

CARBON MONOXIDE MAINTENANCE PLAN FOR THE DENVER METROPOLITAN AREA

Approved by:
Colorado Air Quality Control Commission
December 15, 2005

CONTACT INFORMATION

Colorado Air Quality Control Commission
4300 Cherry Creek Drive South
Denver, CO 80246
(303) 692-3476



REGIONAL AIR QUALITY COUNCIL

1445 Market Street, Suite 260
Denver, CO 80202
(303) 629-5450



**Colorado Department
of Public Health
and Environment**

Air Pollution Control Division
4300 Cherry Creek Drive South
Denver, CO 80246
(303) 692-3100

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CARBON MONOXIDE MAINTENANCE PLAN FOR THE DENVER METROPOLITAN AREA

The State of Colorado, in coordination with the Regional Air Quality Council (RAQC), is submitting this Carbon Monoxide (CO) Maintenance Plan Revision to provide for maintenance of the CO National Ambient Air Quality Standard (NAAQS) for an additional 10-year period following the first ten-year period after redesignation to attainment as required by the Clean Air Act (CAA) 176A(b) and the U.S. Environmental Protection Agency (EPA).

The previously approved Denver Metro Area Carbon Monoxide Maintenance Plan, which was submitted by the Governor on May 10, 2000, was formally approved by the EPA (66 FR 64751) on December 14, 2001 (effective date January 14, 2002). In that action the Denver Metro Area was redesignated by the EPA from a “serious” CO non-attainment area to attainment of the CO NAAQS. In addition, the approved Plan demonstrated maintenance of the standard for a ten-year period after redesignation to attainment as required by CAA 175A(a).

In response to EPA issued policy guidance (January 2002) for states and local areas to use when developing SIP revisions using MOBILE6 (*“Policy Guidance on the Use of MOBILE6 for SIP Development and Transportation Conformity,” January 18, 2002*), the State of Colorado in coordination with the RAQC developed a revised CO Maintenance Plan based on the procedures outlined in this guidance. The revised maintenance plan was approved by the EPA on September 16, 2004. The revised maintenance plan merely replaced the existing MOBILE5 maintenance plan motor vehicle emissions inventories with MOBILE6 base (attainment) and maintenance year inventories, while maintaining the strategies reflected in the previously approved maintenance plan.

In developing this CO maintenance plan revision to provide for maintenance of the CO NAAQS for an additional 10-year period, the RAQC and the State conducted a comprehensive reevaluation of mobile source control programs with MOBILE6.2 and the latest transportation data sets from Denver Regional Council of Governments’ (DRCOG) 2030 Regional Transportation Plan. This revision removes the Air Quality Regulations No. 11 (Inspection/Maintenance) and No. 13 (Oxygenated Fuels) from the Denver metro area CO State Implementation Plan (SIP).

Since this revision to the Denver area SIP includes the 2013 maintenance year contained in the previously approved maintenance plan, 2013 must remain as an interim budget year in this revised maintenance plan. The maintenance year for this revision is 2021.

The most recent three years (2002-04) of monitored data, which are presented in Section A, show the Denver area has maintained attainment of the standard since the redesignation was approved.

Finally, the following sections contain the core elements EPA has established as necessary for approval of maintenance plans:

1. Description of the control measures for the maintenance period
2. Emission inventories for current and future years
3. Maintenance demonstration

4. Mobile source emissions budget
5. Approved monitoring network
6. Verification of continued attainment
7. Contingency plan
8. Subsequent maintenance plan revisions

This maintenance plan revision follows the same format as the previously approved maintenance plan.

A. CONTINUED ATTAINMENT OF THE CARBON MONOXIDE STANDARD

Attainment of the national ambient air quality standard for carbon monoxide is demonstrated when two consecutive years of monitoring data for each site show no more than one exceedance per year of the 8-hour (9 ppm) and 1-hour (35 ppm) standards. Monitoring data for 2000-04 demonstrates that the Denver metropolitan area continues to attain/maintain the national standard for carbon monoxide as required by 40 CFR 50.8. Data from 2000 through 2004 are provided to demonstrate continual attainment/maintenance since the previously approved maintenance plan was adopted (December 14, 2001). This is based on quality assured monitoring data representative of the location of expected maximum concentrations of carbon monoxide in the area (downtown Denver).

The current carbon monoxide ambient monitoring network consists of 7 sites operated by the Colorado Air Pollution Control Division. The sites are listed along with summary data from 2000 through 2004 in Tables 1 and 2.

The monitoring data presented in Tables 1 and 2 verify that the Denver area continues to attain the national standard for carbon monoxide. Data recovery rates for the monitors exceed the 75% completeness requirements for all years, and all state and federal quality assurance procedures have been complied with, further substantiating their validity as indicators of ambient carbon monoxide levels in the Denver metropolitan area. Figure 1, Historical Monitoring Data for the CO NAAQS by Monitor Site, includes long term monitoring records of each monitoring site which demonstrate that the Denver area has been in attainment with the national ambient air quality standard for carbon monoxide since 1996 and has had a continuous downward trend in CO levels since 1992. Figure 2 shows the geographic distribution of the monitors.

Table 1:
2000-2004, 1-Hour Carbon Monoxide Summary for the Denver Metropolitan Area
 Standard: 1-hour = 35 ppm*

Site Name	1-Hour 1 st Maximum (ppm)				
	2000	2001	2002	2003	2004
Welby, 78 th Ave. & Steele St.	4.3	6.1	4.8	5.4	4.2
Boulder, 2150 28 th St.	10.0	9.1	5.0	4.8	4.7
Denver – CAMP, 2105 Broadway***	17.1	14.4	7.4	15.0	8.7
Denver – NJH, 14 th Ave. & Albion St.	8.7	9.7	6.3	6.7	7.3
Denver – Carriage, 23 rd Ave. & Julian St.	5.8	7.1	4.9	4.5	5.3
Denver – Firehouse #6, Speer & Auraria	9.3	7.8	8.5	7.8	5.9
Arvada, 57 th Ave. & Garrison St.	7.1	6.2	4.9	7.1	4.3

Site Name	1-Hour 2 nd Maximum (ppm)				
	2000	2001	2002	2003	2004
Welby, 78 th Ave. & Steele St.	4.3	5.8	4.4	5.2	4.0
Boulder, 2150 28 th St.	9.6	6.8	5.0	4.7	4.5
Denver – CAMP, 2105 Broadway***	12.8	9.3	7.4	14.9	8.7
Denver – NJH, 14 th Ave. & Albion St.	7.6	8.5	6.0	6.5	6.8
Denver – Carriage, 23 rd Ave. & Julian St.	5.6	6.5	4.6	4.5	4.9
Denver – Firehouse #6, Speer & Auraria	8.6	7.0	7.5	6.1	5.8
Arvada, 57 th Ave. & Garrison St.	6.2	5.0	4.7	4.7	3.7

* Due to mathematical rounding, a value of 35.5 ppm or greater is necessary to exceed the standard.

** Due to mathematical rounding, a value of 9.5 ppm or greater is necessary to exceed the standard.

*** Site was closed for part of 2000 for reconstruction.

Table 2:
2000-2004, 8-Hour Carbon Monoxide Summary for the Denver Metropolitan Area
 Standard: 8-hour = 9 ppm**

