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Revision to the Massachusetts State Implementation Plan for Carbon Monoxide

Second 10-Year Limited Maintenance Plan for the Boston Metropolitan Area, Lowell, Springfield, Waltham, and Worcester

February 9, 2018

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SUMMARY

Massachusetts was designated non-attainment for carbon monoxide (CO) in the mid-1970s. Since then CO concentrations have been reduced well below the National Ambient Air Quality Standards (NAAQS) throughout the Commonwealth. At the request of the Massachusetts Department of Environmental Protection (MassDEP), the U.S. Environmental Protection Agency (EPA) redesignated all areas in Massachusetts to attainment, and approved the 10-year maintenance plan for the Boston Metropolitan Area in 1996 and 10-year Maintenance Plan for Lowell, Springfield, Waltham, and Worcester in 2002. Since then Massachusetts has maintained attainment of the CO NAAQS. Monitored levels are currently less than 25% of the standard and continue to decline. Section 175A of the federal Clean Air Act requires a second 10-year maintenance plan for areas that were redesignated to attainment. This document contains the second 10-year Maintenance Plan for the Boston Metropolitan Area and for Lowell, Springfield, Waltham, and Worcester. It summarizes air monitoring data and CO emissions inventory data that demonstrates that attainment has and will be maintained in all areas. It also modifies previous maintenance plans by proposing to discontinue CO monitoring in Springfield and to move the location of CO monitoring in Boston from Kenmore Square to Von Hillern Street. This Maintenance Plan meets the requirements of Section 175A of the Clean Air Act and conforms to EPA guidance for CO maintenance plans.

1. BACKGROUND

Carbon monoxide (CO) is a colorless and odorless gas. When inhaled CO binds with hemoglobin in the blood, reducing the amount of oxygen carried to organs and tissues. Symptoms of high CO exposure include shortness of breath, chest pain, headaches, confusion, and loss of coordination. Prolonged exposure to CO can be fatal. The health threat is most severe for those with cardiovascular disease.

CO is produced from the incomplete combustion of carbon in fuels. Motor vehicle emissions are the largest source of CO in Massachusetts. Emissions are highest during vehicle idling and low speeds. Industrial processes and non-transportation fuel combustion (e.g., wood-burning, boilers and generators, and lawn and garden equipment) also are significant sources of CO.

During winter months, vehicles emit larger amounts of CO due to cold starts and longer warm up periods. Increased combustion of fuels for space heating, industrial processes, and solid waste combustion also contribute to higher CO emissions during the winter. During cold weather months temperature inversions occur more frequently resulting in poorer dispersion of CO. Therefore, MassDEP's CO emissions inventory is for the winter period.

The CO NAAQS are 9 parts per million (ppm) averaged over 8 hours and 35 parts per million averaged over one hour. The CO NAAQS may not be exceeded more than once in any year at any monitoring site. The secondary standard to protect public welfare is the same as the primary standard.

MassDEP currently operates two CO monitors in Boston and one each in Chicopee, Lynn, Springfield, and Worcester (see Figure 1). A monitor in Lowell was closed in 2010 and is now represented by the Worcester monitor.[1] Several of the existing CO monitors have been continuously operated for more than 30 years.

2. HISTORY

In 1978 EPA designated 7 urban communities in Massachusetts as non-attainment for the 8-hour CO NAAQS of 9 ppm: Boston, Cambridge, Lowell, Medford, Springfield, Waltham, and Worcester.[2]

In 1979 and 1982 MassDEP developed State Implementation Plans (SIPs) to reduce CO emissions and lower ambient CO concentrations to acceptable levels. These CO SIPs[3] included state and federal transportation control measures.[4] The control measures substantially reduced traffic-related CO emissions throughout the 1980s and 1990s resulting in significantly lower ambient CO levels throughout the Commonwealth.

The 1990 Clean Air Act Amendments maintained the pre-existing non-attainment CO designations. Initially, EPA proposed to designate the entire Boston Consolidated Metropolitan Statistical Area (CMSA) as non-attainment for CO; however, MassDEP submitted a request on March 15, 1991 to limit the area to 9 contiguous communities: Boston, Cambridge, Chelsea, Everett, Malden, Medford, Quincy, Revere, and Somerville (known collectively as the Boston Metropolitan Nonattainment Area).[5] On November 6, 1991 EPA designated this more limited Boston area as non-attainment for CO with an 8-hour design value of 9.8 ppm.[6] EPA classified this area as moderate nonattainment.[7] EPA in the same action also designated Springfield, Worcester, Waltham, and Lowell as non-attainment, unclassified.[8] Figure 1 shows the CO non-attainment areas in Massachusetts in 1991.

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[1] MassDEP Bureau of Waste Prevention: *"Revision to the Carbon Monoxide Maintenance State Implementation Plan for Lowell, MA."* December, 2009. http://www.mass.gov/eea/agencies/massdep/air/reports/state-implementation-plans.html

[2] 43 FR 9003, March 3, 1978.

[3] MassDEP *"Massachusetts State Implementation Plan for Ozone and Carbon Monoxide*." May, 1979 and August, 1982.

[4] Federal mobile source reduction strategies include the pre-1990 Federal Motor Vehicle Control Program (FMVCP), federal Tier I emission standards for newly manufactured cars and trucks (phased-in beginning with the 1994 model year), and reformulated gasoline (beginning in January 1995). In 1983, MassDEP began implementation of a basic inspection and maintenance (I/M) program for on-road vehicles. In 1999 MassDEP implemented an enhanced inspection and maintenance program. Local traffic flow improvements were implemented in heavily congested areas to reduce CO emissions.

[5] Revision to the Massachusetts State Implementation Plan for Carbon Monoxide, Request for Redesignation to Attainment and Maintenance Plan for the Boston metropolitan Nonattainment Area including the communities of Boston, Cambridge, Revere, Chelsea, Somerville, Medford, Everett, Malden and Quincy in the Metropolitan Boston Air Pollution Control District. Transmittal letter from T. Powers, Acting Commissioner, December 12, 1994.

[6] Federal Register Vol. 56 p.56694. November 6, 1991.

[7] Designation of Areas for Air Quality Planning Purposes, Final Rule. Federal Register/Vol. 56, No. 215/Wednesday, November 6, 1991. https://www3.epa.gov/airquality/greenbook/frn/56fr56694nov61991.pdf

[8] EPA designated these areas 'not classified' since ambient monitoring data showed that these areas were attaining the CO NAAQS (56 FR 56694 and 67 FR7273 #33 Feb 19, 2002). Non-classifiable in this action meant that there

The attainment deadline for moderate CO non-attainment areas was 5 years after the designation date, or December 31, 1995. Massachusetts monitored no exceedances of the 8-hour standard after 1987.

On December 12, 1994, MassDEP submitted a request for redesignation to attainment and an initial 10-year maintenance plan for the Boston area. EPA approved the redesignation and maintenance plan on January 30, 1996.

On May 25, 2001, MassDEP submitted a request for redesignation to attainment and a 10-year maintenance plan for the cities of Lowell, Springfield, Waltham, and Worcester. EPA approved the redesignations and maintenance plan on February 19, 2002.

