All major SO_2 emission sources in Massachusetts have ceased operation and SO_2 values have remained very low for several years.

Figure 5-35
Area Served for SO_2 Monitor



Source: NetAssess2025 Ambient Air Monitoring Network Assessment Tool

5.4.3 Monitoring Data

2024 SO_2 Data Summary

Figure 5-36 summarizes 2024 monitoring data for SO_2. All values are well below the applicable NAAQS.

Figure 5-37
2024 SO_2 Monitoring Data Summary (ppb)

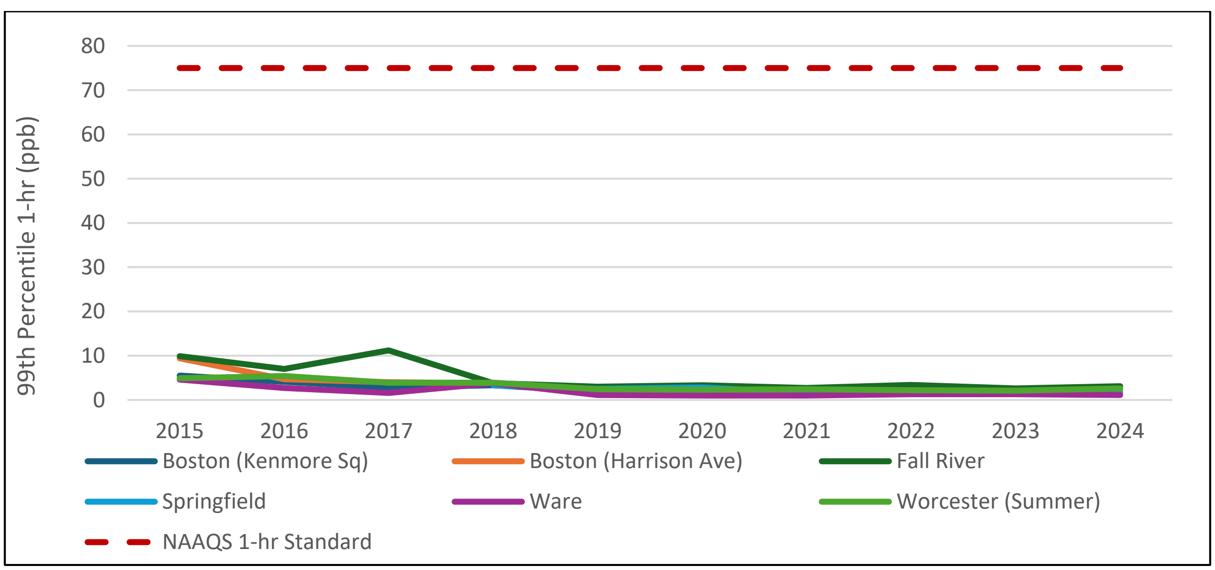
City	County	Address	1ST MAX 1-HR	2ND MAX 1-HR	99TH PCTL 1-HR	ARITH MEAN	1ST MAX 24-HR	2ND MAX 24-HR
Boston	Suffolk	Kenmore Square	2.5	2.0	1.9	0.43	1.2	1.0
Boston	Suffolk	Harrison Avenue	3.1	2.8	2.1	0.48	1.3	1.2
Fall River	Bristol	Globe Street	3.9	3.2	3.1	0.36	1.0	1.0
Springfield	Hampden	Liberty Street	2.5	1.5	1.5	0.14	0.8	0.7
Ware	Hampshire	Skyline Drive	2.0	1.4	1.1	0.33	0.9	0.8
Worcester	Worcester	Summer Street	3.7	3.3	2.6	0.42	1.5	1.4

Primary NAAQS: 1-hour = 75 ppb
Secondary NAAQS: 3-hour = 10 ppb
1st, 2nd MAX 1-HR = First and Second highest 1-hour value
99th PCTL 1-HR = 99th Percentile of the 1-hour maximum value
ARITH MEAN = Annual mean
1st, 2nd MAX 24-HR = First and Second highest 24-hour value

SO_2 Trend Data

Figure 5-37 shows the trends for each SO2 monitor relative to the 1-hour standard of 75 ppb.

