CARBON MONOXIDE REDESIGNATION REQUEST AND MAINTENANCE PLAN FOR THE DENVER METROPOLITAN AREA

Approved by:
Colorado Air Quality Control Commission
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PART 1 – BACKGROUND

CHAPTER 1: INTRODUCTION

The State of Colorado, in coordination with the Regional Air Quality Council (RAQC), is requesting that the U.S. Environmental Protection Agency (EPA) redesignate the Denver metropolitan nonattainment area to attainment status for the National Ambient Air Quality Standards for carbon monoxide. The Denver metropolitan area has been designated as a carbon monoxide nonattainment area since the 1970's, but has not violated the standard since 1995. Therefore, the area is now eligible for redesignation.

Part 1 of this document, including Chapter 1: Introduction and Chapter 2: Description of Strategy Analysis and Modifications to the Oxygenated Gasoline and Vehicle Inspection and Maintenance Programs, are provided as background information only and are not to be construed to be part of the State's official submittal to EPA.

Part 2 of this document, including Chapter 3: Requirements for Redesignation and Chapter 4: Maintenance Plan, constitute the State's official submittal to EPA. The Maintenance Plan, which is being submitted for inclusion in the State's federally-enforceable State Implementation Plan (SIP), provides for maintenance of the national standard for carbon monoxide in the Denver metropolitan area through the year 2013. The Maintenance Plan has been approved by the Regional Air Quality Council (RAQC) and the Colorado Air Quality Control Commission (AQCC), and complies with all State and federal requirements.

- **Regional Air Quality Council**

The Regional Air Quality Council is designated by Governor Owens as the lead air quality planning agency for the Denver metropolitan area. In this capacity, the mission of the RAQC is to develop effective and cost-efficient air quality initiatives with input from state and local government, the private sector, stakeholder groups, and private citizens. The RAQC's primary task is to prepare state implementation plans (SIPs) for compliance with federal air quality standards. The RAQC consists of a nine-member board appointed by the Governor. The board is comprised of local government, state agency, and citizen representatives.

In April 1999, the RAQC formed a Carbon Monoxide Maintenance Plan Subcommittee to develop recommendations for this Maintenance Plan. The Subcommittee was co-chaired by RAQC board member Mr. Jim Scherer, former Regional Administrator for EPA Region VIII, and Mr. Dennis Creamer, Director of External Affairs, Conoco, Inc. The Subcommittee held five meetings and participation was open to all interested parties. Meeting notices were sent to over 100 individuals and organizations, and approximately 30 people attended each meeting. Subcommittee participants included state and local government representatives, researchers, industry, environmental groups, citizens, and EPA staff.

- **Colorado Air Quality Control Commission**

The Colorado Air Quality Control Commission (AQCC) is a regulatory body with responsibility for adopting air quality regulations consistent with State statute. This includes the responsibility and authority to adopt State Implementation Plans (SIPs) and their implementing regulations. The Commission takes action on SIPs and regulations through a public rule-making process. The Commission has nine members who are appointed by the Governor and confirmed by the State Senate.

A. National Ambient Air Quality Standards for Carbon Monoxide

The EPA has two standards for carbon monoxide, a rolling 8-hour average concentration of 9.0 parts per million (ppm), and a 1-hour concentration of 35 parts per million. The national standard for carbon monoxide allows for no more than one exceedance of either standard in each calendar year. A violation occurs when two or more exceedances of the standard are recorded at the same monitoring site during a calendar year.

B. Health Effects of Carbon Monoxide

Carbon monoxide is a colorless, odorless, tasteless gas that enters the body through the lungs where it is absorbed by the bloodstream and then combines with hemoglobin in the red blood cells. Hemoglobin is the compound in the red blood cells that normally picks up oxygen from the lungs and carries it to the tissues. In the lungs, carbon monoxide competes with oxygen for available hemoglobin. When carbon monoxide binds with hemoglobin, it forms carboxyhemoglobin (COHb). Carbon monoxide attaches to hemoglobin much more readily than does oxygen. Once attached it does not disassociate from the hemoglobin as easily as oxygen. As a result, COHb levels can continue to increase in the bloodstream and the amount of oxygen being distributed throughout the body is reduced.

Blood containing carbon monoxide can weaken heart contractions, lowering the blood volume being distributed through the body. Effects include fatigue, dizziness, headaches, loss of visual acuity, and mental confusion. Individuals with cardiovascular or chronic obstructive pulmonary disease, pregnant women, and children are at greatest risk from exposure to carbon monoxide. Carbon monoxide also affects the central nervous system by depriving it of oxygen. Therefore, even healthy individuals can experience adverse effects from carbon monoxide exposure, such as a reduced ability to concentrate. Carbon monoxide exposure in high altitude environments like the Denver area can present a greater risk because of the lower levels of oxygen present in the atmosphere.

C. Denver Carbon Monoxide Area Designation History

The Denver metropolitan area was originally designated as nonattainment for carbon monoxide under provisions of the 1977 Clean Air Act (CAA) Amendments. This designation was reaffirmed by the 1990 CAA Amendments when the Denver area was classified as a moderate carbon monoxide nonattainment area with a design value greater than 12.7 parts per million. The Denver metropolitan area was then reclassified as a "serious" nonattainment area by EPA in 1997 for failing to demonstrate attainment of the carbon monoxide standard by the December 31, 1995 deadline for moderate areas.

The carbon monoxide standard has not been violated in the Denver metropolitan area since 1995, making the area eligible to submit this request for redesignation to attainment status for the carbon monoxide standard.

D. Denver Metropolitan Attainment/Maintenance Area

The six-county Denver metropolitan area is characterized by a broad valley along the South Platte River. The terrain to the east of the region is dominated by gently rolling plains, while the Front Range foothills of the Rocky Mountains dominate the west. The elevation of downtown Denver is 5,280 feet above sea level, with somewhat higher elevations in some suburban areas.

The boundaries of the Denver metropolitan nonattainment area are defined in Colorado's Ambient Air Quality Standards Regulation and in 40 CFR 81.306. Once redesignated, these will become the boundaries of the Denver metropolitan attainment/maintenance area. The area includes the entire City and County of Denver; those portions of Adams and Arapahoe counties west of Kiowa Creek, the portion of Douglas County east of the Pike National Forest boundary, the portion of Jefferson County below 6,000 feet but including the US-6, I-70, and US-285 highway corridors; and the southeast portion of Boulder County below 6,000 feet (see Figure 3.1). The City of Longmont in Boulder County is a separate nonattainment area and is the subject of a separate Maintenance Plan, which has already been approved by EPA.

E. Required Components of a Redesignation Request

Sections 107(d)(3)(d) and (e) of the Clean Air Act define the criteria an area must meet before being redesignated to attainment/maintenance status. With the submittal of this Maintenance Plan, the Denver metropolitan area meets all of these criteria.

1. Attainment of the standard

The State must show that the area has attained the national standards for carbon monoxide.

2. State Implementation Plan approval

The area must have a fully approved carbon monoxide State Implementation Plan.

3. Improvement in air quality due to permanent and enforceable emissions reductions

The State must demonstrate that the improvement in air quality leading to attainment of the standard is due to permanent and federally enforceable emissions reductions.

4. CAA Section 110 and Part D requirements

The State must meet all requirements of Section 110 and Part D of the CAA. Section 110 describes general requirements for SIPs, while Part D pertains to general requirements applicable to all nonattainment areas.

5. Maintenance Plan

The area must have a fully approved carbon monoxide Maintenance Plan that meets the requirements of CAA Section 175a, including a demonstration that the area will maintain the standard for a period of at least 10 years following redesignation by EPA. The plan must also contain contingency measures that could be implemented if a violation of the standard is monitored at any time during the maintenance period.

F. USE OF MOBILE5 EMISSIONS MODEL

In order to complete this redesignation request in a timely fashion, the State had to use EPA's currently available mobile source emissions model – MOBILE5. Based on research conducted in Colorado and elsewhere, it is widely accepted that the MOBILE5 model overstates the current benefits of the oxygenated gasoline program and the vehicle inspection and maintenance program. It is also known that the model over predicts emissions in the future because new technology vehicles are staying cleaner than anticipated when the MOBILE5 model was developed.

EPA plans to address these problems when they release the MOBILE6 model. However, MOBILE6 is more than a year behind schedule and there is no firm release date for the model at this time, although it may be available sometime in 2000.

Despite the problems with MOBILE5, the State has been able to use it in this plan (as required by EPA) to demonstrate maintenance with the carbon monoxide standard through 2013. The model provides the region with some flexibility to modify the two primary carbon monoxide control programs – oxygenated gasoline and vehicle inspection and maintenance (I/M). However, it is anticipated that the region will be able to justify even more flexibility, particularly with oxygenated gasoline, when MOBILE6 is available. Therefore, it is the intention of the RAQC and the State to prepare a revised maintenance plan as soon as possible after MOBILE6 or an equivalent tool is released by EPA.

A revision to this plan using MOBILE6 is likely to involve updated dispersion and intersection modeling that includes meteorological inputs from more recent carbon monoxide episodes. Remodeling with MOBILE6 and more recent meteorological inputs will require a major technical effort by APCD and is likely to take a year or longer to complete. However, this effort is justified because it will provide a much better indication of which programs are effective and what level of controls are needed for the region to stay in long-term compliance with the carbon monoxide standard.

Given the uncertainty regarding when MOBILE6 will be released, and the time that it will take to prepare a revised maintenance plan once the model is released, the RAQC and the AQCC have moved forward with this plan so that the region can achieve attainment status as soon as possible and begin making appropriate incremental program changes.

CHAPTER 2
DESCRIPTION OF STRATEGY ANALYSIS AND MODIFICATIONS TO THE OXYGENATED GASOLINE AND VEHICLE INSPECTION AND MAINTENANCE PROGRAMS

As a result of cleaner cars in the fleet, emission projections for the Denver metropolitan area show that it is possible to relax and/or modify current carbon monoxide control programs while maintaining compliance with the carbon monoxide standard through 2013. The analysis conducted for this maintenance plan focused on modifications to the region's two primary carbon monoxide control programs – oxygenated gasoline and vehicle inspection & maintenance (A.I.R. Program). Relaxing or modifying these programs is appropriate at this time because it will reduce the cost of compliance for consumers and businesses and increase motorist convenience without jeopardizing compliance with the standard.