Lowell Monitor Closure. In April 2010, MassDEP submitted to EPA a revised CO SIP and 10-year maintenance plan to discontinue CO monitoring in Lowell because the Lowell CO monitor had shown attainment for over 20 years and values were well below the CO NAAQS.[9] MassDEP proposed the use of the Worcester monitor as a surrogate for monitoring CO in Lowell. In May 2011 EPA approved the discontinuation of the Lowell monitor and the use of the Worcester monitor as a surrogate.[10]

EPA, on April 31, 2011, decided to retain the pre-existing primary 1-hour and 8-hour standards for CO.[11] This decision was based on a court ordered review of the CO standards. EPA concluded that the current primary standards are requisite to protect public health, with an adequate margin of safety. Additionally, EPA, concluded that no secondary standard should be set for CO at that time.

Table 1 is a chronological summary of the CO SIP revisions for both the Boston area and the cities of Lowell, Springfield, Waltham, and Worcester.

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were no air quality measurements that would justify classifying these non-attainment areas as either serious or moderate non-attainment areas.

[9] MassDEP "Revision to the Carbon Monoxide Maintenance State Implementation Plan for Lowell, MA, December 2009. http://www.mass.gov/eea/docs/dep/air/priorities/7lowclos.pdf. http://www.mass.gov/eea/docs/dep/air/priorities/8lowdept.pdf

[10] 76 FR 27908, No.93 40 CFR Part 52 May 13, 2011. http://www.gpo.gov/fdsys/pkg/FR-2011-05-13/pdf/FR-2011-05-13.pdf

[11] EPA 40 CFR Parts 50, 53 and 58, Review of National Ambient Air Quality Standards for Carbon Monoxide; Final Rule. Federal Register / Vol. 76 , No. 169 / Wednesday, August 31, 2011 / Page 54294. https://www.gpo.gov/fdsys/pkg/FR-2011-08-31/html/2011-21359.htm