Figure 5-37
Sulfur Dioxide Trends 2014 – 2023
1-hour 99th Percentile Annual Average



SO_2 Design Values

Figure 5-37 shows the 2024 design values for each SO2 monitor. The annual SO2 NAAQS is 75 ppb measured as the 99th percentile of the 1-hour daily maximum concentrations averaged over three years. Design values for all monitors are well below the NAAQS.

Figure 5-37 2022-2024 SO_2 Design Values (ppb)			
City	County	Address	Design Value 2022-2024
Boston	Suffolk	Kenmore Square	2
Boston	Suffolk	Harrison Avenue	2
Fall River	Bristol	Globe Street	3
Springfield	Hampden	Liberty Street	1
Ware	Hampshire	Skyline Drive	1
Worcester	Worcester	Summer Street	2

5.4.4 Monitoring Technology

MassDEP uses an ultraviolet (UV) fluorescence absorption continuous monitoring technology to measure ambient SO_2 trace concentrations. There is no need to change to a different monitoring technology at this time.

5.4.5 Adequacy of the Monitoring Network

EPA Requirements

The current SO_2 monitoring network meets EPA requirements. Figure 5-39 shows the population weighted emissions index (PWEI) and number of SO_2 monitors for the state's MSAs.

Figure 5-39 EPA Monitoring Requirements for SO_2							
MSA	MA Counties in MSA	County Population	MA Population in MSA	SO_2 Emissions	PWEI	Monitors Required	Monitors in Network
Boston-Cambridge-Newton	Essex	810,089	4,465,247	2,366	10,565	1	2 (both in Boston)
	Middlesex	1,623,952					
	Suffolk	768,425					
	Norfolk	727,473					
	Plymouth	535,308					
Barnstable	Barnstable	231,735	231,735	146	34	0	0
Providence-Warwick	Bristol	581,841	581,841	2,287	1,331	0	1

Worcester	Worcester	866,866	866,866	401	348	0	1
Springfield	Hampden	460,291	622,793	338	211	0	2
	Hampshire	162,502					
Pittsfield	Berkshire	126,818	126,818	79	10	0	0

Notes: SO2 emissions measured in tons per year. SO_2 emissions for all counties are presented in Figure 4-4.
PWEI = Population weighted emissions index
PWEI = (MA Population in MSA x SO_2 Emissions) / 1,000,000

Design criteria:

- MSAs with a PWEI greater than 1,000,000 require 3 monitors
- MSAs with a PWEI between 100,000 and 1,000,000 require 2 monitors
- MSAs with a PWEI between 5,000 and 100,000 require 1 monitor

5.4.6 Analysis Results

MassDEP's SO_2 monitoring network meets EPA monitoring requirements and objectives and provides adequate coverage for the state given the very low levels of SO_2 monitored, and no additional monitors are needed. Massachusetts no longer has significant SO_2 emissions sources that would warrant SO_2 monitoring.

5.5 Nitrogen Dioxide (NO_2)

5.5.1 Network Description

MassDEP operates 12 NO_2 monitors in 10 municipalities (see Figure 5-40) located in Suffolk, Norfolk, Essex, Worcester, Hampshire and Hampden Counties. NO_2 is a NAAQS pollutant and, along with other oxides of nitrogen, an ozone precursor. NO_2 monitoring is essential at Near-Road monitoring sites and in areas designated by EPA as susceptible and vulnerable populations. Boston - Von Hillern Street and Chelmsford – Manning Road are required Near-Road sites for monitoring compliance with the 1-hour NO_2 standard, and three monitors (Boston – Roxbury, Boston – Kenmore, and Springfield) are designated as representing susceptible and vulnerable populations

Figure 5-40
NO_2 Monitor Site Location, Description and Other Pollutants Monitored