A. Options from Screening Analysis

As part of the RAQC's Carbon Monoxide Maintenance Plan Subcommittee process, the APCD carried out a screening analysis that evaluated a series of options for modifying the oxygenated fuels and I/M programs. This analysis assumed a biennial, transient test and focused on three potential program modifications:

- Reduced oxygen content in wintertime gasoline
- Additional model year exemptions from the I/M program (currently 4)
- Use of remote sensing to clean screen vehicles out of the I/M program

The results of the screening analysis yielded the program design options shown in Table 2.1. Each of these program designs results in roughly equivalent regional emissions and would allow the region to demonstrate maintenance of the carbon monoxide standard through 2013. This screening analysis was completed using the MOBILE5 emissions model, including the model's new component for estimating the impact of remote sensing clean screen programs. The clean screen component indicates some loss of I/M program benefit because remote sensing will screen out a small number of vehicles that would have failed their emissions test. The data EPA used to develop the clean screen component for MOBILE5 is based primarily on data collected in Colorado.

TABLE 2.1
PROGRAM DESIGN OPTIONS FOR MAINTENANCE DEMONSTRATION
(Based on full implementation in 2006)

	Oxygen Content	Number of Model Years Exempted	Percent of Fleet Evaluated with Remote Sensing[(1)]
1)	2.0%	4	100%
2)	1.0%	4	50%
3)	1.5%	4	80%
4)	0.0%	4	10%
5)	2.0%	5	100%
6)	1.0%	5	40%
7)	0.0%	5	0%
8)	2.0%	6	90%
9)	1.0%	6	20%

(1) Important Note: The percentages shown indicate the target for the percentage of the fleet that would be evaluated with remote sensing, not the percentage of the fleet that would be exempted from testing. Current data suggest that 60-70% of the vehicles evaluated with remote sensing would be screened out of the routine testing program.

B. Recommended Option

The Maintenance Plan implements Option 3 – 1.5% oxygen content, exempting new vehicles from testing for four years, and evaluating up to 80% of the fleet with remote sensing. It is estimated that through the combination of model year exemptions and clean screening, this approach will result in routine testing exemptions for approximately 60% of the fleet – 25% by model year and 35% by clean screening.

Also, this approach will allow the region to substantially modify both the oxygenated gasoline program and the I/M program, as opposed to making significant changes to only one program. By selecting to retain the I/M exemption for the first four model years and implementing an aggressive remote sensing program, the region can achieve the goal of reducing the number of vehicles subjected to routine testing, while at the same time providing the option to use the remote sensing network to identify high emitting vehicles.

C. OXYGENATED GASOLINE PROGRAM CHANGES

With new, cleaner cars replacing older, dirtier cars in the fleet, and because oxygenated gasoline has been show to be less effective in newer technology vehicles which are already very clean, it is reasonable to begin phasing down the use of oxygenated gasoline in the Denver metropolitan area. As shown in the maintenance demonstration, assuming the other control measures included in this plan, the Denver metropolitan area can begin reducing the required oxygen content in its wintertime gasoline during the 2001-02 season while maintaining compliance with the carbon monoxide standard.

1. Current Oxygenated Gasoline Program

With the changes to the oxygenated gasoline program recently approved by EPA (64 FR 46279, August 25, 1999), the current program requirements for the Denver metropolitan area are as follows:

a. Control period is from November 1 through February 7 of each year.

b. At least 2.0% oxygen content by weight from November 1 through November 7.

c. At least 2.7% by weight from November 8 through February 7, with a requirement for maximum allowable oxygenate blending between November 8 and January 31. Maximum blending for ethanol is 10% by volume (provides 3.5% oxygen content) and for MTBE is 15% by volume (provides 2.7% oxygen content).

d. If the market does not achieve an average oxygenate content of 3.1% for the area during the maximum blending period, a mandatory averaging program to achieve 3.1% shall be implemented. (Note: The mandatory averaging program has never been needed.)

2. Changes to the Oxygenated Gasoline Program

As described in detail in the revisions to AQCC Regulation No. 13 which are being submitted to EPA for incorporation into the SIP, the changes to the oxygenated gasoline program are as follows:

Effective upon final approval by EPA:

a. Eliminate the maximum blending requirement effective February 8, 2001;

b. Gradually reduce the minimum oxygen content requirement to 1.5% on November 1, 2005 according to the schedule shown in Table 2.2; and

c. Reduce the minimum oxygen content to 1.5% for the week of February 1 to February 7 in 2003 and 2004, and eliminate the oxygenate requirement for the week of February 1 to February 7 from 2005 through 2013.

TABLE 2.2
CHANGES TO OXYGENATED GASOLINE PROGRAM

Winter Season	Nov. 1 - Nov. 7	Nov. 8 - Jan. 31	Feb. 1 - Feb. 7
2001-2002	2.0%	2.7%	2.7%
2002-2003	2.0%	2.6%	1.5%
2003-2004	2.0%	2.0%	1.5%
2004-2005	1.9%	1.9%	0.0%
2005-06 thru 2011-12	1.5%	1.5%	0.0%
2012-2013	1.7%	1.7%	0.0%
2013-14 thru 2018-19	1.7%	1.7%	1.7%
2019-20 and beyond	3.1%	3.1%	3.1%

As described in the maintenance demonstration (Part 2, Chapter 4), the gradual phase down to the target of 1.5% oxygen content is necessary to show compliance with the standard between 2002 and 2006.

The assumption that the oxygen content in the 2012-2013 season increases to 1.7% is based on the MOBILE5 emissions estimates which indicate that with the projected growth in VMT, emissions in that year will be slightly higher than in 2006. Therefore, it was necessary to assume a slightly higher oxygen content to demonstrate maintenance of the standard in 2013.

The changes to Regulation No. 13 adopted by the AQCC also include a State-only provision that reinstates the 3.1% oxygenated fuels program in the year 2019. Using currently available models, such an increase in oxygen levels appears to be necessary to ensure maintenance of the carbon monoxide standard after 2019 and to allow the Denver Regional Council of Governments (DRCOG) to make transportation conformity determinations required by federal law. The AQCC expects to repeal the State-only 3.1% oxygen requirement if it proves unnecessary when the Maintenance Plan is revised using an updated mobile source emissions model.

As discussed in Chapter 1, the RAQC and APCD expect to revise this modeling once EPA releases their updated mobile source emissions model, MOBILE6. The MOBILE6 model is expected to be released by EPA sometime in 2000. This new model will show a reduced benefit for oxygenated gasoline and will also show lower future carbon monoxide emissions from the fleet when compared to current estimates. Once completed, this new

modeling should allow the area to further reduce or eliminate the oxygenated gasoline requirement, and to do so sooner than proposed here. Therefore, the assumption of 1.7% oxygen content in 2012-13 should be viewed as a "placeholder" strategy that will be replaced when the maintenance plan is revised.

3. Cost Savings Associated with Changes to Oxygenated Gasoline Program

The cost of the oxygenated gasoline program along the Front Range in 1996/97 was estimated at $11.8 million dollars (Performance Audit of the Colorado AIR Program, March 1998, Office of the State Auditor). Assuming that 75% of this cost is borne by the Denver metropolitan area, the annual cost of the program is estimated at $8.9 million per year. This cost includes increased gasoline prices and fuel economy decreases.

It is important to recognize that the impact of oxygenates on gasoline prices in the Denver metropolitan area varies from year to year depending on the cost of ethanol and gasoline. While oxygenates may increase gasoline costs, retail prices are driven mostly by market conditions. Factors such as crude oil prices and competition have a much larger effect on prices than oxygenates. Nevertheless, the proposed changes do provide regulatory relief, and protection from State and federal enforcement, to those entities subject to Regulation No. 13.

Since the cost of the program is related in a linear fashion to the oxygen content required, a simple proration based on the change in oxygen content required and the cost figure stated above can be used to estimate the cost savings associated with the proposed changes to the program as follows:

TABLE 2.3
ESTIMATED COST SAVINGS WITH CHANGES TO OXYGENATED GASOLINE PROGRAM

Oxygen Content	Annual Cost (millions)	Annual Cost Savings (millions)
3.5%*	$8.9	
2.7%	$6.8	$2.0
2.0%	$5.1	$3.8
1.5%	$3.8	$5.1

* Audit used 95% ethanol blending which reflects current market practices.

D. GASOLINE VEHICLE INSPECTION AND MAINTENANCE PROGRAM CHANGES

The analysis completed for this Maintenance Plan indicates that, at this time, it is not possible to eliminate routine vehicle testing in the Denver metropolitan area and still show compliance with the carbon monoxide standard as required by EPA. However, there is substantial flexibility to reduce the number of vehicles subjected to routine testing. Reducing the number of vehicles tested each year – and thereby reducing consumer cost and increasing convenience – and improving programs to identify and repair high emitting and smoking vehicles are the primary goals of the I/M program changes included in this maintenance plan.

1. I/M Test Type

Since 1995, the Denver metropolitan area has operated an enhanced I/M program that includes a biennial, IM240 test for 1982 and newer vehicles, with new vehicles exempted for their first four years. The area also operates an annual, idle-test for 1981 and older vehicles. Both the IM240 and idle test stations are required to be "test-only" facilities, meaning that they are not permitted to perform repairs or sell automotive parts. All vehicles in the region are required to be tested upon change of ownership. The program also includes waiver provisions for hardship cases and for motorists who spend $450 on repairs. No waivers are allowed for vehicles that emit visible smoke.

The RAQC's Carbon Monoxide Maintenance Plan Subcommittee addressed the issue of whether to retain the current tests or to recommend moving to a different test type and/or frequency of testing. Three test types were considered by the subcommittee:

1) Transient test: A loaded mode test, of which IM240 is one version, that tests a vehicle on a dynamometer at different speeds. Can be centralized or de-centralized.

2) Steady-state test: Also a loaded mode test, but tests vehicle at a single speed. Can be centralized or de-centralized.

3) Idle-test: Vehicle is not placed under load. Normally a de-centralized test.

The information presented to the subcommittee indicated that the transient test is the most effective test for new technology vehicles and receives the most credit from EPA. The steady-state test costs roughly the same as the transient test but may yield more false failures and gets less credit from EPA. It was determined that the idle test is not a viable test for new technology vehicles and gets very little credit from EPA.