FIGURE 1: 2015 CO MONITORING SITES AND MAINTENANCE AREAS

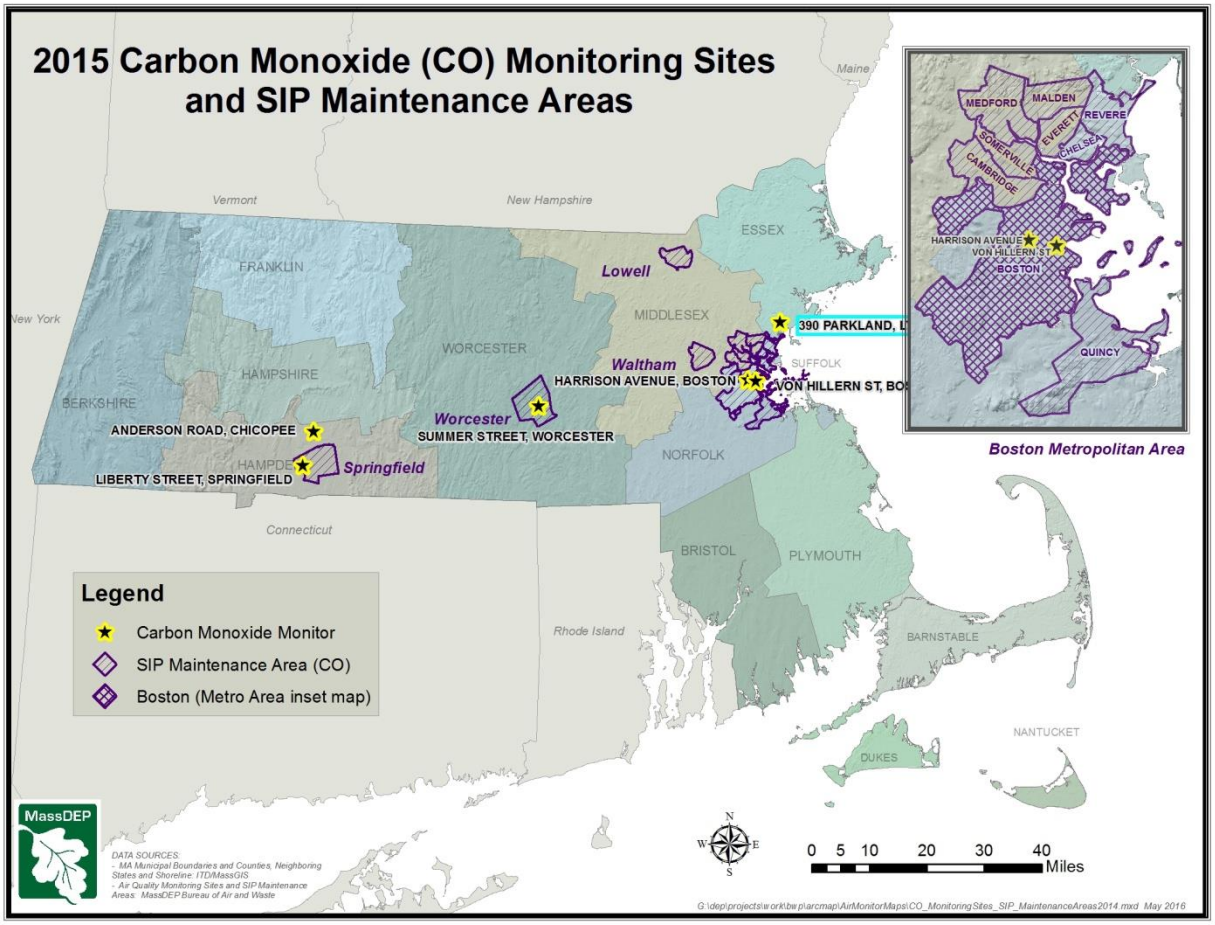


TABLE 1:
CHRONOLOGY OF MA CO SIP SUBMITTALS, DESIGNATIONS, AND APPROVALS

March 3, 1978:	EPA designated 7 communities in MA as non-attainment for the 8-hour CO standard: Boston, Cambridge, Lowell, Medford, Springfield, Waltham, and Worcester. (43 FR 9003)
May 1979:	MassDEP submitted to EPA the Massachusetts SIP for Ozone and CO with 1977 base year emissions and projected transportation-related reductions leading to attainment by 1987 for all cities except Boston. The SIP included a request for an extension to 1987 from the original deadline for attainment of 1982.
August 1982:	MassDEP submitted to EPA the Massachusetts SIP for Ozone and Carbon Monoxide. EPA approved the CO SIP on Nov 9, 1983. The emissions inventory baseline was 1980 and emissions were projected to 1987. Transportation control measures included FMVCP, Basic I/M, RACMs, and Hot Spot Screening Program for worst case scenarios in Kenmore Square, Leverett Circle, and Sumner/Callahan Tunnel.
November 15, 1990:	The Clean Air Act Amendments set the attainment year for moderate CO non-attainment areas at December 31, 1995.
March 15, 1991:	MassDEP requested from EPA an adjustment for the Boston CMSA to a smaller Boston metropolitan area comprising nine communities: Boston, Cambridge, Revere, Chelsea, Somerville, Medford, Everett, Malden, and Quincy.
November 6, 1991:	EPA approved MassDEP's request for a smaller non-attainment Boston area comprising nine metropolitan communities and classified the area as moderate nonattainment (56 FR 56694 Nov. 6, 1991, see 61 FR 2919 Vol.61 No.20 Jan.30, 1996). EPA also designated Lowell, Springfield, Waltham, and Worcester as non-attainment for CO unclassifiable because ambient monitoring data showed attainment of CO NAAQS. (56 FR 56694 Nov 6 1991 and 67 FR 7273 Vol.33 Feb.19, 2002)
December 12, 1994:	MassDEP requested redesignation of the Boston area CO non-attainment area to attainment and submitted a 10-year CO maintenance plan.
January 30, 1996:	EPA redesignated the Boston moderate non-attainment area to attainment and approved MassDEP's 10-year CO Maintenance Plan effective April, 1996. (61 FR 2918 No.20 Jan.30, 1996)
May 25, 2001:	MassDEP requested redesignation to attainment for the cities of Lowell, Springfield, Waltham, and Worcester and submitted a 10-year Maintenance Plan.
February 19, 2002:	EPA approved the redesignation request and 10-year Maintenance Plan for Lowell, Springfield, Waltham, and Worcester effective April 2002. (67 FR 7272 No.33 Feb 19, 2002)
April 14, 2010:	MassDEP submitted to EPA a revised CO SIP and 10-year Maintenance plan to discontinue CO monitoring in Lowell
May 2011:	EPA approved discontinuation of the Lowell Monitor and use of Worcester as a surrogate. (76 FR 27908, No.93 May 13, 2011)
August 31, 2011	EPA retained the primary 1-hour and 8-hour standards and did not set secondary standards.

3. MASSACHUSETTS 10-YEAR CO MAINTENANCE PLANS

Section 175A of the Clean Air Act requires that the initial 10-year maintenance plan demonstrate how the area will maintain compliance with the NAAQS for at least the next 10 years after EPA approves the redesignation request to attainment. It also requires that areas designated non-attainment must submit a second 10-year maintenance plan to EPA 8 years after the first 10-year maintenance plan was approved. The second 10-year maintenance plan must demonstrate that compliance with the CO NAAQS will continue during the 10-year period after the expiration of the first maintenance plan. Table 2 provides a summary of the maintenance plan periods for the previous nonattainment areas.

TABLE 2: MASSACHUSETTS CO MAINTENANCE PLAN SCHEDULE

CO MAINTENANCE AREA	EPA APPROVAL/ EFFECTIVE DATE	INITIAL 10-YEAR MAINTENANCE PERIOD	SECOND 10-YEAR MAINENANCE PERIOD
BOSTON METROPOLITAN AREA	January 30, 1996	1996 to 2006	2006 to 2016
LOWELL, SPRINGFIELD, WALTHAM & WORCESTER	February 19, 2002	2002 to 2012	2012 to 2022

4. LIMITED MAINTENANCE PLAN OPTION FOR SECOND 10-YEAR PLANS

In October 1995, EPA issued guidance on a limited maintenance plan option for non-classifiable CO nonattainment areas.[12] The EPA guidance memo states that to qualify for the limited maintenance plan option an area's 8-hour average CO design value at the time of redesignation must be at or below 7.65 ppm (85% of the NAAQS) for 2 consecutive years.

Boston. The 1994 CO redesignation request for the Boston area showed that the 8-hour CO design value (annual 2nd max. 8-hr) was 4.8 ppm in 1993. Subsequent CO monitoring demonstrated that the 8-hour design values have remained well below 7.65 ppm. For example, the highest CO design value for the Boston area in 2014 was 1.1 ppm and in 2015 was 0.9 ppm. Therefore the Boston area remains eligible for the limited maintenance plan option.

Lowell, Springfield, Waltham, Worcester. CO design values in these cities have been well below 7.65 ppm since 1997. The highest CO 8-hr design value in 2014 was 1.1 ppm for Worcester and in 2013 was 1.2 ppm for Springfield. Therefore the 4 cities have remained eligible for the limited maintenance plan option.

[12] Memorandum from Joseph W. Paisie, Group Leader, Integrated Policy and Strategies Group, *"Limited Maintenance Plan for Non-classifiable CO Non-attainment Areas*." October 6, 1995.

EPA's guidance on limited maintenance plans for CO specifies that such plans should include the following components:

1. Attainment Inventory
2. Maintenance Demonstration
3. Monitoring Network/Verification of Continued Attainment
4. Contingency Plan

Unlike full maintenance plans, limited maintenance plans are not required to include a projection of emissions over the maintenance period. However, because on-road mobile vehicles have the most impact on CO ambient levels in congested urban areas, MassDEP ran the EPA MOVES model for 2014, 2018, and 2022 for a typical winter day (see Section 6). The projected CO emission reductions from on-road mobile sources provide continued assurance that CO levels will remain well below the CO standard in Boston, Lowell, Springfield, Waltham and Worcester.

Emissions budgets for transportation and general conformity are not constraining where there is an approved limited maintenance plan according to EPA's guidance. Approval of this limited maintenance could satisfy the "budget test" under both conformity rules during the maintenance period "because *it is unreasonable to expect that such an area will experience so much growth in that period that a violation of the CO NAAQS would result.*"

5. MAINTENANCE DEMONSTRATION

EPA's 1995 guidance states that meeting the criteria for a limited maintenance plan (7.65 ppm or lower design value for 2 consecutive years) also satisfies the requirement for a maintenance demonstration. The guidance states:

> *The EPA believes if the area begins the maintenance period at or below 85% of exceedance levels, the air quality along with the continued applicability of PSD requirements, and control measures already in the SIP, and Federal measures, should provide adequate assurance of maintenance over the initial 10-year maintenance period.*

A summary of the 2014 and 2015 CO data for Massachusetts is shown in Tables 3 and 4. MassDEP operated 7 CO monitoring sites during both years. All of the sites achieved the required 75% or greater data capture for the year (except for the Kenmore CO monitor, which was discontinued after January 2015).

As shown in Figure 2, monitored CO levels in all areas have declined significantly since the 1980s. There has not been an exceedance of the 1-hour standard of 35 ppm since 1983. An exceedance of the 8-hour standard has not occurred in the Boston area or the other cities since 1987. The design values (i.e., the second-highest monitored 8-hour concentrations) have been under 2.0 ppm (less than 25% of the NAAQS) for the past 3 years. The statewide average 8-hour 2nd max in 2014 was 0.9 ppm, and has declined to 0.8 ppm in 2015.

Thus CO levels were below the 85% Limited Maintenance Plan benchmark of 7.65 ppm for the entire period of the initial 10-year maintenance plans and the beginning of the second 10-year maintenance periods for all areas in Massachusetts.