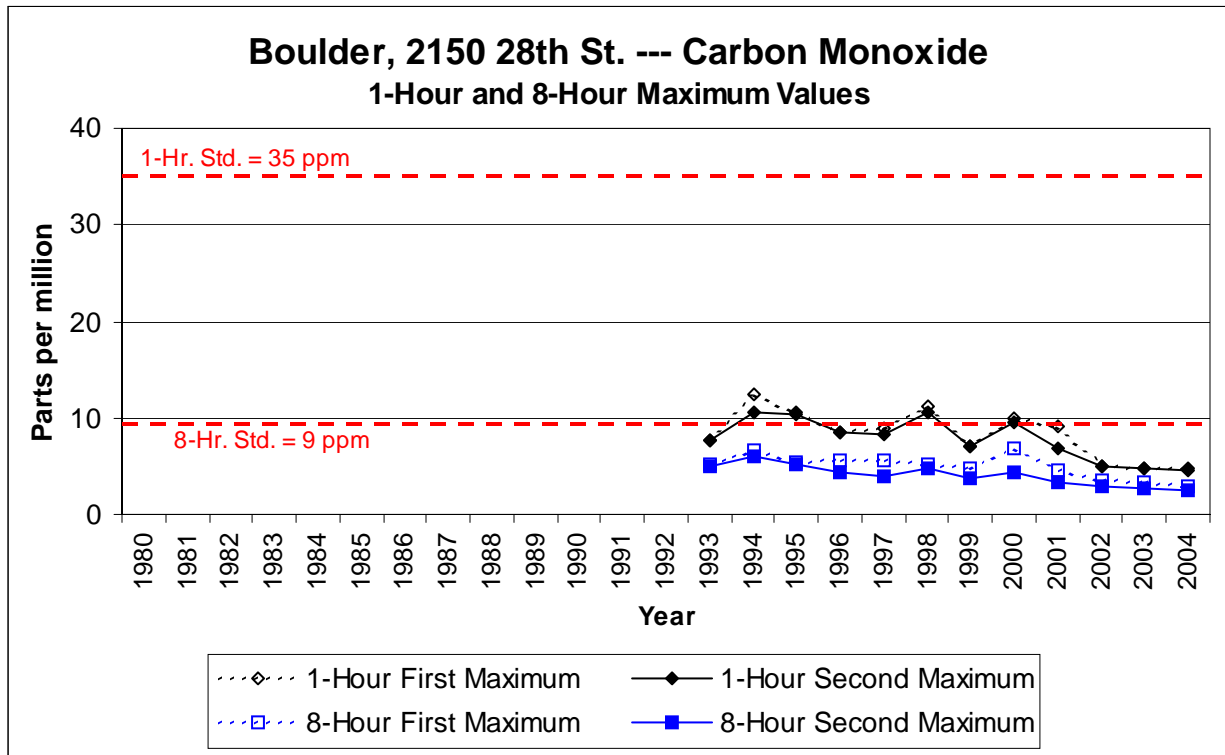
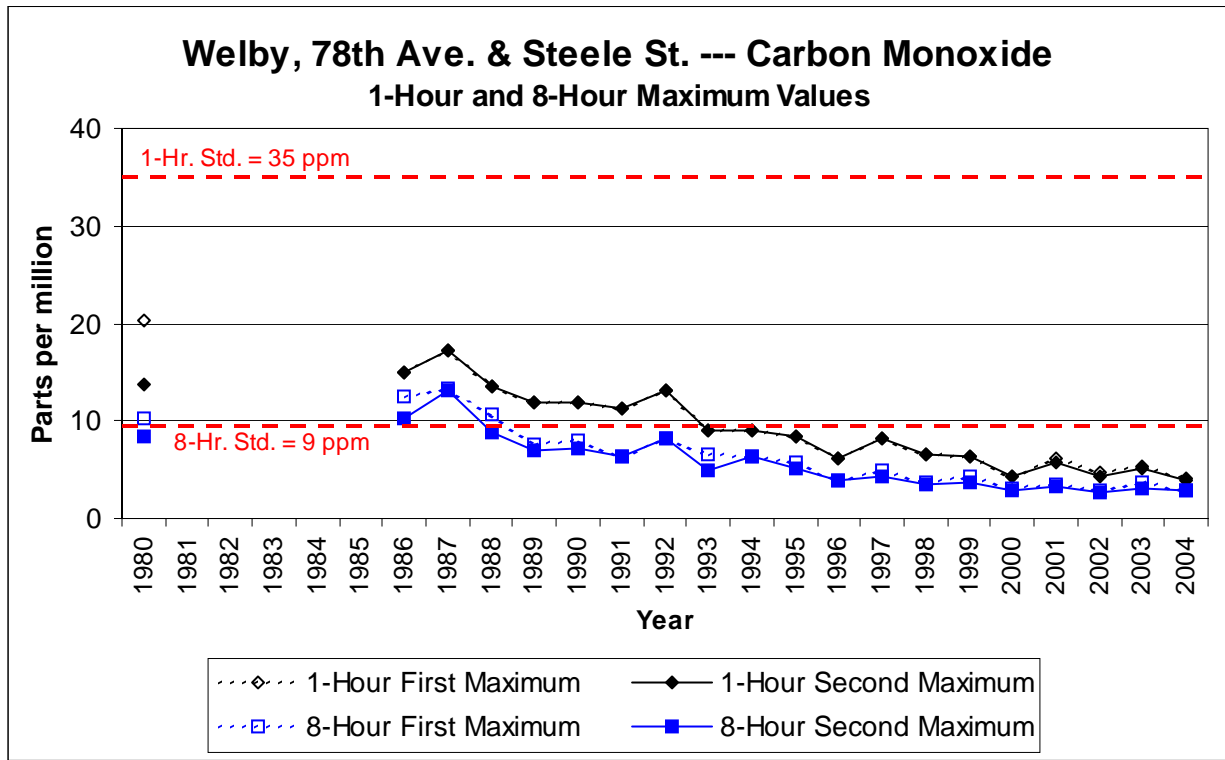
Site Name	8-Hour 1 st Maximum (ppm)				
	2000	2001	2002	2003	2004
Welby, 78 th Ave. & Steele St.	3.0	3.4	2.8	3.6	2.9
Boulder, 2150 28 th St.	6.8	4.5	3.5	3.3	2.9
Denver – CAMP, 2105 Broadway***	8.5	4.4	3.7	6.3	4.4
Denver – NJH, 14 th Ave. & Albion St.	4.8	4.0	3.5	3.5	3.6
Denver – Carriage, 23 rd Ave. & Julian St.	4.1	3.8	3.7	3.9	3.7
Denver – Firehouse #6, Speer & Auraria	5.0	4.6	3.9	3.5	3.7
Arvada, 57 th Ave. & Garrison St.	3.9	3.1	3.0	2.5	2.7
Site Name	8-Hour 2 nd Maximum (ppm)				
	2000	2001	2002	2003	2004
Welby, 78 th Ave. & Steele St.	2.9	3.3	2.6	3.0	2.8
Boulder, 2150 28 th St.	4.3	3.4	3.0	2.7	2.5
Denver – CAMP, 2105 Broadway***	5.4	4.1	3.7	4.5	4.1
Denver – NJH, 14 th Ave. & Albion St.	4.7	3.9	3.1	3.3	3.4
Denver – Carriage, 23 rd Ave. & Julian St.	3.4	3.7	2.7	3.2	3.4
Denver – Firehouse #6, Speer & Auraria	4.6	4.0	3.6	3.4	3.6
Arvada, 57 th Ave. & Garrison St.	3.8	3.0	2.6	2.3	2.6