Therefore, this plan recommends moving forward under existing State statutory authority which includes a centralized, biennial, transient test for 1982 and newer vehicles. As described below, the change to the program that is being recommended in this maintenance plan is to implement a remote sensing, clean-screening program that will reduce the number of vehicles subjected to routine inspection. The remote sensing program can also be used to identify high emitting vehicles on the road. As shown in Table 4.4, the changes to Regulation No. 11 also include more stringent cutpoints for the

inspection and maintenance program beginning in 2002.

The decision whether to administer the transient test through a centralized or a decentralized program after the State's current contract with Envirotest expires on December 31, 2001 does not affect the air quality benefits of the program and is a decision that should be made by the General Assembly and the agencies responsible for implementing the program based on cost, convenience, and other appropriate factors.

For the purposes of preparing this maintenance plan, the RAQC has assumed that the other elements of the current program remain unchanged. These include retaining the:

- Test-only requirement for both the transient and idle testing programs
- Requirement for testing upon change of ownership
- Current waiver policies
- Idle test for 1981 and older vehicles

2. Remote Sensing, Clean-Screen Program

Data from Colorado's enhanced vehicle inspection and maintenance program show that a relatively small percentage of vehicles in the Denver metropolitan area fail their required annual or biannual emissions tests. This is particularly true for vehicles with the latest emission control technology which will comprise more of the fleet in the future. In 1998, less than 4% of 1991 and newer vehicles failed their emissions tests (vehicles less than four years old are exempted from testing except upon change of ownership). The 1998 failure rate was higher for older vehicles – approximately 4-6% for 1988 - 90 model years; 10-17% for 1982-1987 model years; and 18-35% for 1981 and older vehicles (idle test). Failure rates during the first four months of 1999 have increased compared to 1998, particularly for light-duty trucks, due to the phase-in of tighter standards on January 1, 1999.

In an effort to reduce the future cost of the I/M program and improve motorist convenience – without significantly diminishing the program's air quality benefits – the State is amending Regulation 11 and the SIP to implement a remote sensing, clean-screen program in the Denver metropolitan area.

Remote sensing technology takes an instantaneous measurement of a vehicle's emissions as it is driven on the road. This technology has been utilized in pilot projects and special studies in Colorado and other states and has been shown to be a reliable method for measuring emissions. In recent years, several states have begun using remote sensing on a routine basis to identify clean and dirty vehicles on the road as part of their I/M programs.

State statute adopted in 1998 provided the authority for clean screen programs in Colorado. As a result, in April 1999, the AQCC amended Regulation 11 to include the provisions necessary to begin clean screen programs in Ft. Collins and Greeley. As part of this Maintenance Plan, the AQCC has modified Regulation 11 to allow for implementation of a clean screen program in the Denver metropolitan area.

In accordance with State statute, the clean screen program in the Denver metropolitan area will be implemented by a contractor who will notify owners when their vehicle has been identified as clean. Vehicle owners will then remit a fee not to exceed $15 to the contractor, who will issue the necessary emissions certification.

The ultimate goal of the clean-screen program for the Denver metropolitan area is to evaluate up to 80% of the fleet with remote sensing, although achieving such a high percentage of fleet coverage has not yet been attempted in any other state program.

It is anticipated that 60-70% of the vehicles evaluated with remote sensing would pass the clean screen test and not be required to have a routine inspection at an emissions testing station. The clean-screen program will begin exempting vehicles from their routine inspection upon the expiration of the State's current contract with Envirotest on December 31, 2001. The initial data collection phase of the program may begin in 2001 so that the first clean-screen exemptions can be given in January 2002.

As described in the maintenance demonstration (Part 2, Chapter 4), the remote sensing, clean-screen program will be phased in between 2002 and 2006. This phasing is necessary to show continued compliance with the carbon monoxide standard during this time period. Phasing in the program will also allow for assessments and modifications to be made along the way that increase the effectiveness and cost-efficiency of the program. This will include determining if there is a cost-effectiveness break point below 80% fleet coverage.

The phase-in schedule for the remote sensing clean-screen program is shown below in Table 2.4.

TABLE 2.4
PHASE-IN OF REMOTE SENSING CLEAN SCREEN PROGRAM

Time Period	Maximum % of Fleet Evaluated with Remote Sensing	Maximum % of Fleet Exempted by Remote Sensing	% of Fleet Exempted by Model Year	Total % of Fleet Exempted from Testing
3/1/02-2/28/03	20%	9%	25%	34%
3/1/03-2/29/04	40%	18%	25%	43%
3/1/04-2/28/05	60%	27%	25%	52%
3/1/05-12/31/10	80% in any 12 month period	36%	25%	61%

3. Cost Savings Associated with a Remote Sensing, Clean-Screen Program

a. Achieving 80% Coverage

Evaluating up to 80% of the light-duty gasoline fleet in the Denver metropolitan area with remote sensing will require a substantial network of remote sensing units. Because a program of this magnitude has not yet been implemented anywhere in the nation, the program design and the analysis of cost and effectiveness must rely on data from a number of remote sensing pilot projects. While this is not ideal, the pilot projects do provide a reasonable basis for the analysis, and some of the projects have been carried out in Colorado (Denver and Greeley).

The remote sensing pilot projects conducted to date suggest that it is preferable to obtain two valid remote sensing readings on a vehicle before making a determination as to whether a vehicle is clean or dirty. This is particularly true for high emitter identification where the false failure rate increases significantly if the determination is made based on only one reading. For clean screening, it is suggested that the readings be taken no longer than one year before the vehicle's scheduled inspection.

The pilot project reports also suggest that in order to obtain two valid readings on a large fraction of the fleet (e.g., 80%) it would be necessary to have a number of valid readings that equals 3 to 4 times the number of light duty vehicles registered in the program area. With an estimated light-duty fleet of approximately 2 million vehicles operating in the six-county Denver area by 2002, this means that 6 - 8 million valid readings per year would be needed to implement a comprehensive remote sensing clean screen and high emitter identification program. For the purposes of this analysis, a mid-range value of 7 million valid readings will be assumed.

Because remote sensing readings are taken on the road where it is not possible to control factors such as driving mode or vehicle type measured, not all of the readings obtained by the remote sensing units are useful. Data from Phoenix and the pilot projects suggest that approximately 35% of the readings taken will be invalid due to factors such as operating mode of the vehicle (speed and acceleration), measurements taken on motorcycles, diesel trucks, etc., inability to read the vehicles license plate, and invalid emission measurements.

Of the valid readings, some will not be useful because the plate cannot be matched to the registration data base, the vehicle has an out of state plate, or the vehicle is registered outside of the program area. The remote sensing data collected in the Denver study suggest that about 15% of the valid readings will fall into one of these categories.

Using these figures, the total number of remote sensing readings needed to achieve 80% coverage of the fleet in the Denver metropolitan area is 12.67 million --
[7 million/(0.65*0.85)].

However, the remote sensing data from the Denver report shows that approximately 40% of the remote sensing readings were taken on vehicles within the first four model years which are already exempted from testing. This result is expected due to the fact that

newer cars are driven more, and are therefore seen more frequently in random roadside testing. These data suggest that more than 12.67 million remote sensing readings may be needed to obtain two valid measurements on 80% of the fleet.

An estimate of the additional readings that may be needed to compensate for the "over sampling" of exempt vehicles is provided below in order to establish a range for the number of total measurements needed to achieve 80% coverage.

Estimated Light-Duty Gasoline Fleet (2002)

1981 and older (non-exempt)		150,000
1982 and newer (non-exempt)		1,350,000
Model year exempt		500,000
	Total	**2,000,000**

For this analysis, it is assumed that 90% of the model year exempt vehicles are seen at least twice by the remote sensing program (since newer vehicles are seen more frequently on the road) and that the task is to obtain two valid readings on 1.15 million of the 1.5 million non-exempt vehicles in order to reach 80% coverage.

Following the same method described above, the number of valid readings needed on non-exempt vehicles is 5.25 million (1.5 million vehicles * 3.5), and the total number of readings needed on non-exempt vehicles is 9.5 million -- [5.25 million/(0.65*0.85)].

Assuming from the Denver data that the readings on the non-exempt vehicles will comprise 60% of the readings taken, the total number of readings needed would be 15.83 million (9.5/0.6). The breakdown of vehicles evaluated by the program would then be as follows:

80% Coverage with Remote Sensing

1981 and older (67%)		100,000
1982 and newer (78%)		1,050,000
Model year exempt (90%)		450,000
	Total	**1,600,000**

The estimated distribution of 1981 and older versus 1982 and newer vehicles measured by the program is also based on the Denver data.

b. Productivity of Remote Sensing Units

The productivity of a remote sensing unit depends in large part on traffic volumes. Therefore, the productivity can be increased by selecting sites with higher traffic volumes. However, the remote sensing vans would need to rotate frequently among a number of sites in order to increase the number of different vehicles observed. Obtaining two valid readings on 80% of the fleet will also require some effort on the part of motorists to seek out the remote sensing locations. This suggests that the optimal remote sensing network will include a mix of mobile and permanent units. It also suggests that it will be necessary to inform motorists of the remote sensing site locations.