TABLE 3:
CARBON MONOXIDE LEVELS AT MASSACHUSETTS MONITORS IN 2014

SITE ID	CITY	COUNTY	ADDRESS	% OBS	1ST MAX 1-HR	2ND MAX 1-HR	OBS >1HR STD	1ST MAX 8-HR	2ND MAX 8-HR	OBS >8HR STD
25-025-0002	Boston	Suffolk	KENMORE SQ	90	1.5	1.3	0	1.1	.9	0
25-025-0042	Boston	Suffolk	HARRISON AVE	91	1.950	1.713	0	1.4	1.1	0
25-025-0044	Boston	Suffolk	19 VON HILLERN	78	1.890	1.620	0	.9	.9	0
25-013-0008	Chicopee	Hampden	ANDERSON RD AFB	92	1.030	.945	0	.8	.7	0
25-009-2006	Lynn	Essex	390 PARKLAND	87	1.096	.885	0	.8	.7	0
25-013-0016	Springfield	Hampden	LIBERTY STREET	93	1.5	1.4	0	.9	.9	0
25-027-0023	Worcester	Worcester	SUMMER ST	92	2.6	2.6	0	1.5	1.1	0

Avg = 0.9

TABLE 4:
CARBON MONOXIDE LEVELS AT MASSACHUSETTS MONITORS IN 2015

CO 2015 SITE ID	CITY	COUNTY	ADDRESS	Parameter	% OBS	1ST MAX 1-HR	2ND MAX 1-HR	OBS >1HR STD	1ST MAX 8-HR	2ND MAX 8-HR	OBS >8HR STD
25-025-0002	Boston	Suffolk	KENMORE SQ	CO	83 #	0.3	0.3	0	0.3	0.3	0
25-025-0042	Boston	Suffolk	HARRISON AVE	COT	87	1.437	1.362	0	0.9	0.9	0
25-025-0044	Boston	Suffolk	19 VON HILLERN	COT	90	1.792	1.681	0	1.1	0.9	0
25-013-0008	Chicopee	Hampden	ANDERSON RD AFB	COT	93	1.803	1.289	0	0.8	0.8	0
25-009-2006	Lynn	Essex	390 PARKLAND	COT	83	1.554	1.502	0	1.1	0.7	0
25-013-0016	Springfield	Hampden	LIBERTY STREET	CO	93	1.5	1.4	0	1.3	1.2	0
25-027-0023	Worcester	Worcester	SUMMER ST	COT	85	1.725	1.474	0	1.0	1.0	0
					# Jan monitored only						

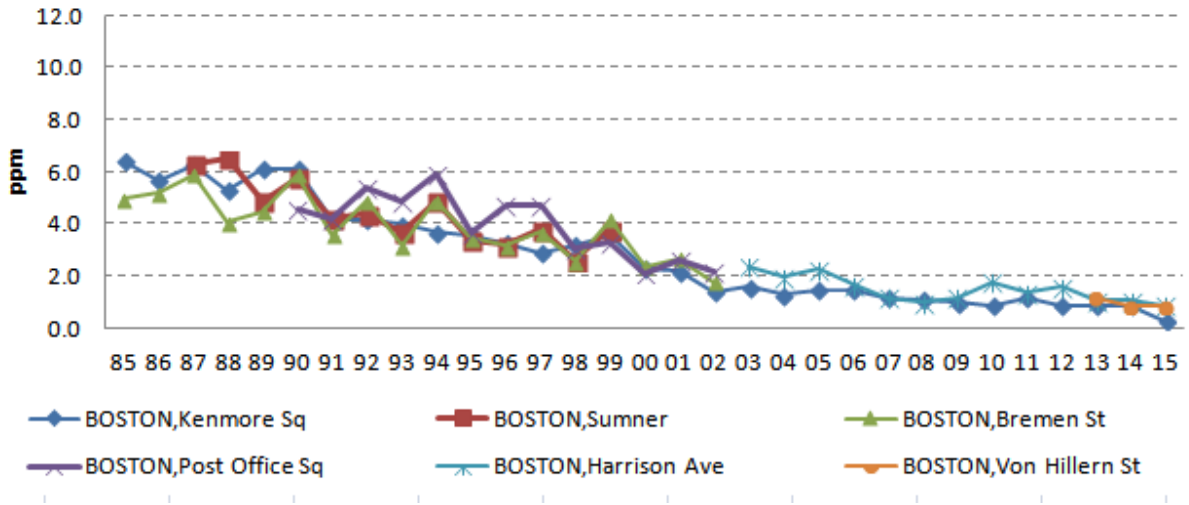
Avg = 0.8

CO NAAQS: 1-hour = 35 ppm 8-hour = 9 ppm CO Limited Maintenance Plan Benchmark Level = 7.65 ppm

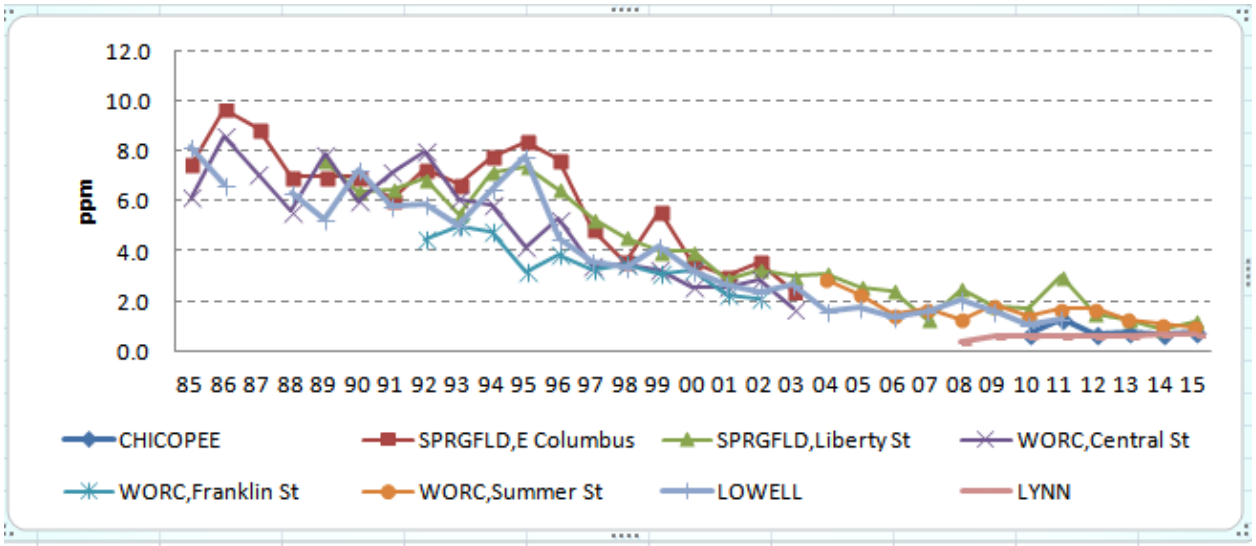
ABBREVIATIONS AND SYMBOLS USED IN TABLE
SITE ID = AIRS SITE IDENTIFICATION NUMBER; **% OBS** = PERCENT OBSERVATIONS; **1ST, 2ND MAX 1-HR** = FIRST AND SECOND HIGHEST 1-HOUR VALUE; **OBS>1 HR STD** = NUMBER OF 1-HR AVERAGES GREATER THAN THE 35 PPM 1-HR STANDARD; **1ST, 2ND MAX 8-HR** = FIRST AND SECOND HIGHEST 8-HOUR VALUE; **OBS>8HR STD** = NUMBER OF 8-HR AVERAGES GREATER THAN 9 PPM THE 8-HR STANDARD