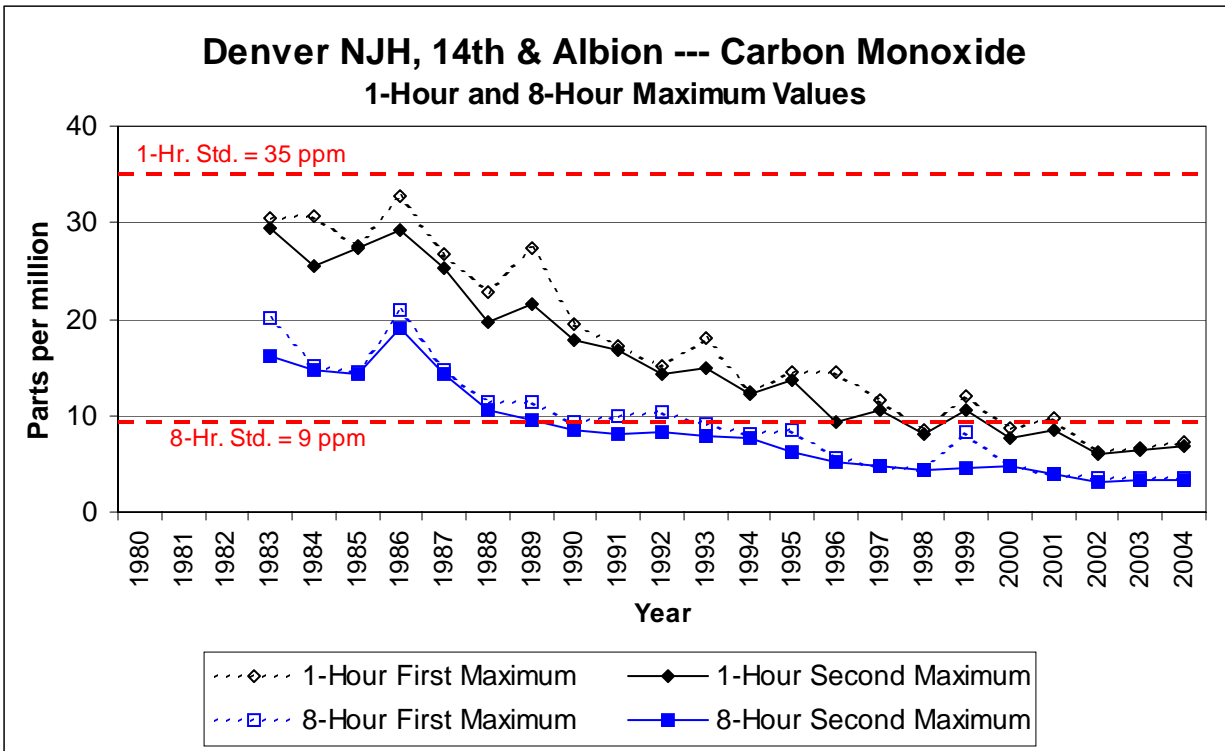
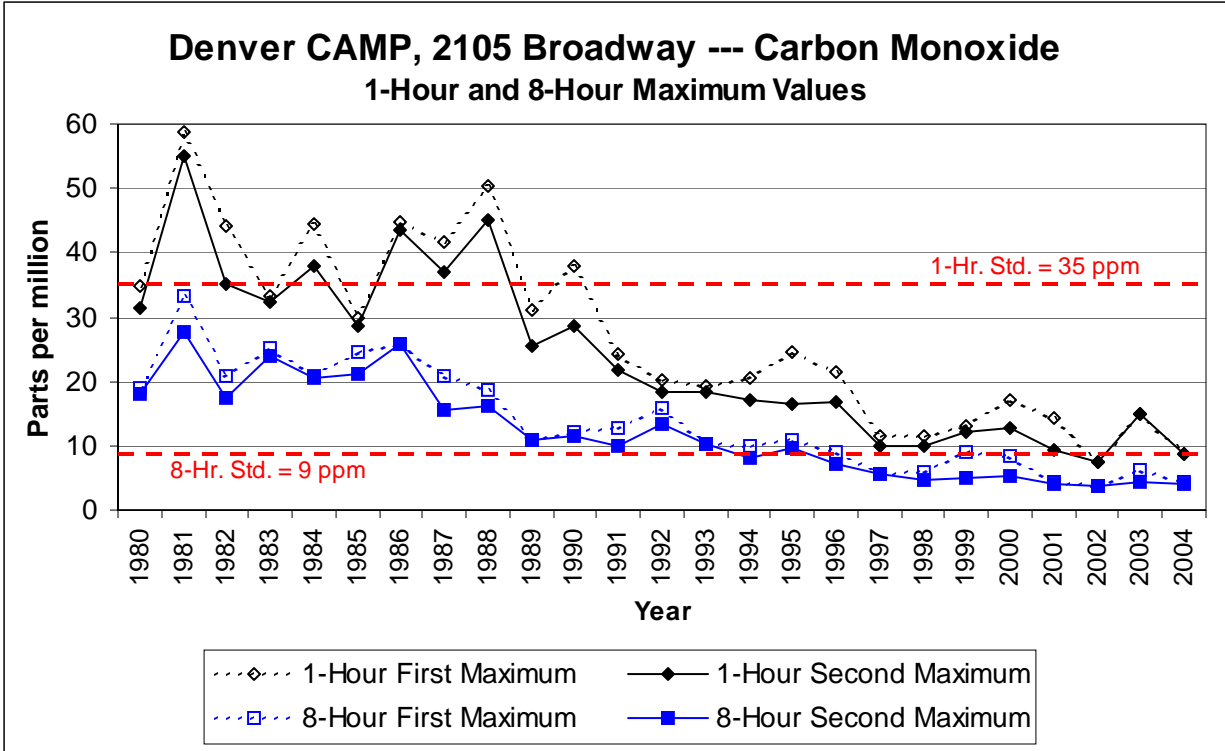
* Due to mathematical rounding, a value of 35.5 ppm or greater is necessary to exceed the standard.

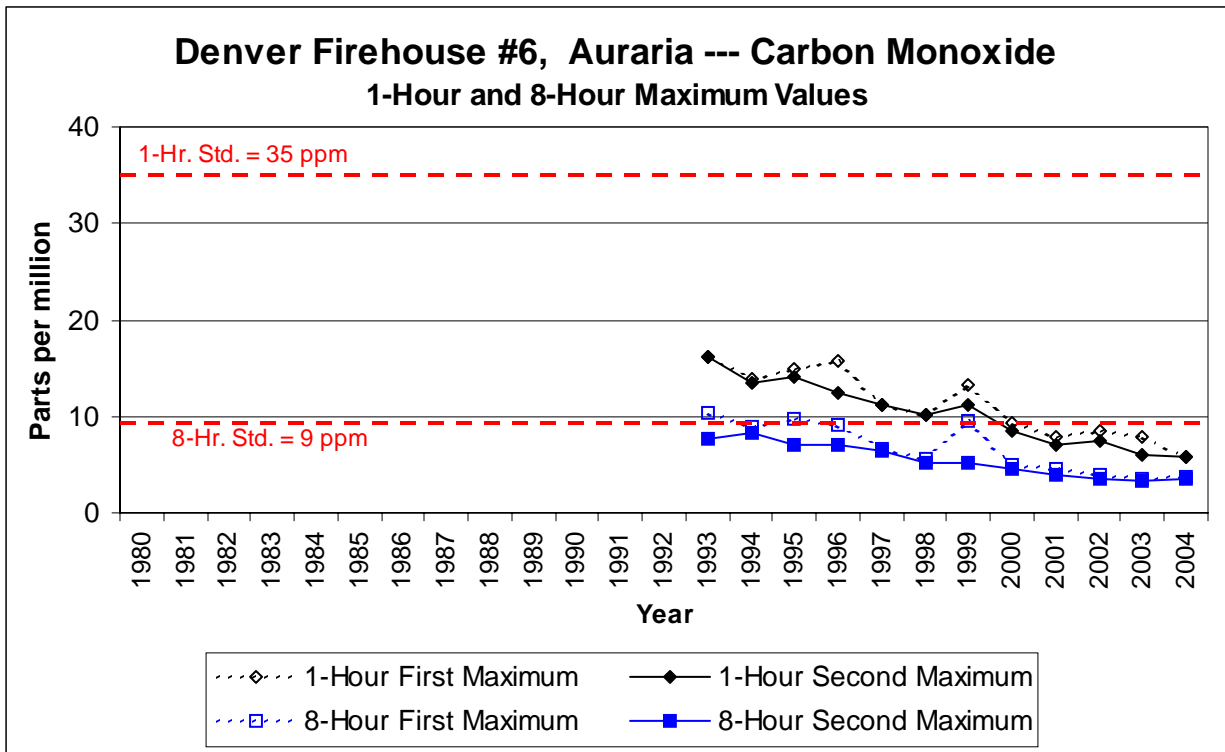
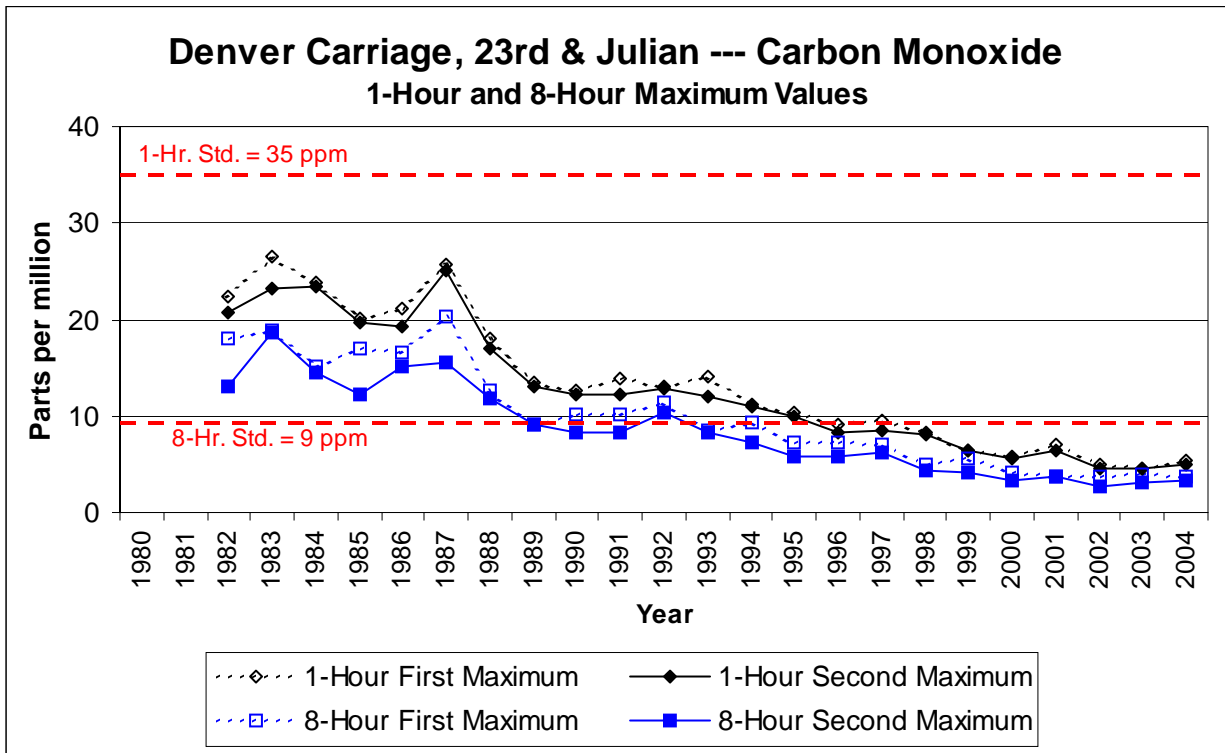
** Due to mathematical rounding, a value of 9.5 ppm or greater is necessary to exceed the standard.