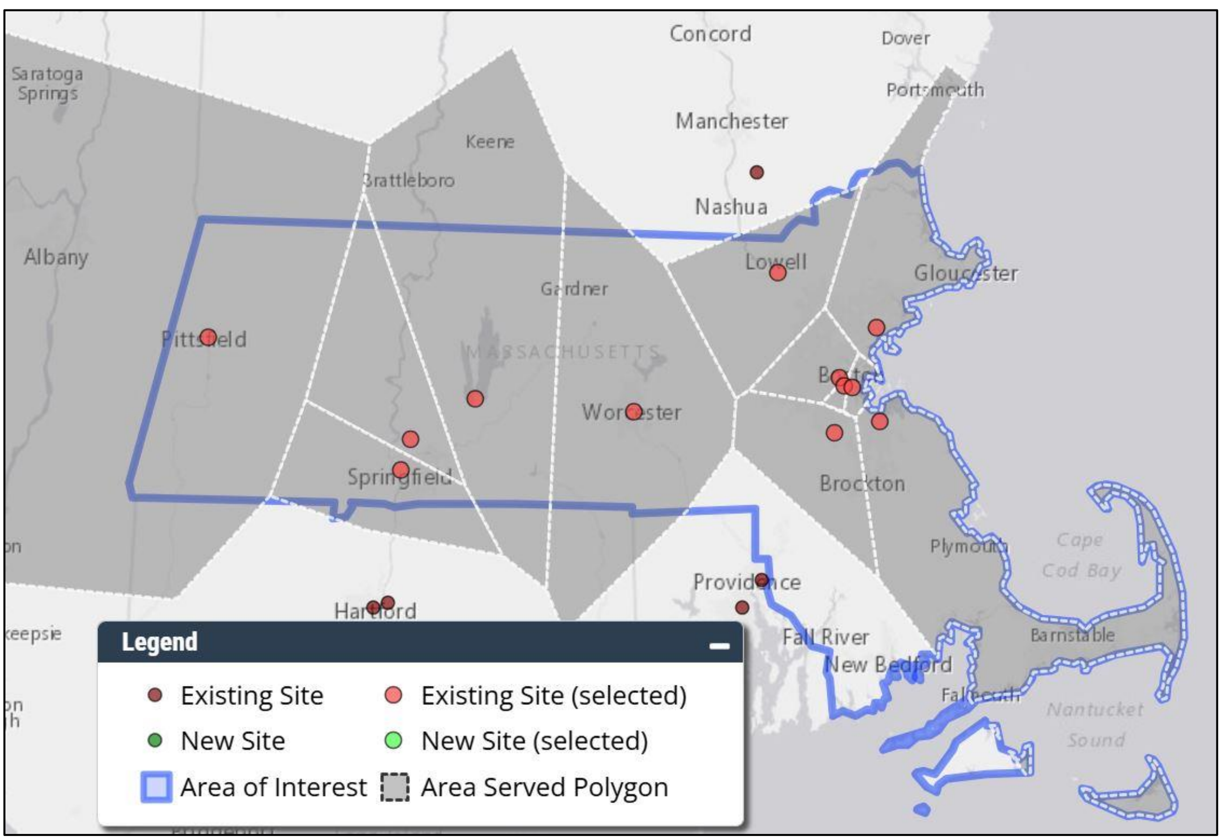
Site ID	Site Name	Scale	Reason for Monitor	MSA/MiSA
25-025-0002	Boston - Kenmore	Micro	Highest Concentration; Population Exposure	Boston-Cambridge-Newton MSA
25-025-0042	Boston - Harrison Ave	Neighborhood	Population Exposure	Boston-Cambridge-Newton MSA
25-025-0044	Boston - Von Hillern St	Middle	Population Exposure; Max. Concentration; Near Road	Boston-Cambridge-Newton MSA
25-017-0010	Chelmsford – Manning Rd	Middle	Population Exposure; Max. Concentration; Near Road	Boston-Cambridge-Newton MSA
25-013-0008	Chicopee	Urban	Population Exposure	Springfield MSA