Sources: Massachusetts 2014 Air Quality Report and 2015 Air Quality Report. MassDEP, Bureau of Air and Waste, Division of Air and Climate Programs, Air Assessment Branch Wall Experiment Station, Lawrence MA, August, 2015, http://www.mass.gov/eea/agencies/massdep/air/quality/air-monitoring-reports-and-studies.html

FIGURE 2:
CO MONITORING TRENDS FOR BOSTON 1985-2015
2nd Maximum 8-hour Values
Standard = 9 ppm



CO MONITORING TRENDS FOR LOWELL, SPRINGFIELD, WORCESTER, CHICOPEE AND LYNN 1985-2015
2nd Maximum 8-hour Values
Standard = 9 ppm



Source: Massachusetts 2015 Air Qu'/ality Report.

6. ATTAINMENT EMISSIONS INVENTORY

EPA's 1995 guidance indicates that maintenance plans must include an attainment emissions inventory that identifies a level of emissions in the area that is sufficient to attain the NAAQS. MassDEP has prepared emission inventories, including emissions for a CO winter day, periodically since 1982 and every three years from 1990 through 2011. The most recent comprehensive periodic emissions inventory (PEI) for CO is the 2011 Base Year Emissions Inventory which can be found at: https://www.mass.gov/lists/massdep-emissions-inventories.

CO Emissions Inventory Methodology

The detailed documentation for the CO emissions inventory is presented in the MassDEP 2011 PEI report. The general methodology involved multiplying activity factors by emission factors specific to each source category. MassDEP followed the EPA inventory guidelines and referenced all sources of information used for generating emissions in the 2011 PEI. MassDEP also adopted EPA's estimates for several categories (see the 2011 PEI for a complete listing). MassDEP used seasonal adjustment factors presented in EPA Volume I guidance[13] to adjust the annual emissions for a typical winter day. The CO PEI consists of the following four sections.

1. *Stationary Point* includes industrial, electric generation, commercial/institutional, and large residential facilities. Facilities submit annual activity and emissions data to MassDEP's point source database.

2. *Stationary Area* (Nonpoint) covers sources too small and numerous to be recorded in the MassDEP point source database such as small industrial, commercial/institutional, residential fuel (including wood-burning), and fires. Fuel use is applied to EPA AP-42 and EIIP factors to generate emissions (after discounting for point source fuel use). MassDEP adopted EPA's estimates for several categories including residential wood-burning, open burning and other fires.

3. *On-road Mobile* includes cars, trucks and buses. The on-road mobile emissions and reductions are particularly significant for the second 10-year maintenance plan because vehicles contribute more to urban ambient CO levels than any other category.

   MassDEP submitted MOVES inputs to EPA's 2011 National Emissions Inventory (NEI). MassDEP then adopted EPA's MOVES annual emissions estimates as reported in the NEI. MassDEP also ran MOVES in order to estimate CO emissions for a typical winter day for Eastern and Western Massachusetts. Because of the new MOVES set-up, the model was not run for individual counties but instead for a subset set of counties representing Eastern and Western Massachusetts. This is explained further in the On-road Mobile section of the 2011 PEI. On-road emissions were apportioned to counties using vehicle miles travelled (VMT) supplied by MassDOT.

[13] EPA "Procedures for the Preparation of Emission Inventories for CO and Precursors of Ozone Volume I: General Guidance for Stationary Sources." Table 5.8-1. EPA 450/4-91-016 May 1991.

4. *Off-road Mobile* includes aircraft, rail locomotives, boats, residential lawn/garden equipment, and industrial/commercial/construction off-road engines. MassDEP adopted the EPA NEI annual CO emissions for all the off-road mobile categories. MassDEP also ran the NONROAD model to estimate emissions for a typical winter day.

CO Emission Reductions

As shown in Tables 5, 7, and 9, and Figures 3 and 5, overall annual emissions have been reduced substantially from 1999 to 2011 (64% in Eastern MA and 57% in Hampden County –Western MA). These reductions are attributable to the 75% and 64% reductions from on-road mobile sources for Eastern MA and Hampden County, respectively.

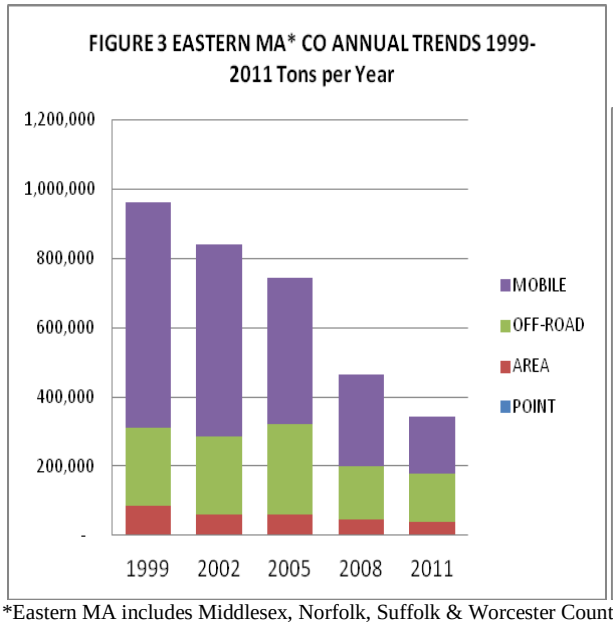
The winter day emissions show a similar pattern for both CO maintenance areas – see Tables 6, 8, and 10. The 74% on-road mobile reduction in Eastern MA is equivalent to 1,467 tons per winter day between 1999 and 2011 (i.e., 1,978 tons reduced to 511 tons). As shown in Figures 9 and 10, on-road mobile sources accounted for the majority of both the 1999 inventory (66%) and the 2011 inventory (59%).

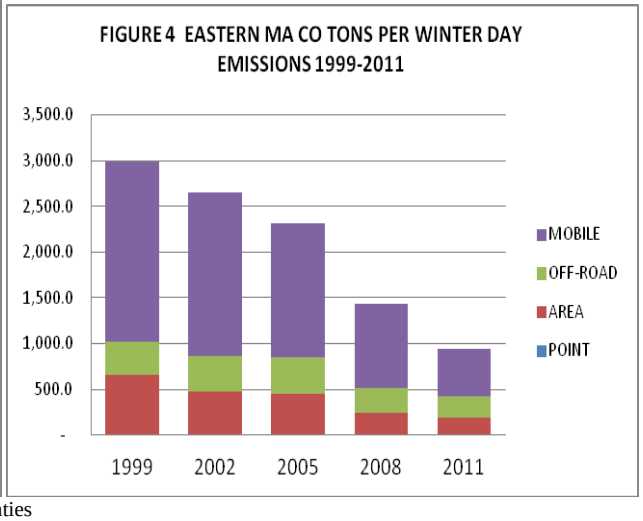
TABLE 5:
EASTERN MA ANNUAL CO EMISSIONS IN TONS 1999-2011
(Includes Suffolk, Middlesex, Norfolk & Worcester counties)