Over a period of 32 months, six remote sensing units operating as part of a high emitter identification program in Phoenix collected 9.1 million remote sensing readings. The average number of readings per year for these units is about 570,000. This is consistent with the productivity shown in other studies. However, remote sensing technology is improving and it is reasonable to assume that the productivity of units in the future will increase by at least 10%. With these assumptions, it is estimated that up to 20 - 25 remote sensing units would be required to obtain the needed number of readings shown above.

c. Cost of Remote Sensing Units

The annual cost of operation, maintenance, and data processing for each remote sensing unit in Phoenix is approximately $150,000 – although the technology in use there is now outdated. The annual cost estimated in the Northern Virginia report is $250,000 per unit. Both of these cost figures reflect mobile remote sensing units operating from a staffed van. Once again however, it is important to consider current advances in remote sensing technology. As the need for a staff person to operate the remote sensing units becomes less necessary, the cost of unit operation will also decrease. Therefore, for this analysis an estimated cost of $180,000 per unit is assumed. Therefore, the cost of a remote sensing program that achieves two valid readings on 80% of the Denver metro fleet is estimated at $3.6 - $4.5 million per year.

d. Number of Vehicles Clean Screened Annually

As indicated above, the vehicle breakdown based on 80% coverage of the fleet may be:

80% Coverage with Remote Sensing	
1981 and older (67%)	100,000
1982 and newer (78%)	1,050,000
Model year exempt (90%)	450,000
Total	**1,600,000**

However, if clean screen readings must be within 1 year of inspection for 1982 and newer vehicles (which have a biennial inspection cycle), half of the vehicles seen by the remote sensing program will be eliminated because their inspection is more than one year away. The yield of vehicles that are candidates for clean screen would be:

Clean Screen Candidates Per Year	
1981 and older	100,000
1982 and newer	525,000
Total	**625,000**

Data collected in Denver found that approximately 60% of model year 1990 and newer vehicles passed clean screen cut points of 0.5% carbon monoxide and 200 ppm HC. These are the same cut-points assumed in the mobile source modeling being done for the Carbon Monoxide Maintenance Plan. It is reasonable to assume that this percentage may increase in the future with more new technology vehicles in the fleet. Therefore, a pass rate range of 60% to 70% is assumed here. The Denver data also indicate that up to 20% of 1981 and older vehicles would pass these clean screen cut points. Ultimately, the cut points and pass rates for the program will be based on the real world experience and data that are obtained after the program begins. However, using these assumptions, the resulting number of clean screened vehicles per year would be as follows:

Number of Vehicles Clean Screened Per Year	
60% - 70% Pass Rate for 1982 and newer vehicles	315,000-367,500
20% Pass Rate for 1981 and older vehicles	20,000
Total	**335,000-387,500**

e. Annual Test Cost Savings with Clean Screen

Assuming the current transient test cost of $24.25 and the current idle test cost of up to $15, a remote sensing clean screening program with the effectiveness assumed above could reduce annual test costs by as much as $7.9 - $9.2 million. This may result in a net annual savings of between $3.4 - $5.6 million as follows:

Annual Test Cost Savings with Clean Screen	
315,000-367,500 @ $24.25:	$7.6 - $8.9 million
20,000 @ $15.00:	$0.3 million
Test Cost Reduction:	**$7.9 - $9.2 million**
Remote Sensing Costs:	**$3.6 - $4.5 million**
Net Savings:	**$3.4 - $5.6 million**

It is important to recognize that the estimates presented here do not include any administrative costs associated with motorist notification or incorporating the clean screen program into the vehicle registration process at the state and county level. No attempt will be made here to quantify those costs but they will certainly not be zero. The administrative ease and costs for implementing the program will depend in large part on how the remote sensing program is funded and what roles the contractor, the State, and the county clerks play in the process.

An alternative cost savings analysis can be done based on the implementation approach recommended in this Maintenance Plan, which is to have the clean-screen contractor notify owners when their vehicle has been identified as clean. Vehicle owners will then remit a fee not to exceed $15 to the contractor, who will issue the necessary emissions certification.

For 1981 and older vehicles which are subject to the idle test, there would be no test cost savings. For 1982 and newer vehicles which are subject to the transient test, there would be a test cost savings of up to $10, since the maximum fee for the transient test is capped in statute at $25 (currently the fee is $24.25). Based on the analysis presented above (315,000-367,500 1982 and newer vehicles clean-screened each year), this would result in test cost savings of approximately $3.2 to $3.7 million per year. It may also be reasonable to assume that the $15 fee paid to the contractor would be sufficient to cover the administrative costs of the program. In this case, the cost savings estimated above would reflect the net cost savings of the program.

An important additional benefit of a remote sensing clean screen program is the convenience associated with not having to have a transient test performed on one's vehicle. If the value to the motorist of not having to go in for a routine inspection is estimated at $10 - $20, the additional economic benefit of the program described above would be in the range of $3.4 - $7.7 million dollars per year.

It may be useful to consider these potential savings by comparing them to the total test costs that could be expected in 2002 using the fleet numbers assumed above and current test fees as follows:

Annual Test Costs Without Remote Sensing

750,000 @ $24.25:	$18.2 million
150,000 @ $15.00:	$ 2.3 million
Total:	**$20.5 million**

PART II - REDESIGNATION REQUEST AND MAINTENANCE PLAN

CHAPTER 3
REQUIREMENTS FOR REDESIGNATION

The State of Colorado, in coordination with the Regional Air Quality Council (RAQC), requests that the U.S. Environmental Protection Agency (EPA) redesignate the Denver metropolitan nonattainment area to attainment status for the National Ambient Air Quality Standards for carbon monoxide. The Denver metropolitan area has been designated as a carbon monoxide nonattainment area since the 1970's, but has not violated the standard since 1995. Therefore, the area is now eligible for redesignation.

A. REQUIRED COMPONENTS OF A REDESIGNATION REQUEST

Sections 107(d)(3)(D) and (E) of the CAA define the following five required components of a redesignation request.

1. Attainment of the Standard

The State must show that the area has attained the national standards for carbon monoxide. This demonstration must be based on monitoring data representative of the location of the expected maximum concentrations of carbon monoxide in the area.

2. State Implementation Plan Approval

The State must have a fully approved Carbon Monoxide State Implementation Plan element for the Denver metropolitan area under Section 110(k) of the CAA.

3. Improvement in Air Quality Due to Permanent and Enforceable Emissions Reductions

The State must demonstrate that the improvement in air quality leading to redesignation is due to permanent and federally enforceable emissions reductions.

4. CAA Section 110 and Part D Requirements

The State must meet all requirements of Section 110 and Part D of the CAA. Section 110 describes general requirements for SIPs, while Part D pertains to general requirements applicable to all nonattainment areas.

5. Maintenance Plan

The State must have a fully approved carbon monoxide maintenance plan that meets the requirements of CAA Section 175A, including a demonstration that the area will maintain the standard for a period of at least 10 years following redesignation by EPA. The plan must also contain contingency measures that could be implemented if a violation of the standard is monitored at any time during the maintenance period.

Requirements 1 - 4 are addressed below in this chapter. The fifth requirement – the Maintenance Plan – is addressed in Chapter 4.

B. ATTAINMENT OF THE CARBON MONOXIDE STANDARD

Attainment of the national 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. The following information demonstrates, as required by Section 107(d)(3)(E) of the Clean Air Act, that the Denver metropolitan area has attained the national standard for carbon monoxide. This is based on quality assured monitoring data representative of the location of expected maximum concentrations of carbon monoxide in the area (downtown Denver).

1. DENVER AREA HISTORICAL PERSPECTIVE

Historically, the carbon monoxide standards were exceeded frequently throughout the Denver metropolitan area. With the implementation of emission control programs aimed at reducing automobile, truck, and wood burning emissions, carbon monoxide concentrations began to decrease substantially. The last recorded violation of the 8-hour standard occurred in 1995 and the last violation of the 1-hour standard occurred in 1990.

2. CARBON MONOXIDE MONITORING NETWORK

The current carbon monoxide ambient air monitoring network in the Denver area consists of one National Air Monitoring Station (NAMS) and seven State and Local Air Monitoring Stations (SLAMS) operated by the Colorado Air Pollution Control Division. The monitoring sites are listed, along with summary data from 1997, 1998 and 1999, in Tables 3.1 through 3.3. Figure 3-1 shows the geographical distribution of the monitors.

3. MONITORING RESULTS AND ATTAINMENT DEMONSTRATION

The monitoring data presented in Tables 3.1 through 3.3 and in Figure 3.2 verify that the Denver area has been in attainment with the national standard for carbon monoxide since 1996 and for the most recent two year period (1997-98), in accordance with the federal requirements of 40 CFR 50.8. The 1999 data demonstrate continued attainment of the standard. Data recovery rates for the monitors exceed the 75 percent 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 3.2 presents the long-term record for each monitor in the network.

4. QUALITY ASSURANCE PROGRAM

Carbon monoxide data for the Denver area have been collected and quality-assured in accordance with 40 CFR, Part 58, Appendix A, EPA*s "Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. 11; Ambient Air Specific Methods", the APCD*s Standard Operating Procedures Manual, and Colorado's Monitoring SIP which EPA approved in 1993. The data are recorded in EPA's Aerometric Information Retrieval System (AIRS) and are available for public review at the APCD and through EPA*s AIRS database. In addition, the APCD has verified that the integrity of the air quality monitoring network has been preserved. The precision and accuracy results for Denver area monitoring network for the years 1997 and 1998 are summarized in the technical support document for this redesignation request and maintenance plan. The calculated 95 percent probability limits for the precision checks and accuracy audits demonstrate that the sites were meeting acceptable quality assurance limits for repeatability and accuracy.

TABLE 3.1
1997 Carbon Monoxide Data Summary for the Denver Metropolitan Area
Standards: 1-hour: 35 ppm*; 8-hour: 9-ppm**

Site Name	Data Capture (%)	1-Hour		8-Hour	
		Maximum ppm	2nd Maximum ppm	Maximum ppm	2nd Maximum ppm
Welby, 78th Ave & Steele St.	99%	8.3	6.6	5	4.3
Highland, 8100 S. University Blvd.	97%	4.3	4	3	2
Boulder, 2150 28th St	99%	9	8.2	5.5	3.9
Boulder, 2320 Marine St.	97%	7.1	6.9	5.1	3.3
Denver CAMP, 2105 Broadway	99%	11.4	10	5.7	5.5
Denver, NJH, 14th Ave. & Albion St.	99%	11.6	10.6	4.8	4.7
Denver Carriage, 23rd Ave & Julian St.	99%	9.5	8.4	7	6.2
Speer & Auraria, Firehouse #6	95%	11.2	11.2	6.6	6.4
Arvada, 57th Ave. & Garrison St.	99%	9.2	7.7	5.1	4.9

* Due to mathematical rounding, a value of 35.5 ppm or greater is necessary to exceed the standard.
** Due to mathematical rounding, a value or 9.5 ppm or greater is necessary to exceed the standard.