25-009-2006	Lynn	Urban	PAMS - Max. Precursor O_3; Population Exposure	Boston-Cambridge-Newton MSA
25-021-3003	Milton - Blue Hill	Regional	Upwind Background $PM_{2.5}$; Maximum Ozone	Boston-Cambridge-Newton MSA
25-013-0018	Springfield	Urban	Population Exposure; Highest Concentration	Springfield MSA
25-015-4002	Ware	Urban	Max. O_3 Conc.; background for other pollutants	Springfield MSA
25-027-0023	Worcester - Summer St	Urban	Population Exposure	Worcester MSA

5.5.2 Area Served

Figure 5-41 shows the area served by each NO_2 monitor as defined by Voronoi polygons. These polygons were developed using NetAssess2025. The NO_2 monitoring network provides adequate coverage for the state given that the largest sources of NO_2 are roadways, and the network has two near-road sites (Boston – Von Hillern Street and Chelmsford Manning Street) that are sited where the highest concentrations in the state are expected to be.

Figure 5-41
NO_2 Area Served



Source: NetAssess2025 Ambient Air Monitoring Network Assessment Tool

5.5.3 Monitoring Data

2024 NO2 Data Summary

A summary of the 2024 NO_2 data is shown in Figure 5-42. All levels are well below applicable NAAQS.

Figure 5-42
2024 NO_2 Monitoring Data Summary (ppb)

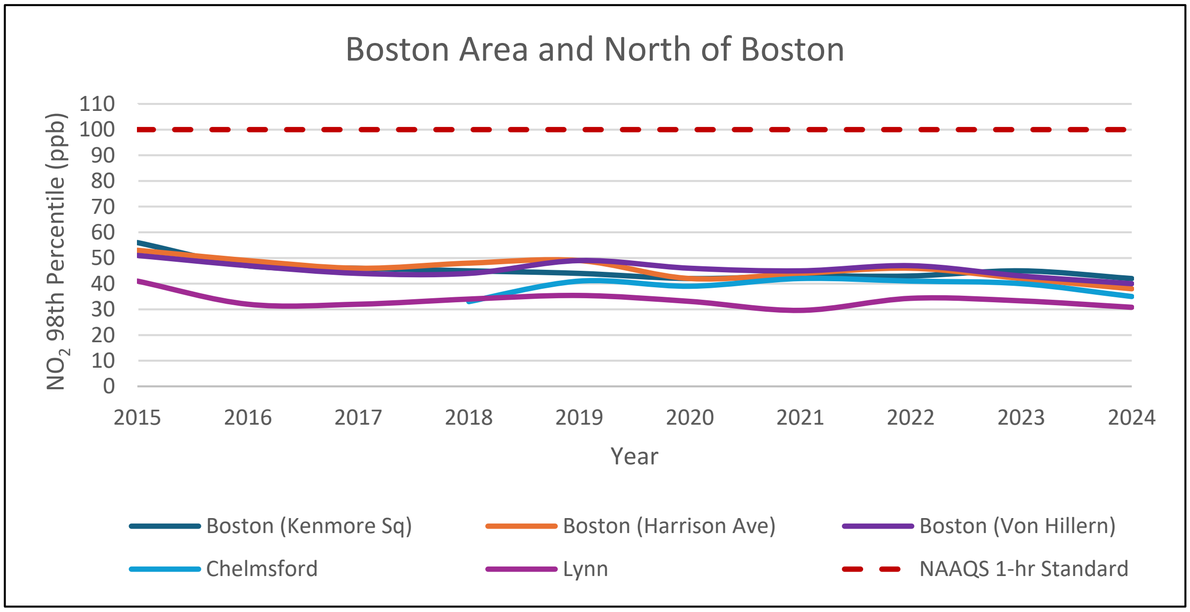
City	County	Address	1ST MAX 1-HR	2ND MAX 1-HR	98TH PERCENTILE VALUE	ARITH MEAN
Boston	Suffolk	Kenmore Square	48.0	48.0	42.0	9.99
Boston	Suffolk	Harrison Avenue	47.0	46.0	38.0	8.62
Boston	Suffolk	Von Hillern Street	44.0	42.0	40.0	11.83
Chelmsford	Middlesex	Manning Road	40.0	39.0	35.0	9.97
Chicopee	Hampden	Anderson Road	32.0	31.0	26.0	4.05
Lynn	Essex	Parkland Avenue	42.1	37.2	30.8	4.52
Milton	Norfolk	Canton Avenue	35.0	28.0	25.0	2.94
Pittsfield	Berkshire	Silver Lake Blvd	31.0	31.0	26.0	4.63
Springfield	Hampden	Liberty Street	45.0	44.0	40.0	8.81
Ware	Hampshire	Skyline Drive	37.0	20.0	12.0	1.23
Weymouth	Norfolk	Monatiquot Street	39.0	36.0	30.0	4.80
Worcester	Worcester	Summer Street	53.0	45.0	41.0	7.99