	1999	2002	2005	2008	2011	Reduction
POINT	3,714	804	1,106	3,011	2,015	-46%
AREA	80,820	59,323	60,032	41,654	36,346	-55%
OFF-ROAD	225,692	223,854	259,589	156,032	139,688	-38%
MOBILE	652,401	558,056	423,620	265,602	165,763	-75%
TOTAL	**962,627**	**842,037**	**744,347**	**466,299**	**343,812**	**-64%**

TABLE 6:
EASTERN MA CO WINTER DAY EMISSIONS IN TONS 1999-2011
(Includes Suffolk, Middlesex, Norfolk & Worcester counties)

	1999	2002	2005	2008	2011	Reduction
POINT	11.1	2.3	3.1	8.3	5.3	-52%
AREA	644.2	469.8	452.8	231.8	187.6	-71%
OFF-ROAD	359.8	398.9	396.6	272.6	236.6	-34%
MOBILE	1,978.2	1,776.3	1,465.0	918.7	511.3	-74%
TOTAL	**2,993.3**	**2,647.3**	**2,317.5**	**1,431.4**	**940.8**	**-69%**





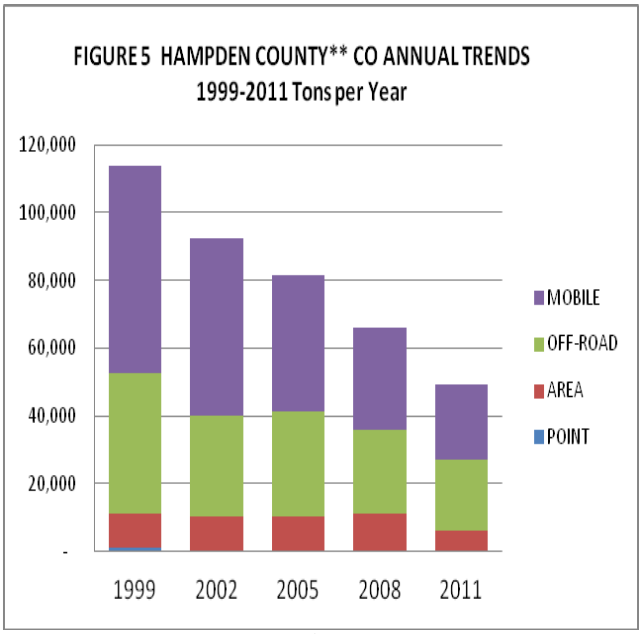
*Eastern MA includes Middlesex, Norfolk, Suffolk & Worcester Counties

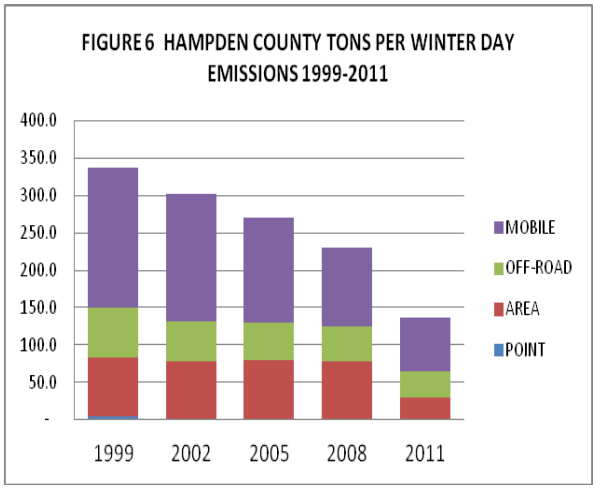
TABLE 7:
HAMPDEN COUNTY ANNUAL CO EMISSIONS IN TONS 1999-2011

	1999	2002	2005	2008	2011	Reduction
POINT	1,275	144	76	348	365	-71%
AREA	9,903	10,044	10,164	10,659	5,574	-44%
OFF-ROAD	41,405	29,725	31,007	24,683	21,255	-49%
MOBILE	61,276	52,386	40,132	30,346	21,983	-64%
TOTAL	**113,859**	**92,299**	**81,379**	**66,036**	**49,177**	**-57%**

TABLE 8:
HAMPDEN COUNTY CO WINTER DAY EMISSIONS IN TONS 1999-2011

	1999	2002	2005	2008	2011	Reduction
POINT	1,275	144	76	348	365	-71%
AREA	9,903	10,044	10,164	10,659	5,574	-44%
OFF-ROAD	41,405	29,725	31,007	24,683	21,255	-49%
MOBILE	61,276	52,386	40,132	30,346	21,983	-64%
TOTAL	**113,859**	**92,299**	**81,379**	**66,036**	**49,177**	**-57%**





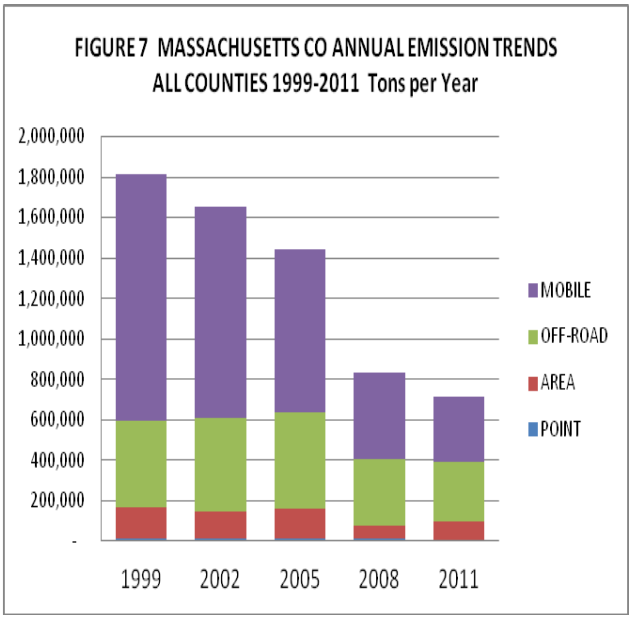
**Hampden County includes Springfield City