*** Site was closed for part of 2000 for reconstruction.

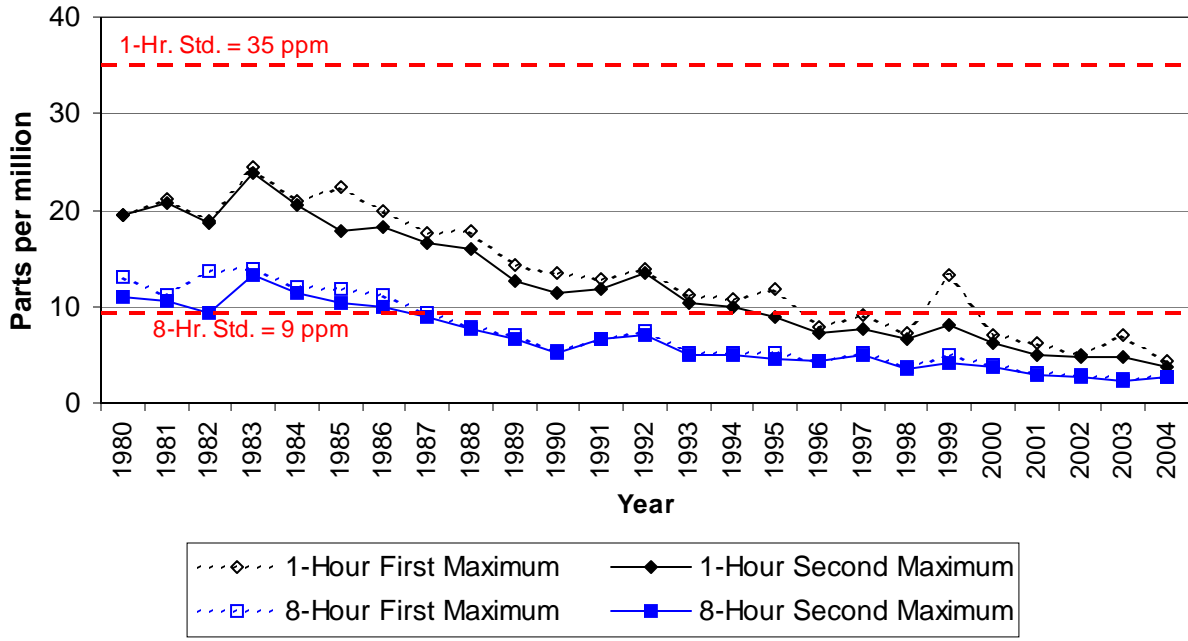
**Figure 1:
Historical Monitoring Data for the CO NAAQS by Monitor Site**



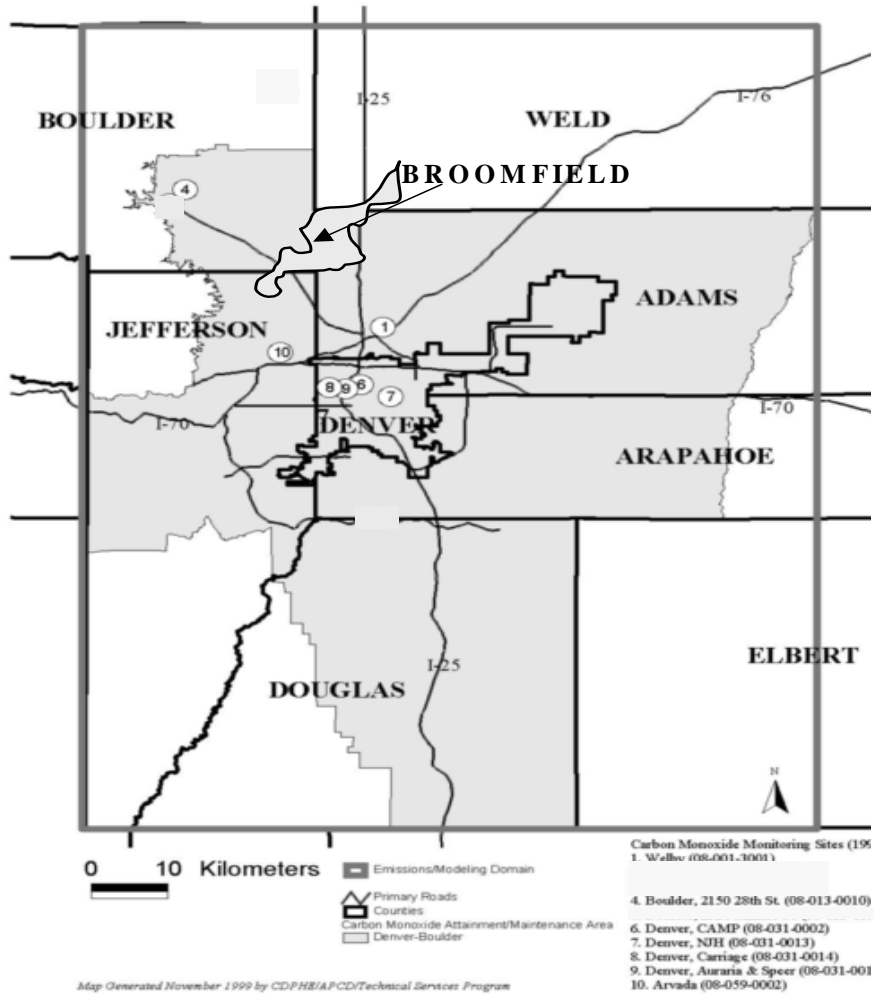




Arvada, 57th & Garrison --- Carbon Monoxide 1-Hour and 8-Hour Maximum Values



**Figure 2:
Map of Denver Metropolitan Attainment/Maintenance Area,
Modeling Domain, and Location of Carbon Monoxide Monitors**



B. MAINTENANCE PLAN CONTROL MEASURES

The Inspection/Maintenance (AQR No.11) and Oxygenated Fuels (AQR No.13) programs will be removed from Denver metro area CO SIP effective December 31, 2007. With the removal of these regulations from the SIP, the Denver metropolitan area will continue to rely on other control programs contained in the maintenance plan approved on September 16, 2004 to demonstrate maintenance of the carbon monoxide standards through 2021.

No emission reduction credit has been taken in the maintenance demonstration for any other current State or local control programs and no other such programs, strategies, or regulations shall be incorporated or deemed as enforceable measures for the purposes of this maintenance demonstration.

The specific enforceable control measures that continue to be a part of the maintenance plan until December 31, 2007 are listed below:

1. Air Quality Control Commission Regulation No. 11 -- covering the Automobile Inspection and Readjustment (A.I.R.) Program. This maintenance plan removes this regulation from the Denver metro area CO SIP effective December 31, 2007. A corresponding revision to the Longmont CO maintenance plan is being made by separate submittal.
2. Air Quality Control Commission Regulation No. 13 -- covering the oxygenated gasoline program. This maintenance plan, together with a corresponding revision to the Longmont CO maintenance plan, removes this regulation from the federally enforceable SIP effective December 31, 2007.

The specific enforceable control measures that continue to be a part of the maintenance plan through 2021 are listed below:

1. Federal tailpipe standards and regulations, including those for small engines and non-road mobile sources. Credit is taken for these federal requirements but they are not part of the Colorado SIP.
2. Air Quality Control Commission Regulation No. 4 -- covering residential wood burning control programs. The Maintenance plan makes no revisions to residential wood burning control programs.
3. Air Quality Control Commission Regulations No. 3, No. 6 and Common Provisions -- covering industrial source control programs. The Common Provisions, and Parts A and B of Regulation No. 3, are already included in the approved SIP. Regulation No. 6, and Part C of Regulation No. 3, implement the federal standards of performance for new stationary sources and the federal operating permit program. The maintenance plan makes no revisions to these regulations. This reference to Regulation No. 6 and Part C of Regulation No. 3 shall not be construed to mean that these regulations are included in the SIP.
4. In accordance with State and federal regulations and policies, the State and federal nonattainment New Source Review (NSR) requirements in effect for the Denver area reverted to the State and federal attainment Prevention of Significant Deterioration (PSD) permitting requirements once EPA approved the redesignation request and maintenance

plan. This maintenance plan revision makes no changes to these PSD permitting requirements.

C. EMISSION INVENTORIES

This section presents the emission inventories portion of the maintenance plan. Emission inventories are provided for the 2001 attainment year, the 2009, 2010, the 2013 budget year from the recent revision, 2015, 2020 and the 2021 maintenance year (see Table 3).