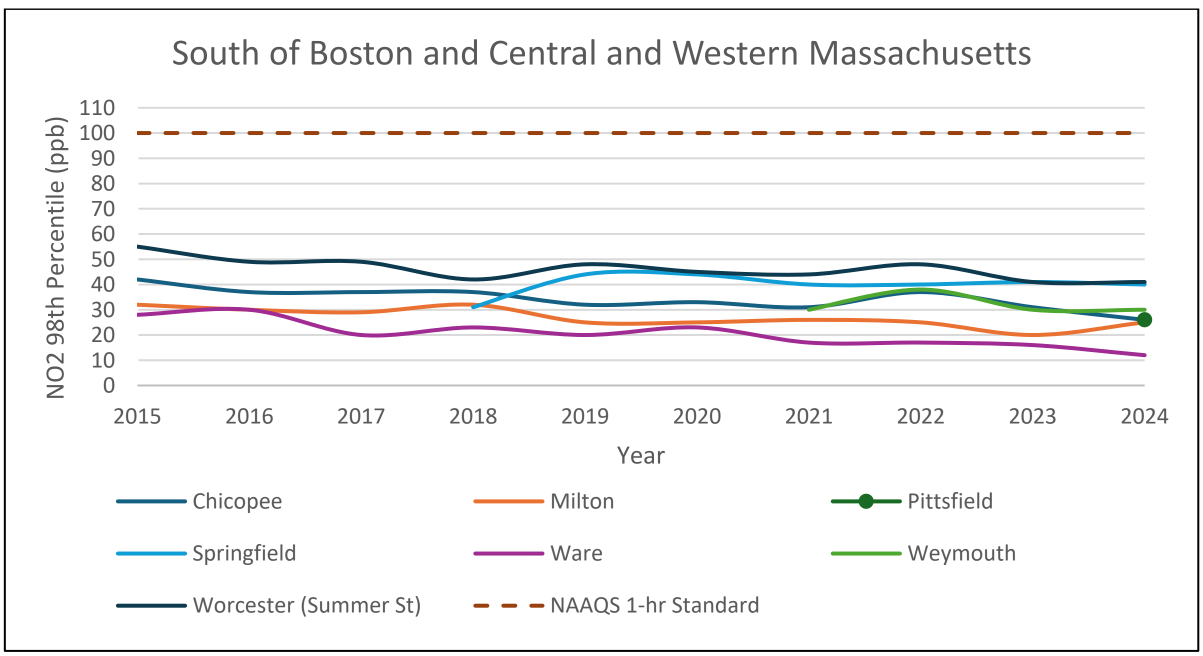
Primary NAAQS: 1-hour = 100 ppb
Primary and Secondary NAAQS: Annual mean = 53 ppb
1^{st}, 2^{nd} MAX 1-HR = First and Second Highest 1-hour Value
ARITH MEAN = Annual Mean

NO_2 Trends Data

Figure 5-44 shows trends for each NO_2 monitor relative to the 1-hour standard of 100 ppb.

Figure 5-44
Nitrogen Dioxide Trends 2015 - 2024
1-hour 98th Percentile Annual Average





NO_2 Design Values

Figure 5-43 shows the 2024 design values for NO_2. The annual average NO_2 NAAQS is 53 ppb. The 1-hour NO_2 NAAQS is 100 ppb calculated as the 3-year average of the annual 98th percentile of the daily 1-hour maximum.