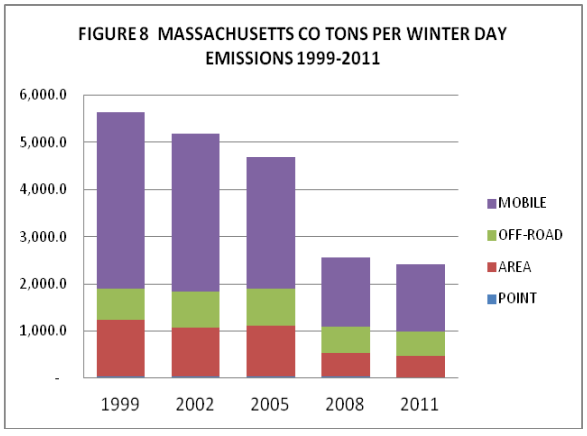
TABLE 9:
MASSACHUSETTS STATEWIDE ANNUAL CO EMISSIONS IN TONS 1999-2011

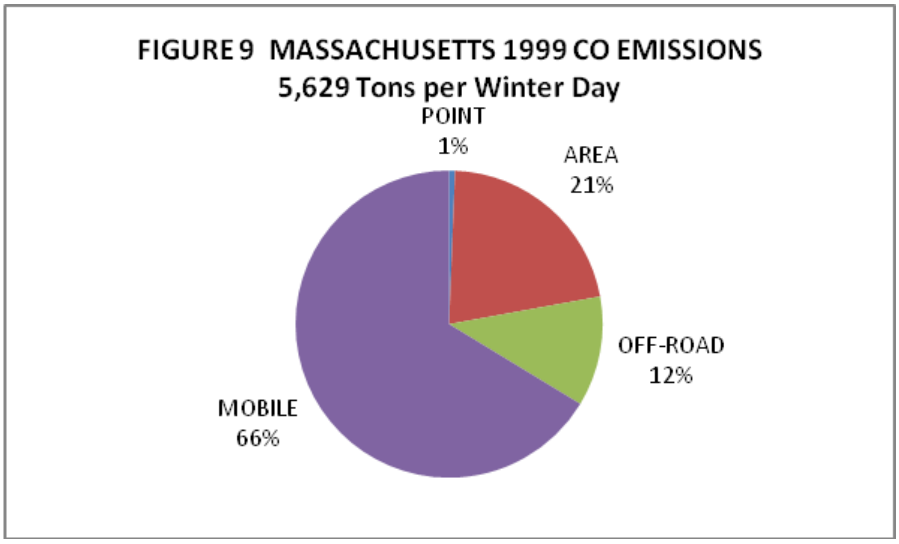
	TPY 1999	TPY 2002	TPY 2005	TPY 2008	TPY 2011	Reduction
POINT	12,237	12,104	15,697	9,861	5,542	-55%
AREA	154,441	137,278	142,562	68,554	93,286	-40%
OFF-ROAD	427,580	462,382	478,507	327,495	293,752	-31%
MOBILE	1,220,487	1,039,100	802,797	428,396	324,234	-73%
TOTAL	**1,814,745**	**1,650,864**	**1,439,563**	**834,306**	**716,814**	**-61%**

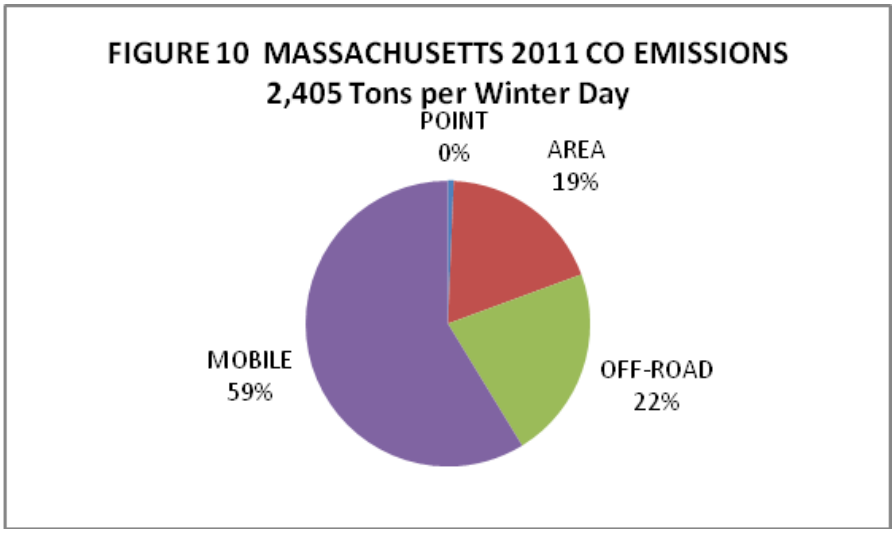
TABLE 10:
MASSACHUSETTS STATEWIDE CO WINTER DAY EMISSIONS IN TONS 1999-2011

	TPWD 1999	TPWD 2002	TPWD 2005	TPWD 2008	TPWD 2011	Reduction
POINT	34.9	33.3	43.3	30.6	16.1	-54%
AREA	1,209.6	1,027.9	1,067.6	494.5	450.9	-63%
OFF-ROAD	651.4	770.4	796.9	556.6	524.4	-19%
MOBILE	3,732.6	3,347.3	2,777.1	1,481.8	1,413.9	-62%
TOTAL	**5,628.5**	**5,178.9**	**4,684.9**	**2,563.5**	**2,405.3**	**-57%**







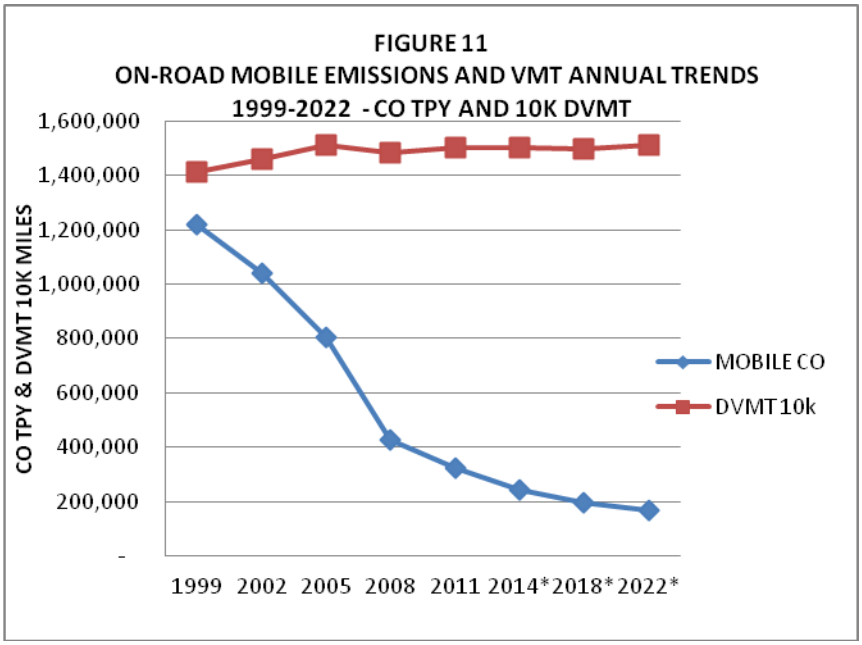


7. DEMONSTRATION OF FUTURE ATTAINMENT – ON-ROAD MOBILE PROJECTIONS

Although no CO emission projections are necessary for a limited maintenance plan, MassDEP ran the MOVES model for 2014, 2018, and 2022 to show continued CO reductions from on-road mobile sources. The year 2022 is the end of the second 10-year maintenance period for Lowell, Springfield, Waltham, and Worcester. Table 11 and Figure 11 show that statewide annual on-road CO emissions were reduced by 73% from 1999 to 2011. The MOVES runs project a further 48% reduction in on-road mobile emissions from 2011 to 2022 despite a projected increase in VMT.