TABLE 3.2
1998 Carbon Monoxide Data Summary for the Denver Metropolitan Area
Standards: 1-hour: 35 ppm*; 8-hour: 9-ppm**

Site Name	Data Capture (%)	1-Hour		8-Hour	
		Maximum ppm	2nd Maximum ppm	Maximum ppm	2nd Maximum ppm
Welby, 78th Ave & Steele St.	99%	6.6	6.1	3.7	3.5
Boulder, 2150 28th St	99%	11.1	10.6	5.1	4.8
Boulder, 2320 Marine St.	98%	5.2	4.1	2.5	2.1
Denver CAMP, 2105 Broadway	97%	11.6	9.9	5.8	4.7
Denver, NJH, 14th Ave. & Albion St.	99%	8.5	8.1	4.3	4.3
Denver Carriage, 23rd Ave & Julian St.	99%	8.3	8.1	5	4.4
Speer & Auraria, Firehouse #6	96%	10.1	10.1	5.6	5.2
Arvada, 57th Ave. & Garrison St.	99%	7.2	6.6	3.7	3.6

TABLE 3.3
1999 Carbon Monoxide Data Summary for the Denver Metropolitan Area

Site Name	Data Capture (%)	1-Hour		8-Hour	
		Maximum	2nd Maximum ppm	Maximum	2nd Maximum ppm
Welby, 78th Ave & Steele St.	97%	6.4	6.0	4.3	3.6
Boulder, 2150 28th St	99%	7.1	7.0	4.8	3.7
Denver CAMP, 2105 Broadway	54%	13.1	12.1	9.1	4.4
Denver, NJH, 14th Ave. & Albion St.	99%	12.1	10.6	8.2	7.5
Denver Carriage, 23rd Ave & Julian St.	99%	6.5	6.5	5.5	4.2
Speer & Auraria, Firehouse #6	99%	13.2	11.2	9.5	4.7
Arvada, 57th Ave. & Garrison St.	99%	13.2	8.0	4.9	4.1

* Due to mathematical rounding, a value of 35.5 ppm or greater is necessary to exceed the standard.
** Due to mathematical rounding, a value or 9.5 ppm or greater is necessary to exceed the standard.

Figure 3.1
Denver Metropolitan Attainment/Maintenance Area
And Location of Carbon Monoxide Monitors

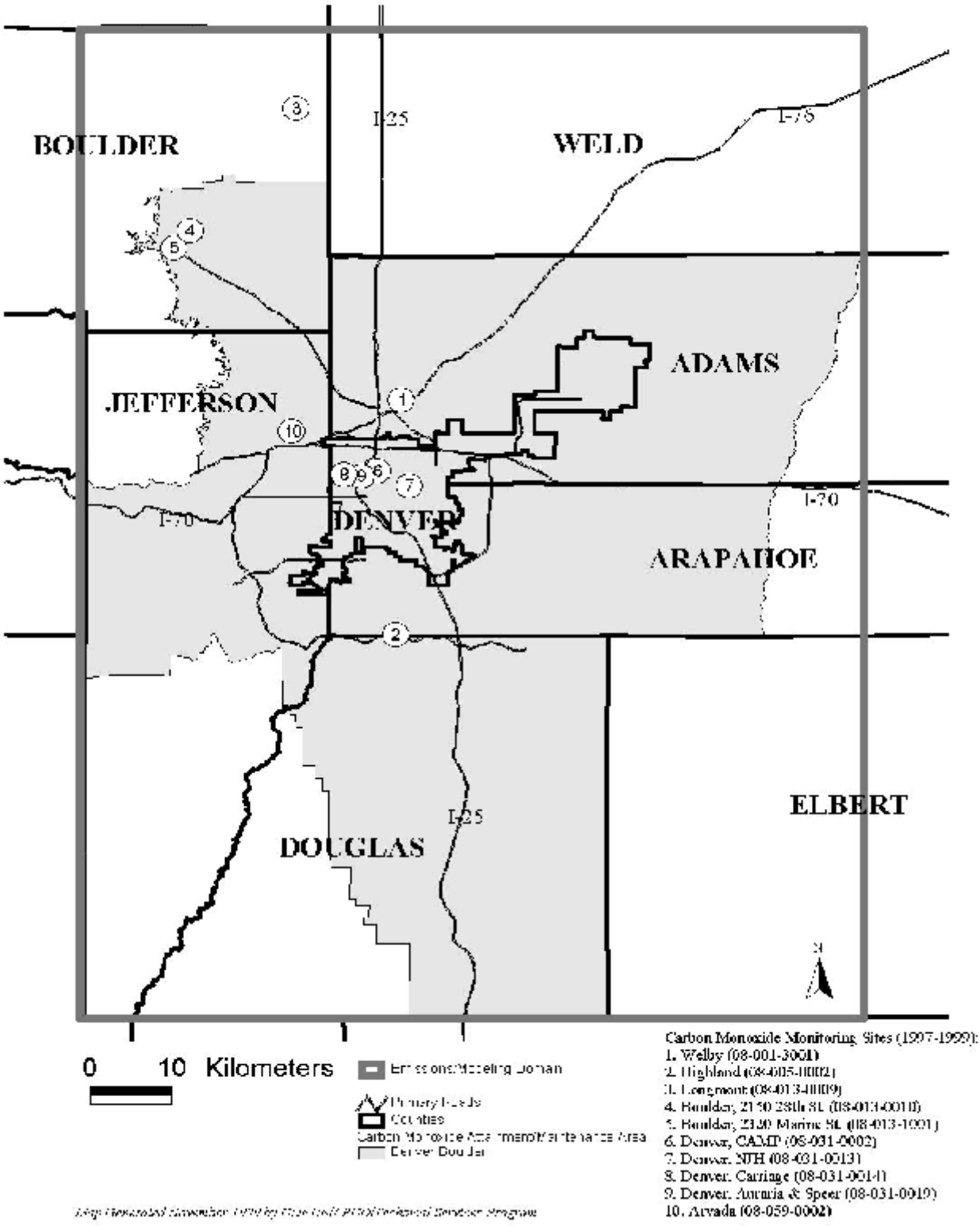
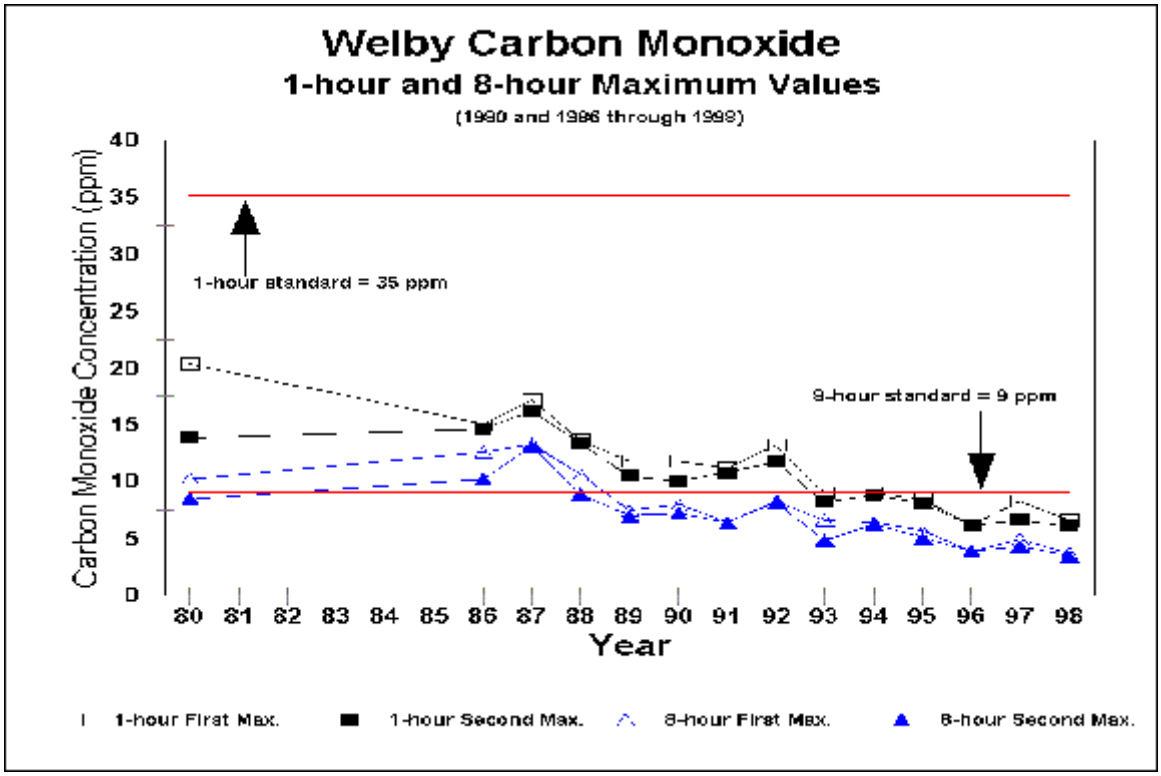