Figure 5-43
2024 Design Values for NO_2

City	County	Address	2022-2024 98th Percentile 1-hour Maximum Design Value	2022-2024 Average Annual Mean
Boston	Suffolk	Kenmore Square	43	10.94
Boston	Suffolk	Harrison Avenue	42	9.12
Boston	Suffolk	Von Hillern Street	43	11.52
Chelmsford	Middlesex	Manning Road	39	10.54
Chicopee	Hampden	Anderson Road	31	4.60
Lynn	Essex	Parkland Avenue	33	4.84
Milton	Norfolk	Canton Avenue	23	3.08
Pittsfield	Berkshire	Silver Lake Blvd	*	*
Springfield	Hampden	Liberty Street	40	9.28
Ware	Hampshire	Skyline Drive	15	1.57
Weymouth	Norfolk	Monatiquot Street	33	4.97
Worcester	Worcester	Summer Street	43	9.08

Primary NAAQS: 1-hour = 100 ppb
Primary and Secondary NAAQS: Annual mean = 53 ppb

* The Pittsfield monitor was deployed in 2023; therefore, data capture is insufficient for a design value.

5.5.4 Technology

MassDEP uses continuous chemiluminescence-based instruments to measure NO_2, NOx, and NOy. Chemilumenescent NOx monitors measure NO_2 indirectly, by subtracting NO (Nitric Oxide) from NOx (total oxides of nitrogen). Under some circumstances, this difference can include the inadvertent inclusion of other nitrogen compounds. In accordance with PAMS requirements, MassDEP uses one Cavity Attenuated Phase Shift (CAPS) analyzer at the Lynn PAMS site. The CAPS spectroscopy technique provides a direct absorption measurement and relies on producing very long optical paths (up to 2 km) using very high reflectivity mirrors in a sampling cell that is less than 30 cm in length.

5.5.5 Adequacy of the Monitoring Network

EPA Monitoring Requirements

In February 2010, EPA promulgated a 100 ppb 1-hour standard for NO2 and established new Near-Road monitoring requirements for heavily traveled roadways, as well as area-wide monitoring. The number of roadway and area wide monitors required in each MSA depends upon the MSA's population and the Annual Average Daily Traffic counts (AADTs) for major roadways in the MSA. Figure 5-45 shows the number of NO2 monitors required in each Massachusetts MSA.

Figure 5-45
EPA NO_2 Monitoring Requirements

MSA	MA County in MSA	County Population	MA Population in MSA	2024 AADT	Required for Near-Road Monitoring	Required for Area-Wide Monitoring	Near-Road Sites	Area-Wide Sites
Boston-Cambridge-Newton	Essex	810,089	4,465,247	216,500	2	1	2	5
	Middlesex	1,623,952						
	Suffolk	768,425						
	Norfolk	727,473						
	Plymouth	535,308						
Barnstable	Barnstable	231,735	231,735	61,324	0	0	0	0
Providence-Warwick	Bristol	581,841	581,841	124,210	0	0	0	0
Worcester	Worcester	866,866	866,866	141,020	0	0	0	1
Springfield	Hampden	460,291	622,793	134,428	0	0	0	3
	Hampshire	162,502						
Pittsfield	Berkshire	126,818	126,818	29,870	0	0	0	1

Source: AADTs – MassDOT annual traffic data collection program (https://www.mass.gov/traffic-volume-and-classification).

Near-road requirements:

- One Near-Road NO_2 monitoring station in each MSA with a population of 1,000,000 or more persons.
- A second Near-Road NO_2 monitoring station is required for any MSA with a population of 2,500,000 persons or more, or in any MSA with a population of 1,000,000 or more persons that has one or more roadway segments with 250,000 or greater AADT counts

Area-wide NO_2 requirements:

- One monitoring station in each MSA with a population of 1,000,000 or more persons.
- PAMS sites that are situated in an area of expected high NO_2 concentrations may be used to satisfy this minimum requirement

5.5.5 Analysis Results

MassDEP's NO_2 monitoring network meets EPA monitoring requirements and objectives and provides good coverage for the state, and there is no need for NO_2 monitors at this time. While it is possible that some NO_2 monitors could be eliminated, MassDEP measures other pollutants at all NO_2 monitoring sites, providing additional benefit.