TABLE 11:
ON-ROAD ANNUAL EMISSIONS AND VMT 1999 TO 2011
AND PROJECTED TO 2022

	1999	2002	2005	2008	2011	*2014**	*2018**	*2022**	1999-2011	2011-2022
MOBILE CO TONS	1,220,487	1,039,100	802,797	428,396	324,234	241,690	196,671	168,964	**-73%**	**-48%**
DVMT 10k	1,413,460	1,458,380	1,510,750	1,485,370	1,501,140	1,501,070	1,497,580	1,514,230	**6%**	**7%**



8. MONITORING NETWORK AND VERIFICATION OF FUTURE ATTAINMENT

EPA's guidance requires continued operation of an EPA-approved air quality monitoring network during the maintenance period to verify the attainment status of the area. MassDEP currently operates six CO monitors at the locations below.

Boston – Harrison Ave (25-025-0042) trace
Boston – Von Hillern Street (25-025-0044) trace
Chicopee (25-013-0008) trace
Lynn (25-009-2006) trace
Springfield – Liberty Street (25-013-0016)
Worcester – Summer Street (25-027-0023) trace

Springfield Monitor Closure. MassDEP plans to discontinue monitoring at the Springfield-Liberty Street site upon EPA's approval of this SIP Revision. This is because: (1) the concentrations measured for many years at all locations are very low (well below the NAAQS);

(2) MassDEP expects that CO levels will remain well below the NAAQS; and (3) the CO network exceeds EPA requirements for the CO NAAQS. This will leave CO monitors in the two cities with the highest population in Massachusetts (Boston and Worcester).

The approved 2001 CO Maintenance Plan (Section 7.4, Monitoring Network and Verification of Future Attainment) provides that MassDEP will continue to operate an appropriate air quality monitoring network during the maintenance period to verify the attainment status of the area. Once EPA approves discontinuation of the Springfield CO monitor, MassDEP will use the Worcester monitor as a surrogate for Springfield to meet this commitment. Worcester and Springfield are located 56 miles apart. Worcester (pop. 181,045) is somewhat larger than Springfield (pop. 153,060)[14], so its CO concentrations are likely to be slightly higher due to greater motor vehicle emissions. Both monitors are located adjacent to high traffic volume intersections, which are generally areas of highest CO concentrations. As shown in Figure 3, CO concentrations in Springfield and Worcester have tracked very closely for many years and both are well below the NAAQS. Based on these characteristics, ambient CO concentrations in Worcester are a valid surrogate for CO concentrations in Springfield.

Once MassDEP begins to use the Worcester monitor as a surrogate, in the event the second-highest monitored CO concentration in any calendar year in Worcester reaches 75 percent of the 1-hour or 8-hour NAAQS for CO, MassDEP will, within 9 months of the date such concentrations are recorded, re-establish a CO monitoring site in Springfield consistent with EPA siting criteria, and resume analyzing and reporting CO concentrations in Springfield.

Kenmore Monitor Closure. MassDEP stopped monitoring CO at the Kenmore site at the end of January 2015 in accordance with EPA's approval of its 2015 Network Plan.[15] This is because: (1) MassDEP began CO monitoring at the near-road monitoring location on Von Hillern Street; (2) the concentrations measured for many years at Kenmore have been very low (less than 1.5 ppm for the last 3 years); and (3) the nearby Boston - Harrison Avenue monitor is an NCore site that will continue to monitor CO for the foreseeable future. This change leaves two CO monitors in the Boston non-attainment area.

In the approved 1994 CO Maintenance Plan (Section 6.2, Massachusetts Commits to Monitor Attainment) MassDEP committed to operate a CO monitoring network in compliance with 40 CFR Part 53 with the provision that monitors could be shut down with EPA approval. Therefore, the discontinuation of the Kenmore Square CO monitor was consistent with the maintenance plan for the Boston area. Furthermore, the Von Hillern Street CO monitor is located adjacent to a high traffic volume interstate highway where concentrations of CO should be as high, or higher, than the Kenmore Square site.

Future CO Monitoring. Massachusetts will continue to operate CO monitors in Boston, Worcester, Chicopee, and Lynn in accordance with 40 CR Part 58. Any future modification to this network would require approval from EPA to ensure that the attainment status of the area can be adequately verified.

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[15] Massachusetts 2015 Air Monitoring Network Plan
http://www.mass.gov/eea/agencies/massdep/air/reports/annual-ambient-air-quality-monitoring-network-plan.html

9. CONTINGENCY PLAN

Section 175A of the Clean Air Act requires that maintenance plans include contingency provisions that will be implemented in the event that a violation of the NAAQS occurs after redesignation of the area to attainment. In the initial CO Maintenance Plans for the Boston area, Lowell, Springfield, Waltham, and Worcester, MassDEP committed to implement a contingency plan if any of the CO monitors violated the NAAQS, provided that the data met quality assurance criteria and did not qualify for exclusion under EPA's "exceptional events" policy.

The contingency plan measures that MassDEP committed to in 1994 and 2001 were the following (to be implemented in stages):

1. investigation and potential implementation of local traffic control measures such as traffic signal changes and revised parking restrictions
2. reformulated gasoline (1994 Boston only)
3. enhanced vehicle inspection and maintenance
4. California low-emission vehicle program

The latter three programs already have been implemented as part of efforts to reduce ozone. In the unlikely event that the contingency plan is triggered by a monitored CO violation, MassDEP will implement measures necessary to remedy the violation. It will first implement the first contingency measure described in the 2001 CO Maintenance Plan related to local traffic conditions. It will also review and adopt transportation control measures, or other additional vehicle or fuel controls as needed, to reduce monitored concentrations to levels that meet the NAAQS.

Springfield Contingency Plan Trigger. In the 2001 CO Maintenance Plan for Springfield, the trigger for implementing the contingency plan is a violation at the Springfield monitor. Contingent on EPA approval, when CO monitoring in Springfield is discontinued, MassDEP will use the Worcester and Chicopee CO monitor data as triggers for implementation of the contingency plan for Springfield. If either monitor measures a CO violation MassDEP will implement contingency measures (discussed above) in Springfield. Note that a violation at the Worcester monitor would also trigger contingency measures in Worcester under the terms of the existing maintenance plan for Worcester. In the event that MassDEP is required to re-establish a CO monitor in Springfield (which would be triggered by the second-highest CO concentration in any calendar year in Worcester reaching 75 percent of the NAAQS), a violation of the NAAQS at the re-established Springfield monitor would trigger the contingency plan for Springfield.

10. CONCLUSION

CO levels in all of the Massachusetts maintenance areas – Boston, Lowell, Springfield, Waltham and Worcester – have remained well below the CO standard since redesignation to attainment. The current design values for all areas are less than a quarter of the CO NAAQS. The emission controls MassDEP has adopted to maintain the CO standard continue to be permanent and enforceable. MassDEP operates a CO monitoring network that would identify any violations of the NAAQS, and MassDEP has a contingency plan to address any such violations. Therefore,

this Limited Maintenance Plan for the Boston area and the cities of Lowell, Springfield, Waltham, and Worcester meets the requirements of Section 175A(b) of the Clean Air Act for a second 10-year Maintenance Plan for these areas.