FIGURE 3.2
LONG-TERM MONITORING RECORD FOR THE DENVER METROPOLITAN AREA



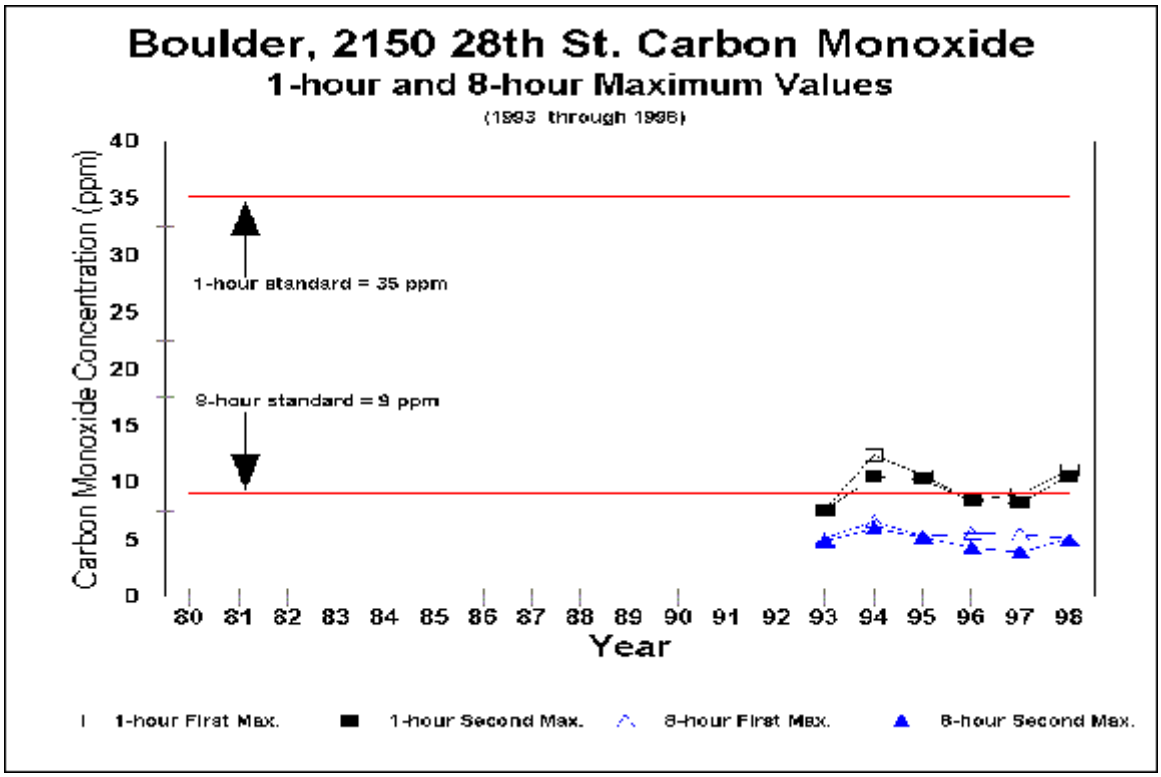
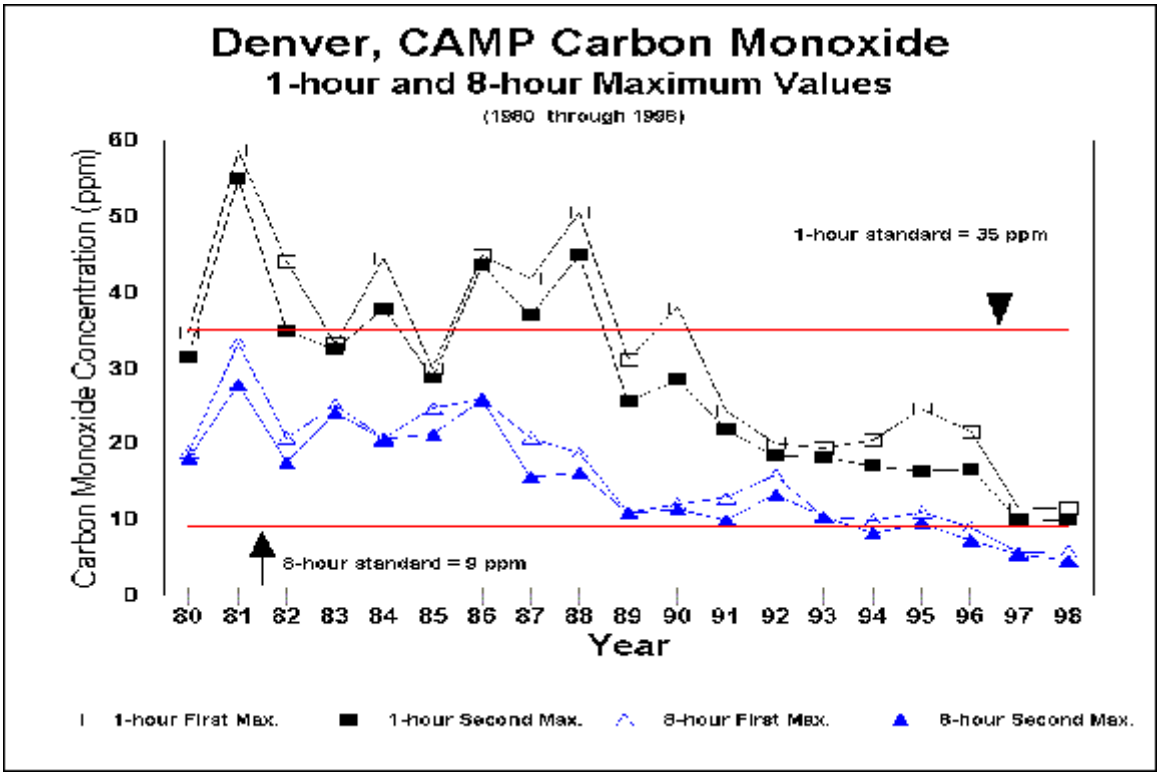


FIGURE 3.2 (cont.)
LONG-TERM MONITORING RECORD FOR THE DENVER METROPOLITAN AREA



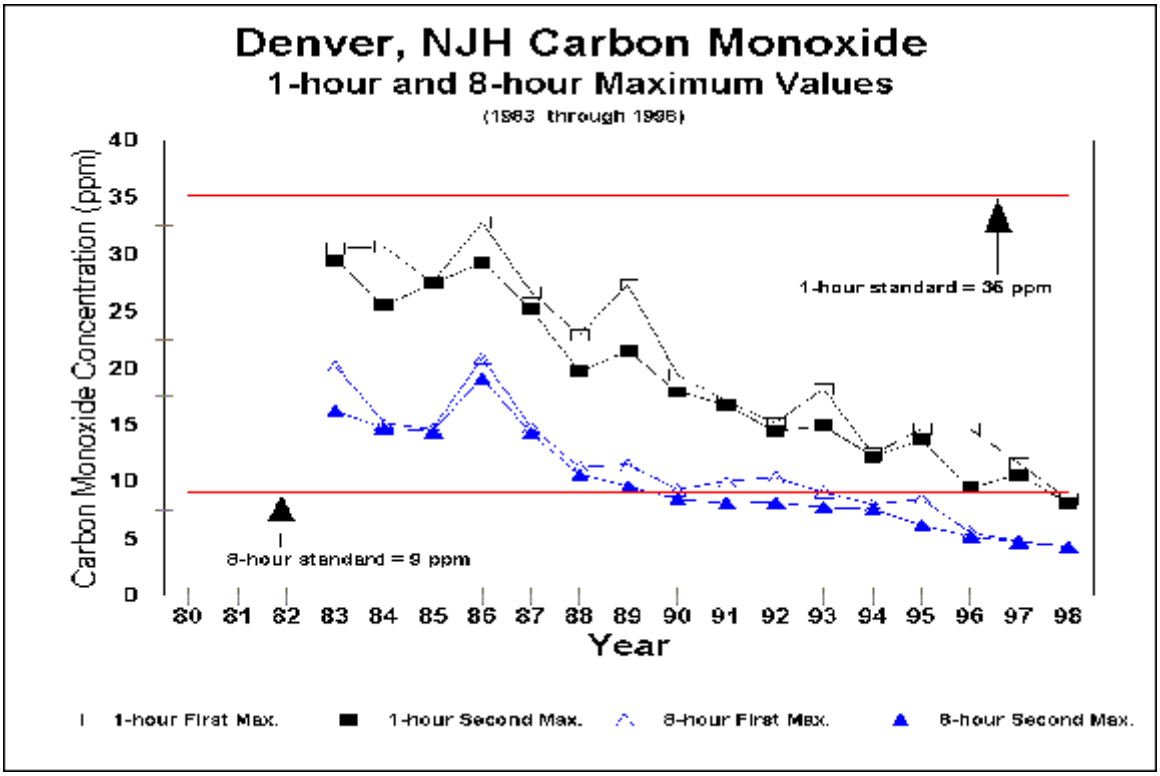
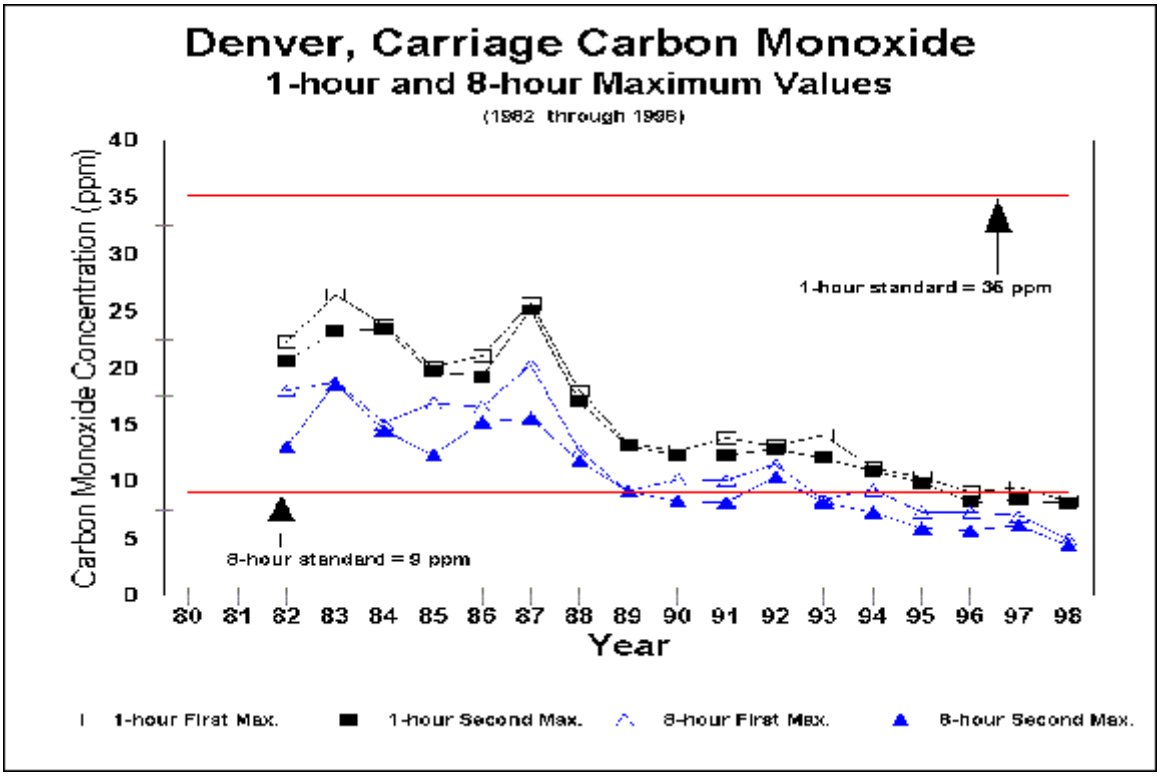