5.6 Lead (Pb)

5.6.1 Network Description

MassDEP monitors lead at the Boston – Harrison Avenue NCore site using a low-volume PM_{10} method for non-NAAQS purposes under the National Air Toxics Trends Site (NATTS) program. MassDEP does not monitor lead for NAAQS comparison.

5.6.2 Monitoring Data

2023 Pb Data Summary

Since 2024 lead results are not available at the time of this report, a summary of the 2023 Pb data is shown in Figure 5-46. All values are well below the NAAQS.

Figure 5-46 2024 Pb Monitoring Data Summary (μg/m³)				
City	County	Address	2023 MAX μg/m³	2023 MEAN μg/m³
Boston	Suffolk	Harrison Avenue	0.0053	0.00194

Standard: 0.15 $\mu g/m^3$ (rolling 3-month average)

MAX = Maximum 24-hour value
MEAN = Annual Arithmetic Mean

5.6.3 Monitoring Technology

MassDEP currently collects Teflon low volume PM_{10} samples at Boston – Harrison Avenue, which is analyzed via X-ray fluorescence by EPA contractors. The samples are collected every 6th day for 24 hours.

5.6.4 Adequacy of the Monitoring Network

EPA Requirements

Because lead levels are well below the NAAQS, EPA no longer requires lead monitoring at MassDEP's Boston NCore site. EPA requires monitoring near lead sources that emit 0.5 tons or greater annually; however, Massachusetts does not have any sources of lead emissions that meet this level.

5.6.5 Analysis Results

MassDEP is not required to monitor lead for NAAQS purposes. However, MassDEP monitors toxics metals, including lead, at its Boston – Harrison Avenue as part of the National Air Toxics Trends Site (NATTS) program. Levels from this monitoring show lead levels are well below the lead NAAQS of 0.15 $\mu g/m^3$.

5.7 Meteorology (MET)

5.7.1 Network Description

MassDEP operates the following types of meteorological instruments at its monitoring sites:

- 13 – Barometric pressure (BP)
- 13 – Relative humidity (RH)
- 13 – Solar radiation (Solar)
- 13 – Temperature (TEMP)
- 13 – Wind speed/wind direction (WS/WD)
- 1 – Precipitation (PRECIP)

In addition, there are two acid rain monitors in Massachusetts that are part of the National Atmospheric Deposition Program (NADP):

- Ware – operated by MassDEP
- Truro – operated by the National Park Service

Figure 5-47 describes all the meteorological monitors MassDEP operates.

Figure 5-47
Description of Existing Meteorological Monitoring Network

Site ID	Site Name	Scale	Reason for Monitor	Parameters
25-025-0042	Boston - Harrison Ave	Neighborhood	Population Exposure	WS/WD, TEMP, RH, BP, SOLAR
25-025-0044	Boston - Von Hillern	Middle	Population Exposure; Max. Concentration; Near Road	WS/WD, TEMP, RH, BP, SOLAR
25-013-0008	Chicopee	Urban	Population Exposure	WS/WD, TEMP, RH, BP, SOLAR
25-005-1006	Fairhaven	Regional	Population Exposure	WS/WD, TEMP, RH, BP, SOLAR
25-011-2005	Greenfield	Regional / Neighborhood	Population Exposure	WS/WD, TEMP, RH, BP, SOLAR
25-009-5005	Haverhill	Urban	Population Exposure	WS/WD, TEMP, RH, BP, SOLAR
25-009-2006	Lynn	Urban / Neighborhood	PAMS - Max. Precursor O_3; Population Exposure	WS/WD, TEMP, RH, BP, SOLAR, PRECIP, ABL
25-021-3003	Milton - Blue Hill	Regional	Upwind Background $PM_{2.5}$; Maximum Ozone	WS/WD, TEMP, RH, BP, SOLAR
25-003-0008	Pittsfield	Urban / Neighborhood	Population Exposure	WS/WD, TEMP, RH, BP, SOLAR
25-001-0002	Truro	Regional	General Background	WS/WD, TEMP, RH, BP, SOLAR
25-027-0024	Uxbridge	Regional	Ozone Transport; Population Exposure	WS/WD, TEMP, RH, BP, SOLAR
25-015-4002	Ware	Urban	Max. O_3 Conc.; background for other pollutants	WS/WD, TEMP, RH, BP, SOLAR
25-027-0015	Worcester - Airport	Urban	Population Exposure	WS/WD, TEMP, RH, BP, SOLAR