The 2001 attainment year inventory is based on the actual control levels in place at that time. The 2009 through 2021 inventories incorporate the maintenance plan control measures described above in Section B. For purposes of the demonstration of maintenance of the CO NAAQS, the I/M 240 program and the oxygenated fuel program are assumed to be removed on January 1, 2008. The phase-out of residual I/M 240 program benefits is estimated in the 2009 and 2010 analysis years. January 1, 2009 will have half the benefit of a biennial I/M 240 program and January 1, 2010 will have no residual benefit due to the I/M 240 program. All inventory estimates are defined by the demographic and transportation data and the programs in effect on January 1st of the year noted.

All of the inventories are for the Denver metropolitan area carbon monoxide attainment/maintenance area (see Figure 2) and provide emissions estimates for a weekday during the winter carbon monoxide season (November through February). The carbon monoxide attainment/maintenance area is used to establish the mobile source emissions budgets for the region as discussed in subsequent sections of this plan.

The inventories presented in this plan to support continued maintenance of the CO NAAQS in the Denver-Boulder area were developed using EPA-approved emissions modeling methods. The transportation and demographic data for this revised maintenance plan have been updated with the most recently available data sets from the Denver Regional Council of Governments 2030 Regional Transportation Plan (adopted in January 2005). The technical support document for this revised maintenance plan summarizes information on the assumed methodology, growth surrogate and/or control assumptions for each non-motor vehicle (point and area) source category.

Table 3 summarizes the inventories for this plan revision.

**Table 3:
Emission Inventories for the Denver Carbon Monoxide Attainment Area
Carbon Monoxide Emissions (tons/day)**

	2001	2009	2010	2013	2015	2020	2021
Area Sources							
Aircraft	13.8	17.6	18.0	19.1	19.9	21.7	22.0
Commercial Cooking	1.0	1.0	1.1	1.1	1.2	1.3	1.3
Fuel Combustion	8.2	9.2	9.4	9.8	10.1	11.0	11.0
Railroads	0.6	0.8	0.8	0.9	0.9	1.0	1.0
Structure Fires	0.4	0.5	0.5	0.5	0.5	0.5	0.5
Woodburning	50.2	51.4	51.5	52.0	52.3	53.2	53.4
Total Area Sources	74.1	80.5	81.2	83.4	84.9	88.7	89.4
NonRoad Sources							
Agricultural Equipment	0.2	0.2	0.2	0.1	0.1	0.1	0.1
Airport Equipment	27.4	34.0	35.3	37.3	38.9	42.9	43.6
Commercial Equipment	116.0	148.2	151.1	159.6	165.2	174.8	176.8
Construction and Mining Equipment	14.4	15.1	15.0	14.1	13.4	12.0	11.9
Industrial Equipment	21.4	15.7	13.5	7.3	4.9	3.2	3.1
Lawn and Garden Equipment (Commercial)	17.4	22.1	22.4	23.3	24.0	25.5	26.0
Lawn and Garden Equipment (Residential)	1.0	0.8	0.9	0.9	0.9	1.0	1.0
Other Oil Field Equipment	0.4	0.5	0.5	0.5	0.5	0.5	0.5
Railroad Equipment	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Recreational Equipment	1.3	2.2	2.3	2.4	2.4	2.4	2.4
Total NonRoad Sources	199.4	239.0	241.3	245.6	250.4	262.6	265.6
Point Sources							
Stack>=25 meters	4.9	5.6	5.8	6.3	6.8	7.9	8.1
Stack<25 meters	10.4	12.5	12.7	13.5	13.6	15.0	15.2
Total Points	15.3	18.1	18.5	19.8	20.4	22.9	23.3
Total Area-Non-Road-Point	288.8	337.7	341.0	348.8	355.7	374.2	378.2
Mobile Sources	1708.1	1476.8	1523.9	1429.2	1416.0	1362.7	1372.1
Grand Total	1997.0	1814.5	1864.9	1778.1	1771.7	1736.9	1750.3

Note: The significant figures in this table are used to show the small contribution of certain source categories. They are not intended to indicate a level of accuracy in the inventories. Totals may not add due to rounding.

1. Demographic and Transportation Data

The most recent planning assumptions for the Denver metropolitan area are incorporated in the Denver Regional Council of Government's 2030 Regional Transportation Plan. Table 4 summarizes the population, households and employment estimates for 2001 - 2030 for the Denver-Boulder attainment area from this plan. These estimates are used as the basis for the emission inventory development.

**Table 4:
Demographic Data Used to Develop
The DRCOG 2030 Regional Transportation Plan
(Based on the 2000 census)**

Period	Population	Households	Employment
2001	2,304,700	916,480	1,306,800
2005	2,454,300	988,000	1,267,100
2015	2,853,200	1,156,300	1,612,300
2020	3,099,300	1,262,300	1,721,300
2030	3,591,600	1,474,400	1,939,500

2. Methodology and Control Assumptions for Source Categories

a. Mobile Sources

The mobile source emission estimates contained in this revised maintenance plan are also based on 2030 Regional Transportation Plan travel demand modeling provided by DRCOG (see Table 5).

**Table 5:
2030 RTP Transportation Vehicle Miles Traveled Used
To Develop this Revised Maintenance Plan**

Year	VMT
2001	57,984,600
2005	61,842,200
2015	77,544,600
2020	84,765,600
2030	98,499,600

Mobile source inventories in this proposed revision are also based on MOBILE6.2 emissions factors, Denver metro area vehicle registration and vehicle-type mix miles traveled estimates. The 2001 inventory is based on MOBILE6.2 credits for the inspection/maintenance and oxygenated gasoline programs that were in use on January 1, 2001. The analysis years of 2009 and 2010 are included in this maintenance demonstration to account for the phase-out of the emissions reduction

due to the removal of the I/M and oxygenated gasoline programs effective December 31, 2007. On January 1, 2009 the residual benefit of the I/M program will be one-half the benefit to the biennial I/M 240 program. On January 1, 2010 it is assumed that there will be no residual benefit due to the I/M 240 program. No benefit from the oxygenated gasoline program is assumed for the 2009 analysis year and beyond. The analysis years at 2010 and later do not include an I/M program or oxygenated fuel program.

The Technical Support Document contains documentation of the modeling methodology using MOBILE6.2.

b. Point Sources

Point source inventories were estimated using data from the CDHPE Air Pollution Control Division APEN reporting system. Urban Airshed Modeling done for a previously approved plan indicates that elevated point sources have little or no impact on the maintenance demonstration since the mixing height on the worst-case days is very shallow. In addition, the larger sources of elevated CO emissions are not located near the Denver central business district. Consequently, carbon monoxide emitted above 25 meters AGL are excluded from the inventory of ground level carbon monoxide sources inventory used for the grid analysis portion of the attainment demonstration. However, elevated sources are included in the inventory totals for the Denver-Boulder attainment/maintenance area. Carbon monoxide emissions from point sources emitted below 15 AGL are included in the grid analysis portion of the attainment demonstration. This treatment of carbon monoxide point sources is consistent with the historical treatment of such sources for the previous Denver-Boulder attainment area plans.

Specific information for point sources in the attainment/maintenance area is summarized in the Technical Support Document for this maintenance plan revision, including the number of new sources permitted since the previously approved maintenance plan was developed.

c. Non-road and Area Sources

The area sources, with the exception of residential woodburning, are based on National Emission Inventory methodologies and data. Residential woodburning emissions are based on the Metropolitan Denver Woodburning Survey (2002). The non-road mobile source emissions were estimated using the EPA Nonroad Model (2004). The emission inventories for both non-road and area sources are documented in the Technical Support Document.

d. Aircraft and Airport Services

In conjunction with this plan revision, DIA has provided CDPHE updated emissions estimates to incorporate in the plan. The aircraft and airport equipment categories in Table 4 incorporate the updated estimates from DIA for the 2001 through 2021 time period as well as from all other airports in the Denver-Boulder attainment area. Summaries of the DIA inventories are included in the Technical Support Document in the airport-related emissions discussions. The DIA inventory documentation is included as an Appendix in the Technical Support Document.