FIGURE 3.2 (cont.)
LONG-TERM MONITORING RECORD FOR THE DENVER METROPOLITAN AREA



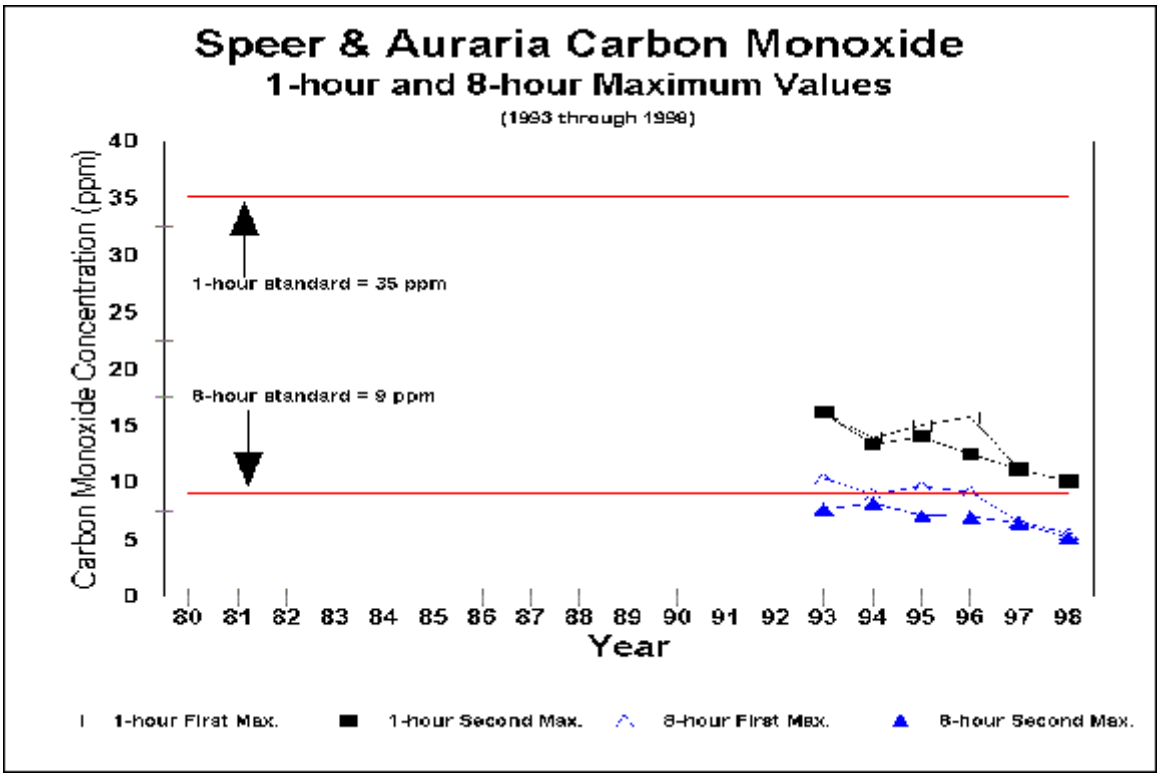
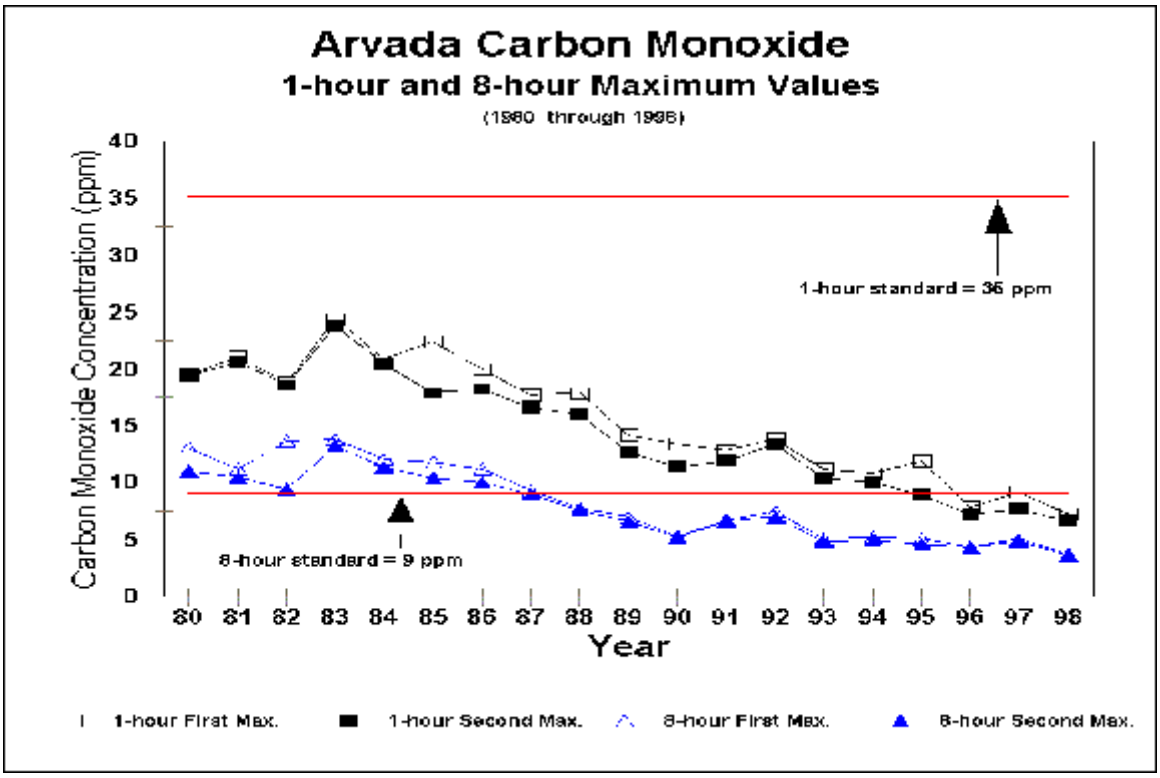


FIGURE 3.2 (cont.)
LONG-TERM MONITORING RECORD FOR THE DENVER METROPOLITAN AREA



C. APPROVAL OF THE CARBON MONOXIDE NONATTAINMENT SIP ELEMENT FOR THE DENVER AREA

Various plans and programs to reduce carbon monoxide emissions from motor vehicles, wood burning, and industrial facilities were adopted by local governments and the State of Colorado in the 1980's, but a comprehensive SIP was never approved by EPA due to continuing violations of the carbon monoxide standard. The Clean Air Act Amendments of 1990 established new requirements and attainment deadlines for carbon monoxide nonattainment areas, and a new plan for addressing the carbon monoxide problem in Denver was completed by the RAQC and APCD in 1994. On June 16, 1994 the Colorado Air Quality Control Commission adopted the Carbon Monoxide State Implementation Plan Element for the Denver metropolitan area.

The 1994 State Implementation Plan was designed to demonstrate attainment with the carbon monoxide standard by December 31, 2000. The plan was successful as demonstrated by the fact that the region reached attainment of the standard on December 31, 1997. The plan also requested that the area be reclassified to a serious area because attainment could not be demonstrated by the CAA deadline for moderate areas of December 31, 1995. The EPA approved the 1994 SIP, the reclassification to serious, and the related control measure regulations on March 10, 1997 (62 FR 10690). Thus, the State has an approved Carbon Monoxide State Implementation Plan for the Denver metropolitan area as required by Section 110(k) of the Clean Air Act.

D. IMPROVEMENT IN AIR QUALITY DUE TO PERMANENT AND ENFORCEABLE EMISSION REDUCTIONS

It is reasonable to attribute the improvement in ambient carbon monoxide concentrations in the Denver area to emission reductions which are permanent and enforceable. The Denver area has met the national standard for carbon monoxide as a result of effective local, state and federal emission reduction measures, as opposed to temporary or “chance” events.

A downturn in the economy is clearly not responsible for the improvement in ambient carbon monoxide levels in the Denver metropolitan area. Over the last ten years, the region has experienced strong growth while at the same time achieving a continuous reduction in carbon monoxide levels. The Colorado State Demographer’s Office reports that between 1990 and 2000, job growth in the Denver area increased at an annual rate of approximately three percent, population increased by about two percent each year, and personal income increased by approximately seven percent each year. In its 1997 Vehicle Miles Traveled (VMT) forecasting and tracking report, the Colorado Department of Transportation (CDOT) estimated a VMT increase of approximately eight percent between 1995 and 2000.

1. CONTROL MEASURES THAT BROUGHT THE DENVER AREA INTO ATTAINMENT

a. Federal Tailpipe Standards

One of the more important carbon monoxide control measures for the Denver metropolitan area and the nation is the Federal Motor Vehicle Emissions Control Program (FMVECP), established in 1968. The Clean Air Act of 1970 and its 1977 Amendments led to the advent of catalytic converters in 1975 and computerized engine control systems in 1981. The 1990 CAA Amendments required additional control measures, including stricter emission standards for cars, light duty trucks, minivans and sport/utility vehicles; cold temperature carbon monoxide standards; and an extended warranty and recall period. Federal standards will continue to provide emission reduction benefits as older vehicles are retired and vehicles meeting the newest standards enter the fleet.

b. Vehicle Inspection & Maintenance Program

Colorado's Automobile Inspection and Readjustment (AIR) Program is described in AQCC Regulation No. 11 and has been applicable in the Denver area since 1981. The AIR Program works to reduce carbon monoxide and other pollutants from gasoline-powered motor vehicles by requiring them to meet emission standards through periodic tailpipe tests, maintenance, and specific repairs. The AIR Program was updated in 1994 to meet the requirements of the Clean Air Act Amendments of 1990, and a more stringent and effective “enhanced” inspection program began in 1995. The enhanced program uses a loaded-mode dynamometer test called I/M 240 for 1982 and newer vehicles and an idle test for older vehicles and heavy trucks.

c. Oxygenated Gasoline

The oxygenated gasoline program, as defined in Air Quality Control Commission Regulation No. 13, was first implemented in the Denver metropolitan area during the winter of 1987-88. Oxygenated gasoline is designed to reduce wintertime carbon monoxide emissions from automobiles by requiring fuel which contains an oxygenate to lower carbon monoxide emissions. The oxygenates are typically ethanol or methyl tertiary butyl ether (MTBE). As part of the 1994 Carbon Monoxide SIP for the Denver metropolitan area, the program was modified in order to achieve a minimum 3.1% oxygen content during the winter high pollution season.

d. Wood burning Controls

The wood burning control requirements of Air Quality Control Commission Regulation No. 4 control wood smoke emissions that contain carbon monoxide and other pollutants. The primary strategy is the mandatory wood burning curtailment program that prohibits most wood burning activity on “high pollution days” between November 1st and March 31st of each year in the Denver metropolitan area. Another strategy requires all new wood

burning stoves and fireplace inserts sold in Colorado to meet state and federal emission control standards. These two measures were first implemented in the 1980's and will continue into the future. Another significant strategy adopted in 1993 is a metro-wide ban on conventional fireplaces in new construction. This ban has dramatically slowed the growth in wood smoke emissions and has encouraged conversion of existing fireplaces to natural gas. Natural gas fireplaces are now common in new construction.

e. Industrial Source Controls

The State's comprehensive permit rules, AQCC Regulations No. 3 and 6, control emissions from industrial facilities and cap carbon monoxide emissions from new or modified major stationary sources. The State continues to enhance its permit and control programs, while simultaneously pursuing a strong inspection and enforcement presence, as authorized by the AQCC's "Common Provisions" regulation.