5.7.2 Technology

The Figure 5-48 below summarizes the technology MassDEP uses to measure meteorology. There are no plans to change existing technology.

Figure 5-48 Meteorological Monitoring Technology			
Parameter	**Analytical Method**	**Sample Frequency**	**Location**
Wind Speed/Direction	Ultrasonic Sensors	Hourly	All Meteorological Sites
Solar	Pyranometer	Hourly	All Meteorological Sites
Relative Humidity	Electronic Sensor	Hourly	All Meteorological Sites
Ambient Temperature	Electronic Thermistor	Hourly	All Meteorological Sites
Barometric Pressure	Electronic Sensor	Hourly	All Meteorological Sites
Precipitation	Tipping Bucket	Hourly	Lynn Only

5.7.3 Analysis Results

MassDEP has access to adequate meteorological information to forecast air quality, including predicting ozone and $PM_{2.5}$ episodes, modeling emissions from individual sources, evaluating the transport of pollution (particularly ozone and its precursors), and creating wind roses. MassDEP added a ceilometer at the Lynn PAMS site in 2021.

Section 6 – Technology Issues

Key technology issues that MassDEP must address as part of operating the air monitoring network are listed below.

Calibration

- MassDEP's field calibrators are suitable for ozone and trace-level dilution as appropriate. The equipment is capable of automated quality control checks. MassDEP has an internal ozone generator–photometer.

- MassDEP's lab and field calibrators can generate Minimum Detection Level (MDL) concentrations (CO, SO2, and NOy).

Zero Air Source

- MassDEP's zero air source is compliant with NCore TAD recommendations. An ultra-pure air cylinder is used for occasional comparison to zero air source. The equipment has the capacity for 20+ LPM of dilution air.

Data Acquisition System

- MassDEP's data system is capable of a digital system, remote diagnostics, and remotely enabled checks. MassDEP has invested in a Data Acquisition System with remote communications capabilities, which has improved data polling times and quality and will significantly improve ongoing quality control assessments through real-time and near real-time communications with fields analyzers.

Gas Cylinder Standards

- MassDEP's gas cylinders are suitable for trace-level dilutions in accordance with Appendix A of 40 CFR Part 58 audit concentrations and EPA protocol certifications, and meet the special low-level standards needed for MDL concentrations (CO, SO2, and NOy).

Meteorological Calibration Devices

- MassDEP's meteorological calibration devices have NIST (National Institute of Standards) traceability for required meteorological parameters. Sonic wind instruments must be shipped to the manufacturer annually for factory calibration.

Sampling Manifold

- MassDEP's sampling meets the standards of Appendix E of 40 CFR Part 58, including residence time <20 seconds, only glass or Teflon materials, and probe and monitor inlets of acceptable heights.

Auditing Equipment

MassDEP has the following auditing equipment:

- Independent calibrators
- Zero air source and gas standards compatible with trace-level specifications
- Independent meteorological and flow standards
- A new dilution system capable of generating EPA-required concentration levels

Other

MassDEP has:

- Automated Gas Chromatograph systems for measuring VOC ozone precursors at the PAMS site and at its laboratory for analyzing field-procured VOC canister samples
- An environmental chamber that houses a robotic weighing device for PM_{10} and $PM_{2.5}$ filters
- A real-time website for displaying current air pollution concentrations to the public