D. MAINTENANCE DEMONSTRATION

This revision to the CO maintenance plan relies on gridded emissions inventory comparisons and selected intersection hot-spot analysis to demonstrate maintenance of the standard through the 2021 maintenance year as was done in the maintenance plan approved September 16, 2004, which replaced MOBILE5 estimates with MOBILE6.2 estimates. The three components of this modeling analysis and demonstration are:

- **Gridded emissions inventory comparisons** address a nine-cell subset of Central Business District (CBD) grid cells where historical maximum concentrations have occurred. The CBD area includes the monitored and modeled locations of the maximum hourly and 8-hour CO concentrations identified in the 1994 attainment plan and the previous 2001 maintenance plan. The analysis compares the 2001 baseline gridded emissions inventories to future year inventories, and demonstrates future year emissions loadings lower than baseline emissions loadings.
- **Areas of high growth** were identified through review of future year multi-grid cell inventories for the entire modeling domain (geographical area defined in the 1995 CO SIP). The gridded emissions evaluation identified no areas of high growth for further analysis.
- **Hot spot analysis** of selected intersection locations is required to assure that the combination of localized area growth and transportation growth does not lead to a violation of the standard in the region. The analysis includes background concentration roll forward modeling and intersection modeling using CAL3QHC. The background concentration, which addresses localized area growth, uses Denver metro area ambient monitoring data for 2000 through 2002 and baseline and future gridded emissions loadings. CAL3QHC modeling for the three highest traffic volume, three most congested intersections, and a CBD intersection, addresses mobile source emissions.

These analyses demonstrate future emissions loadings in the CBD below the levels necessary to maintain attainment. In addition, growth in the suburban areas results in future background concentrations that do not exceed the levels found in the areas identified for hot spot analysis. Finally, continued maintenance of the standard through 2021 is demonstrated based on a hot spot analysis of selected locations in the fringe and urban/suburban areas and the CBD. All modeling for a given year is based on the inventory estimate for January 1st of the analysis year. Additional details are provided below and in the TSD.

1. **Gridded Emissions Inventory Comparison**

a. **Central Business District**

The emissions inventories for a nine-cell subset of the Denver Central Business District grid cells (one square mile) for the 2001 attainment year have been compared to the future year emissions loadings, including 2010 (the highest future emissions year) in Table 6. As can be seen, the future year emissions loadings are well below the 2001 emissions load.

**Table 6:
Comparison of 2001 Baseline Attainment Year Nine-Cell Gridded Inventory
with Interim, Interim Budget & Maintenance Year Inventories
(tons per day)**

Year	TPD
2001	67.9
2010	59.2
2013	53.9
2021	50.0

b. High Growth Areas

The gridded emissions for the entire modeling domain (defined in the 1995 CO SIP and shown in Figure 2) have been evaluated for areas of high growth. A roll forward analysis was used to determine if identified areas of high growth required additional analysis. Since the high growth areas are located a distance away from Denver’s urban core area, background CO levels are estimated from the UAM modeling for the 2001 maintenance plan from the initial CO SIP (1995). The 2001 modeled CO concentrations have been scaled to 2010 (the highest future emissions year), 2013 and 2021 using the ratio of the future year multi-grid cell neighborhood inventory level to the 2001 base inventory as shown in the following Table 7 for high growth areas.

**Table 7:
High Growth Areas**

Year	Parker Rd & I-225		S. Santa Fe Corridor		S. Santa Fe Corridor at Littleton Blvd.		Hwy 285 & Kipling Pkwy		Parker Rd. Corridor at I-225	
	TPD	CO ppm	TPD	CO ppm	TPD	CO ppm	TPD	CO ppm	TPD	CO ppm
2001*	11.1	2.1	10.3	2.3	7.2	1.1	6.0	1.0	9.4	2.3
2010	13.9	2.6	10.6	2.4	7.8	1.2	7.1	1.2	11.7	2.9
2013	12.3	2.3	9.5	2.1	7.0	1.1	6.6	1.1	10.3	2.5
2021	10.8	2.1	8.4	1.9	6.2	0.9	6.6	1.1	9.0	2.2

*2001 CO concentrations = UAM background

Typically, the areas of high growth rates are in suburban areas where baseline background conditions are low. Although there are areas with emissions loadings that are higher in future years, the analysis as shown above indicates that the future year background CO concentrations remain low and do not warrant additional analysis at any of the identified high growth areas. The background concentrations of the highest volume/most congested intersections (see Table 9) are all greater than any of the future year background concentrations presented in Table 7 for high growth areas. Additional details for areas of high growth areas provided in the Technical Support Document.

2. Intersection Modeling Analysis

A modeling analysis, including background roll forward modeling and intersection modeling has been performed for future years 2010, 2013 and 2021 on intersections identified by DRCOG as the current three highest volume and three most congested intersections in the DMA and an intersection in the Denver Central Business District.

The highest volume intersections are as follows:

- University Boulevard and 1st Avenue
- Wadsworth Boulevard and Alameda Avenue
- University Boulevard and Belleview Avenue

The most congested intersections are as follows:

- 28th Street and Arapahoe Road (Boulder)
- University Boulevard and Belleview Avenue
- Foothills Parkway and Arapahoe Road (Boulder)

a. Background Concentration Roll Forward Modeling

The background concentrations for the intersection modeling demonstration are estimated in a manner consistent with the methodology used to estimate background concentrations for the most recent CO SIP revision based on MOBILE6.2. This methodology utilizes the Denver metropolitan area ambient monitoring data for 2000 through 2002. The maximum second-maximum monitored ambient concentration from the 2000-2002 monitoring period is used to define the baseline (2001) background concentration. The following Table 8 shows the eight-hour average ambient carbon monoxide maximum and second maximum values for each monitoring location.

**Table 8:
2000-2002 8-hr Average Ambient Carbon Monoxide (ppm)
Maximum and 2nd Maximum**

Location	Area Type	2000	2001	2002
CAMP	CBD	8.5 / 5.4	4.4 / 4.1	3.7 / 3.7
Speer & Auraria	CBD	5.0 / 4.6	4.6 / 4.0	3.9 / 3.6
Carriage	Fringe	4.1 / 3.4	3.8 / 3.7	3.7 / 2.7
National Jewish Hospital	Fringe	4.8 / 4.7	4.0 / 3.9	3.5 / 3.1
Arvada	Urban/Suburban	3.9 / 3.8	3.1 / 3.0	3.0 / 2.6
Boulder	Urban/Suburban	6.8 / 4.3	4.5 / 3.4	3.5 / 3.0

The highest-volume and most-congested intersections were assigned baseline (2001) background concentrations from Table 8 (the highest of the second high values noted in bold) on the basis of intersection location, area type and intersection roadway class similarities. The 2001 background assignments and rationale for each intersection are shown in Table 9 as follows:

**Table 9:
2001 Background Concentration Assignment for Intersection Modeling**

Intersection	Background Assignment	Rationale
28 th & Arapahoe (Boulder)	4.3 ppm; Boulder	Monitor Location
University & Belleview	3.8 ppm;	Urban/major arterials
University and 1 st Ave.	4.7 ppm;	Fringe/major arterials
Foothills & Arapahoe (Boulder)	4.3 ppm; Boulder	Monitor location
Wadsworth & Alameda	3.8 ppm;	Urban/major arterials
20 th & Broadway (CAMP)	5.4 ppm; CAMP	Monitor location

Background concentrations for intersection locations by area type have been scaled to future years by applying the ratio of the future year nine-cell inventory level and 2001 nine-cell base inventory to the baseline (2001) background concentration. Adjusted background concentrations for 2010 (year of maximum estimated emissions) are presented by intersection in Table 10 below.

b. Intersection Modeling

The intersection modeling has been performed for the identified intersections, using the CAL3QHC model, as described in the Technical Support Document (TSD) for the Carbon Monoxide Redesignation Request and Maintenance Plan for the Denver Metropolitan Area (see Section 3.9). The CAL3QHC input data has been derived as described in Section 3.9.2 of the above noted TSD. The traffic growth between 2001 and future years (2010, 2013 and 2021) have been estimated from DRCOG's 2030 RTP. The mobile source emission factors for the intersection modeling are based on MOBILE6.2 modeling. Intersection modeling results for 2010 (year of maximum estimated emissions) are presented by intersection in Table 10 below. Additional details are included in the Technical Support Document for this revision.

c. Summary of Intersection Analysis

The adjusted background concentrations and intersection modeling for the selected intersections has been summarized and totaled in the following Table 10 for 2010 (year of maximum estimated emissions). As can be seen the totals at all selected intersection locations are below the CO NAAQS of 9.0 ppm.

**Table 10:
Intersection Modeling Analysis for 2010**

Intersection	Background ppm	CAL3QHC ppm	Total ppm
28th & Arapahoe (Boulder)	3.4	4.1	7.5
University & Belleview	3.2	3.9	7.1
University & 1st Ave.	3.8	3.3	7.1
Foothills & Arapahoe (Boulder)	3.7	3.4	7.1
Wadsworth & Alameda	2.9	3.1	6.0
20th & Broadway (CAMP)	5.0	1.4	6.4

Similar analysis of interim budget year 2013 and maintenance year 2021 indicates that the total concentrations are also below the standard as shown in the following Table 11, therefore, demonstrating maintenance of the standard through 2021.

**Table 11:
Summary Intersection Modeling Analysis for Future Years**

Intersection	2010 Total ppm	2013 Total ppm	2021 Total ppm
28th & Arapahoe (Boulder)	7.5	6.6	5.7
University & Belleview	7.1	6.1	5.4
University & 1st Ave.	7.1	6.2	5.3
Foothills & Arapahoe (Boulder)	7.1	6.4	5.6
Wadsworth & Alameda	6.0	5.3	4.5
20th & Broadway (CAMP)	6.4	5.7	5.4

E. CARBON MONOXIDE MOTOR VEHICLE EMISSIONS BUDGET

1. Requirements for Establishing Emission Budgets

The transportation conformity provisions of section 176(c)(2)(A) of the CAA require regional transportation plans and programs to show that "...emissions expected from implementation of plans and programs are consistent with estimates of emissions from motor vehicles and necessary emissions reductions contained in the applicable implementation plan..."

EPA's transportation conformity regulation (40 CFR 93.118) also requires that motor vehicle emission budget(s) must be established for the last year of the maintenance plan, and may be established for any other years deemed appropriate. If the maintenance plan does not establish motor vehicle emissions budgets for any years other than the last year of the maintenance plan, the conformity regulation requires a "demonstration of consistency with the motor vehicle emissions budget(s) must be accompanied by a qualitative finding that there are no factors which would cause or contribute to a new violation or exacerbate an existing violation in the years before the last year of the maintenance plan." The normal interagency consultation process required by the regulation shall determine what must be considered in order to make such a finding.

EPA policy indicates the last year of a previously approved maintenance plan must be kept as an interim budget year in a revision to the maintenance plan.

For transportation plan analysis years after the last year of the maintenance plan (in this case, 2021), a conformity determination must show that emissions are less than or equal to the maintenance plan's motor vehicle emissions budget(s) for the last year of the maintenance plan.

EPA's conformity regulation (40 CFR 93.124) also allows the implementation plan to quantify explicitly the amount by which motor vehicle emissions could be higher while still demonstrating compliance with the maintenance requirement. The implementation plan can then allocate some or all of this additional "safety margin" to the emissions budget(s) for conformity purposes.

EPA's "Policy Guidance on the Use of MOBILE6 for SIP Development and Transportation Conformity," (dated January 18, 2002), notes "that regardless of the technique used for attainment or maintenance demonstrations, a more rigorous assessment of the SIP's demonstration may be necessary if a State decides to reallocate possible excess emission reductions to the motor vehicle emissions budget as a safety factor". Since this plan allocates available excess emissions reductions to the motor vehicle emissions budget, the EPA recommended a "more rigorous assessment" to ensure allocation of excess emissions will still demonstrate maintenance in 2013 and 2021 throughout the region. This methodology is described in more detail below.

2. Revised Motor Vehicle Emissions Budget for Interim Budget Year (2013) and Maintenance Year (2021) and Beyond

This maintenance plan establishes a revised motor vehicle emissions budget for the period 2013 through 2020 and establishes a motor vehicle emissions budget from the last year of the maintenance plan (2021) and beyond. The budgets are established for the boundaries of the attainment/maintenance area.

As shown in the emissions inventories earlier in this plan, the 2013 and 2021 total emissions inventories for carbon monoxide are below the level necessary to demonstrate continued maintenance of the CO standard. As a result, the maintenance plan may allocate some or all of the additional "safety margin" to the emission budget for conformity purposes, consistent with EPA's conformity regulation.

This maintenance plan estimates the available "safety margin" using the EPA recommended "more rigorous assessment" methodology and allocates a portion of the available safety margin to the motor vehicle emission budget in 2013 and 2021 as illustrated in Table 12 below. This maintenance plan allocates 196 tons per day of the potential "safety margin" to the motor vehicle

emission budget in 2013. The remaining 23 tons in 2013 are reserved to account for future point and area source growth, including growth at Denver International Airport, and other modeling uncertainties.

In addition, this maintenance plan allocates 228 tons per day of the potential “safety margin” to the motor vehicle emission budget in 2021. The remaining 19 tons in 2021 are reserved to account for future point and area source growth, including growth at Denver International Airport, and other modeling uncertainties. Mobile source emissions based on MOBILE6.2 are expected to continue to decline during this period.

The “more rigorous assessment” includes the 2001 background concentration and the intersection modeling analysis similar to that performed in both the original attainment SIP and the previously approved maintenance plan and described in this maintenance plan in section D.2 Intersection Modeling Analysis. The six intersections modeled directly address two of the high traffic areas addressed in the two previously approved maintenance plans, including the areas of maximum concentration, 1st & University (plan approved in 2001) and 20th & Broadway (plan approved in 2004).

The background concentration for each intersection utilizes the highest second maximum CO concentration at nearby ambient monitors for the period 2000-2002. The CAL3QHC intersection modeling uses 2013 and 2021 MOBILE6.2 emissions factors and DRCOG traffic data. The background concentration and CAL3QHC modeling value are then combined for each intersection. If the resulting concentration is greater than 9 ppm, the background concentration is reduced by the necessary percentage to bring the total value below 9 ppm. Since it is assumed the background concentrations are influenced by regional emissions of CO, the regional emissions (1997 tons per day in 2001) would be reduced by the same percentage to determine the allowable regional emissions. Similarly, if the resulting concentration is less than 9 ppm, no reduction in background concentration or regional emissions (1997 tons per day in 2001) is necessary. Subtracting the emissions from point and area sources results in the allowable mobile source emissions for purposes of calculating the excess emissions that can be allocated to the motor vehicle emissions budget or reserved for growth.

Table 13 summarizes the results of the intersection modeling analysis based on allocation of excess emissions and the final motor vehicle emissions budget. Since all of the intersections selected for modeling have concentrations below the CO standard in 2013 and 2021 all of the available excess emissions in each year may be allocated to the motor vehicle emission budget (MVEB) or reserved for future growth as discussed above.

The intersection modeling analysis and more rigorous assessment is described in more detail in the Technical Support Document.

The motor vehicle emissions budget of 1625 tons per day for 2013 and a motor vehicle emissions budget of 1600 tons per day for 2021 and beyond will be used to determine whether plans, programs, and projects comply with the SIP in applicable horizon years. The 2013 budget will take effect for future transportation conformity determinations upon EPA approval of this maintenance plan revision. Prior to such approval, the existing 2013 budget of 1520 tons per day shall continue to apply. The 2021 motor vehicle budget will take effect upon a determination of adequacy by the EPA.

Future maintenance plan revisions may reevaluate the motor vehicle emissions budget and may make adjustments as necessary based on the most recent information and future emission projections.

Table 12:
Proposed Motor Vehicle Emissions Budget (TPD)
2013 and 2021 and Beyond
Based on allocation of available safety margin

BUDGET YEARS	2013	2021	Explanation
2001 Total Attainment Inventory	1997	1997	<i>2001 Baseline inventory from all sources that established attainment level of emissions in the attainment/maintenance area</i>
Area & Point Source Emissions	349	378	<i>Total estimated emissions from point and area sources</i>
Mobile Source Emissions	1429	1372	<i>Estimated mobile source emissions based on MOBILE6.2 and SIP control strategies</i>
Total Emissions Inventory	1778	1750	
Potential "Safety Margin"	219	247	<i>Difference between 2001 and 2013 and 2021 total emissions inventories, respectively</i>
Allowable Mobile Source Emissions	1648	1619	<i>Total mobile source emissions that demonstrate attainment of the standard based on EPA's "more rigorous assessment"</i>
Available "Safety Margin"	219	247	<i>Difference between allowable mobile source emissions and estimated mobile source emissions which equals the available "safety margin" that may be allocated to the MVEB</i>
Portion of Safety Margin Reserved	23	19	<i>Portion of available "safety margin" that is reserved to account for point/area growth and other modeling uncertainties.</i>
"Safety Margin" assigned to MVEB	196	228	<i>Difference between available "safety margin" and "safety margin" reserved.</i>
Proposed 2013 and 2021 and Beyond Motor Vehicle Emissions Budgets	1625	1600	<i>Total of estimated mobile source emissions and "safety margin" assigned to the budget, which establishes the motor vehicle emissions budget for 2013 through 2020 and 2021 and beyond</i>

Table 13:
Justification of Available Safety Margin
2013 and 2021 and Beyond
Based on 2001 Background Concentration and Future Year Intersection Modeling

Intersection	2013 Total ppm	2021 Total ppm
28th & Arapahoe (Boulder)	7.8	7.3
University & Belleview	7.1	6.8
University & 1st Ave.	7.5	7.1
Foothills & Arapahoe (Boulder)	7.3	6.9
Wadsworth & Alameda	6.5	6.0
20th & Broadway (CAMP)	6.6	6.5

F. MONITORING NETWORK / VERIFICATION OF CONTINUED ATTAINMENT

Since the Denver metropolitan area has been redesignated to attainment status by EPA, the APCD operates and continues to operate an appropriate air quality monitoring network of NAMS and SLAMS monitors in accordance with 40 CFR Part 58 to verify the continued attainment of the carbon monoxide standard. If measured mobile source parameters (e.g., vehicle miles traveled, congestion, fleet mix, etc.) change significantly over time, the APCD will perform the appropriate studies to determine whether additional and/or re-sited monitors are necessary. Annual review of the NAMS/SLAMS air quality surveillance system will be conducted in accordance with 40 CFR 58.20(d) to determine whether the system continues to meet the monitoring objectives presented in Appendix D of 40 CFR Part 58.

G. CONTINGENCY PROVISIONS

Section 175A(d) of the CAA requires that the maintenance plan contain contingency provisions to assure that the State will promptly correct any violation of the carbon monoxide standard which occurs after redesignation to attainment. Attainment areas are not required to have preselected contingency measures, and this plan removes any commitment to contingency measures contained in the 1994 Denver Carbon monoxide nonattainment SIP Element.

The contingency plan must also ensure that the contingency measures are adopted expeditiously once the need is triggered. The primary elements of the contingency plan are: 1) the list of potential contingency measures; 2) the tracking and triggering mechanisms to determine when contingency measures are needed; and 3) a description of the process for recommending and implementing the contingency measures.

The triggering of the contingency plan does not automatically require a revision of the SIP, nor is the area necessarily redesignated once again to nonattainment. Instead, the State will normally have an appropriate time-frame to correct the violation by implementing one or more of the contingency measures. In the event that violations continue to occur after contingency measures have been implemented, additional contingency measures will be implemented until the violations are corrected.

1. List of Potential Contingency Measures

Section 175A(d) of the CAA requires the maintenance plan to include as potential contingency measures all of the carbon monoxide control measures contained in the SIP before redesignation which were relaxed or modified through the maintenance plan. For the Denver metropolitan area, this includes the following measures:

- A 3.1% oxygenated fuels program from November 8 through February 7, with 2.0% oxygen content required from November 1 through November 7.
- An enhanced vehicle inspection and maintenance program as described in AQCC Regulation No. 11 prior to the modifications adopted on January 10, 2000 as part of the maintenance plan approved by EPA on December 14, 2001 with the addition of any onboard diagnostic components as required by Federal law.
- Transportation control measures that were included in the 1994 attainment SIP as contingency measures, but were required to be implemented because growth in vehicle miles traveled exceeded SIP projections. These measures include transportation management associations, financial incentives for EcoPass, Auraria transit pass, and improved traffic signalization.¹

In addition to this list of potential contingency measures, the State may evaluate other potential strategies in order to address any future violations in the most appropriate and effective manner possible.

2. Tracking and Triggering Mechanisms

a. Tracking

The primary tracking plan for the Denver metropolitan area consists of continuous carbon monoxide monitoring by APCD as described above. APCD will notify EPA, the AQCC, the RAQC, and local governments in the Denver area of any exceedance of the carbon monoxide standard within 30 days of occurrence.

The ongoing regional transportation planning process carried out by the Denver Regional Council of Governments, in coordination with the RAQC, APCD, AQCC, and EPA, will serve as another means of tracking mobile source carbon monoxide emissions into the future.

¹The 1994 attainment SIP also included as a potential contingency measure the conversion of the Broadway/Lincoln bus lanes to bus/HOV lanes, but this measure was never implemented due to the high volume of buses still using these lanes even after the light-rail line from Broadway and I-25 to downtown became operational.

Since revisions to the region's transportation improvement programs are prepared every two years, and must go through a transportation conformity finding, this process will be used to periodically review progress toward meeting the VMT and mobile source emissions projections in this maintenance plan.

b. Triggering

An exceedance of the carbon monoxide standard (any value over 9.5 ppm) may trigger a voluntary, local process by the RAQC and APCD to identify and evaluate potential contingency measures. However, the only federally-enforceable trigger for mandatory implementation of contingency measures shall be a violation of the carbon monoxide standard. Specifically, a violation shall be an officially recorded second value of 9.5 ppm or higher at the same monitor during any calendar year.

3. Process for Recommending and Implementing Contingency Measures

The State will move forward with mandatory implementation of contingency measures under the SIP if a violation (a second exceedance in a calendar year) of the carbon monoxide standard occurs.

No more than 60 days after being notified by the APCD that a violation of the carbon monoxide standard has occurred, the RAQC, in coordination with the APCD and AQCC, will initiate a subcommittee process to begin evaluating potential contingency measures. The subcommittee will present recommendations to the RAQC within 120 days of notification and the RAQC will present recommended contingency measures to the AQCC within 180 days of notification.

The AQCC will then hold a public hearing to consider the contingency measures recommended by the RAQC, along with any other contingency measures the Commission believes may be appropriate to effectively address the violation. The necessary contingency measures will be adopted and implemented within one year after a violation occurs.

H. CAAA SECTION 110(I) ANALYSIS

Section 110(l) of the CAAA prevents the EPA from approving a plan revision if the revision would interfere with any applicable requirement concerning attainment of a standard and reasonable further progress, or any other applicable requirement of the CAAA. This maintenance plan revision removes two specific enforceable control measures from the Denver metro area CO SIP as discussed above. Discussion and analysis of the 110(l) impacts for each of the removed enforceable control measures follows:

1. Air Quality Control Commission Regulation No. 11 -- covering the Automobile Inspection and Readjustment (A.I.R.) Program. The A.I.R. Program will remain part of the Colorado SIP through the EPA approved Early Action Compact Ozone Action Plan for the 8-hour ozone standard (70 FR 48652, August 19, 2005) and the 1-hour Ozone Redesignation Request and Maintenance Plan for the Denver Metropolitan Area (66 FR 48798, September 11, 2001). Since the A.I.R. program remains in the Colorado SIP, removal of the A.I.R. Program from the Denver metro area CO SIP does not interfere with any applicable requirements

concerning other pollutants or other Requirements of the Clean Air Act. This maintenance plan, together with the corresponding revision to the Longmont maintenance plan, obviate the need for any showings under 110(l) concerning carbon monoxide if the State makes any further revisions to the A.I.R. Program contained in the Colorado SIP.

2. Air Quality Control Commission Regulation No. 13 -- covering the oxygenated gasoline program. As is described below, the removal of the oxygenated gasoline program from the federally enforceable SIP will not interfere with attainment of the 8-hour ozone and PM_{2.5} standards, or interfere with maintenance of the 1-hour ozone and PM₁₀ standards:
 - Ozone standards. The oxygenated fuels program is strictly a winter-time program and therefore has no impact on the ozone standards. Moreover, the oxygenated fuels program is not included in the approved maintenance plan for the 1-hour ozone standard or the Ozone Action Plan for the 8-hour ozone standard.
 - PM₁₀ standard. The oxygenated fuels program has already been removed from the current PM₁₀ maintenance plan. The PM₁₀ Redesignation Request and Maintenance Plan for the Denver Metropolitan Area was adopted by the Colorado Air Quality Control Commission April 19, 2001; submitted by the Governor, July 30, 2001; approved by EPA, 40 CFR 52.332(l). The 2001 maintenance plan demonstrated that the oxygenated fuels program is not necessary for maintenance of the PM₁₀ NAAQS.
 - PM_{2.5} standards. Based on MOBILE6.2, the oxygenated fuels program does not receive any credit for reduction of tailpipe emissions of particulate matter. Moreover, even if a small benefit does occur as noted in some studies, the Denver area is well below the PM_{2.5} NAAQS. For the 2002 through 2004 three-year period, the average of the 98th percentile of 24-hour concentrations at the CAMP station (the monitor showing the highest 24-hour readings) was 24.6 ug/m³ – well below the 65 ug/m³ NAAQS. For the same period, the annual average at the Commerce City station (the monitor showing the highest annual readings) was 10.2 ug/m³ – well below the 15 ug/m³ NAAQS. The oxygenated fuels program will not interfere with any applicable requirement to demonstrate attainment of the PM_{2.5} NAAQS.

I. SUBSEQUENT MAINTENANCE PLAN REVISIONS

The previously approved maintenance plan addressed the period 2001 through 2013 and demonstrated, as required in CAAA 175A(a), that the CO standard will be maintained for the initial ten-year period (through 2011) after redesignation in 2001. In accordance with CAA 176A(b) it is required that a maintenance plan revision be submitted to the EPA within eight years after the original redesignation to address maintenance of the standard for a second ten-year period beyond redesignation. The purpose of this maintenance plan revision is to provide for maintenance of the CO standard for the additional ten years (through 2021) following the first ten-year period.

No additional revisions of the CO maintenance plan are anticipated at this time. If future changes in mobile source models or other unforeseen considerations raise potential issues with maintaining the CO standard, the State and the RAQC will address the need to revise the maintenance plan at that time.