E. CAA SECTION 110 AND PART D REQUIREMENTS

For the purposes of redesignation, all of the general nonattainment area requirements of CAA Section 110 and Part D must be met. In general, the requirements of Section 110(a)(2) are:

1) the establishment and implementation of enforceable emission limitations;
2) the monitoring, compiling, and analyzing of ambient air quality data;
3) preconstruction reviews and permitting of new and modified major stationary sources;
4) consulting with and providing for the participation of local governments that are affected by the plan;
5) assurance that the State has the adequate funds and authority to enforce the SIP Element and the associated regulations; and
6) permit fees for stationary sources.

Colorado Revised Statute 25-7-111 requires the APCD to administer and enforce the air quality programs adopted by the AQCC. With a staff of 150 people and a budget of approximately $12.9 million, the APCD has committed to implementing and enforcing the air quality plans and regulations applicable to the Denver carbon monoxide attainment/ maintenance area.

The CAA's Part D, pertaining to nonattainment plan provisions, requires the following items to be addressed:

- the implementation of reasonably available control measures, including reasonably available control technologies (RACT) for existing sources
- reasonable further progress (RFP) towards meeting attainment
- a current emissions inventory and periodic inventories every 3 years until attainment

- the identification and quantification of allowable emissions for new and modified stationary sources
- a stationary source permitting program
- other measures: enforceable emission limitations, other control measures, schedule for compliance
- compliance with section 110 provisions
- contingency measures

The EPA-approved Colorado SIP already includes the provisions required by Section 110(a)(2) and Part D of the CAA. In approving the Carbon Monoxide SIP for the Denver area on March 10, 1997, EPA determined that the state met the requirements of Section 110(a)(2) and Part D of the Clean Air Act.

Other Part D requirements that are applicable in nonattainment and maintenance areas include the general and transportation conformity provisions of CAA Section 176 (c). These provisions ensure that federally funded or approved projects and actions conform to the Denver State Implementation Plan Element/Maintenance Plan for carbon monoxide prior to the projects or actions being implemented. The State has already submitted to EPA a State Implementation Plan revision implementing the requirements of section 176(c).

CHAPTER 4
MAINTENANCE PLAN

Section 107(d)(3)(E) of the CAA stipulates that for a nonattainment area to be redesignated to attainment, EPA must fully approve a maintenance plan which meets the requirements of CAA Section 175A. The maintenance plan is a SIP revision and must provide for maintenance of the relevant NAAQS in the area for at least ten years after redesignation by EPA.

Because EPA is allowed up to two years to approve redesignation requests after receiving a complete submittal, and given the time needed to complete the State processes for legislative approval and AQCC rule-making, the milestone year for this maintenance plan is 2013.

The EPA has established the core elements listed below 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

A. MAINTENANCE PLAN CONTROL MEASURES

The Denver metropolitan area will rely on the control programs listed below to demonstrate maintenance of the carbon monoxide standards through 2013. 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.

Specific programs and requirements that will cease to be part of the State Implementation Plan upon redesignation and approval of this Maintenance Plan by EPA are: 1) the contingency measures included in the 1994 attainment SIP; 2) the requirement for VMT tracking; and 3) the requirement for periodic emission inventories. The Clean Fuels Fleet Program is not necessary to maintain the carbon monoxide standard and no credit for the program was taken in this maintenance demonstration. The State intends to replace the Clean Fuels Fleet Program with a substitute program through a separate submittal.

1. Enforceable Control Measures

a. 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.

b. Air Quality Control Commission Regulation No. 11 -- covering the Automobile Inspection and Readjustment (A.I.R.) Program -- as amended on January 10, 2000. Regulation No. 11 is included as Appendix A.

c. Air Quality Control Commission Regulation No. 13 -- covering the oxygenated gasoline program – as amended on January 10, 2000. Regulation No. 13 is included as Appendix B.

d. Air Quality Control Commission Regulation No. 4 -- covering wood burning control programs. This regulation is already included in the approved SIP. The Maintenance Plan makes no changes to the wood burning control programs.

e. 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 changes 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.

f. In accordance with State and federal regulations and policies, the State and federal nonattainment NSR requirements currently in effect for the Denver area will revert to the State and federal attainment PSD permitting requirements once EPA approves this redesignation request and maintenance plan.

B. EMISSION INVENTORIES

This section presents the emission inventories portion of the maintenance plan. Emission inventories are provided for the 2001 attainment year (as presented in the 1994 Denver Nonattainment Carbon Monoxide SIP Element), the 2006 interim year, and the 2013 maintenance year. (see Table 4.2).

The 2001 inventory from the 1994 Denver Nonattainment SIP Element incorporates the nonattainment control measures described in that SIP element and summarized in Chapter 3 of this document.

The 2006 and 2013 inventories incorporate the maintenance plan control measures described above.

All of the inventories are for the six-county modeling domain (see Figure 1-1) and provide emissions estimates for a weekday during the winter carbon monoxide season (November through February). The modeling domain is somewhat larger than the carbon monoxide non-attainment area. The carbon monoxide non-attainment area is used to establish the mobile source emissions budget for the region as discussed in subsequent sections of this plan.

All of the inventories were developed using EPA-approved emissions modeling methods and the latest transportation and demographics data from DRCOG. The technical support document for this maintenance plan contains detailed information on model assumptions and parameters for each source category.

Section 2.5.1 of the Technical Support Document specifically discusses emissions estimates for the Denver International Airport (DIA). In that section, the Air Pollution Control Division specifically identifies and accounts for DIA emissions in this Maintenance Plan. Therefore, for the purposes of general conformity demonstration DIA should use the emissions inventory from Table 16 of the Technical Support Document.

1. Demographic and Transportation Data

In recent months, DRCOG has updated growth projections for the region. The latest projections for population, households, and employment through 2020 are substantially higher than the previous estimate. At this time, updated transportation and demographic data sets incorporating these new projections are not available. In order to avoid understating the demographic numbers and estimates of vehicle miles traveled (VMT) in this maintenance plan, the RAQC and the APCD were advised by DRCOG to use the current 2011 data sets as representative of 2006 and the current 2020 projections (plus 3.7%) as representative of 2013. Table 4.2 shows the 2006 and 2013 demographic and VMT data used to develop the maintenance plan emission inventories.

TABLE 4.1: DEMOGRAPHIC DATA USED TO DEVELOP EMISSION INVENTORIES FOR THE DENVER CARBON MONOXIDE INVENTORY/MODELING DOMAIN

Period	Population	Households	Employment	Daily VMT
2001 (SIP)	2,021,000	838,000	1,181,000	51,796,000
2001 (Current)	2,364,000	970,000	1,415,500	58,156,000
2006	2,616,000	1,097,000	1,568,000	66,760,000
2013	2,889,000	1,244,000	1,718,000	77,187,000

TABLE 4.2: EMISSION INVENTORIES FOR THE DENVER CARBON MONOXIDE INVENTORY/MODELING DOMAIN
Carbon Monoxide Emissions (tons/day)

Source Category	2001 Attainment SIP Inventory	2006 Interim Year Inventory	2013 Maintenance Year Inventory
Point Sources[(1)]	70.2	46.7	46.7
Wood burning	50.6	32.8	25.8
Natural Gas	7.1	9.1	10.0
Structural Fires	3.9	5.0	5.5
Agriculture Equip.	0.3	0.3	0.3
Airport - Aircraft	16.3	22.3	24.4
Airport Service Equip.	7.6	7.2	7.7
Construction Equip.	9.9	7.9	8.1
Industrial Equip.	25.1	22.8	23.7
Light Commercial Equip.	136.6	125.9	131.3
Helicopters	0.4	0.4	0.4
Railroads	0.3	0.3	0.3
On-Road Mobile	875.2	844.7	867.2
TOTAL	1203.3	1125.4	1151.4

(1) Point source reduction is due to use of actual instead of allowable emissions.
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.

C. MAINTENANCE DEMONSTRATION

As required by CAA Section 175A(a), each request for redesignation shall be accompanied by a SIP revision which provides for maintenance of the NAAQS for at least 10 years after redesignation. Following EPA guidance and policy which requires the same level of modeling for maintenance plans as that which was performed for the attainment demonstration (September 4, 1992 EPA memorandum from John Calcagni to EPA regional offices), this maintenance demonstration is made through the use of area-wide dispersion modeling, along with selected intersection hot-spot modeling, for the years 2006 and 2013. The combined results of the dispersion and intersection modeling show no 8-hour maximum carbon monoxide concentration greater than or equal to 9.0 ppm anywhere in the modeling domain with the implementation of the proposed control measures.

As discussed in Chapter 1, in order to complete this maintenance demonstration in a timely fashion, while at the same time complying with EPA's modeling requirements for maintenance demonstrations, the 2006 and 2013 emission inventories were used as modeling inputs along with meteorological data from December 5, 1988 which was the design day for the 1994 Carbon Monoxide SIP. Because the SIP modeling effort has already been reviewed and approved by EPA, using this same approach for the maintenance plan should avoid any potential problems as far as EPA approval of the maintenance demonstration.

Consistent with EPA modeling guidance, intersections were selected for modeling based on the latest information from DRCOG regarding the highest volume and most congested intersections in the non-attainment area. These intersections differ in some cases from those modeled in the original attainment demonstration.

As in the attainment demonstration, the CAMP intersection was modeled to provide a hot-spot analysis for downtown. From 1993, when a second downtown monitor was added at the corner of Speer and Auraria, through 1999, the CAMP monitor has registered the region’s maximum one-hour carbon monoxide concentration every year except one. (In 1999 the maximum one-hour value at CAMP was 13.1, whereas Speer and Auraria and Arvada had values of 13.2.) During this same period, CAMP registered the region’s maximum eight-hour concentration three times. In one year (1993) the two downtown monitors both registered the same maximum eight-hour readings, and in three years the Speer and Auraria monitor registered the region’s maximum eight-hour concentration. This data supports the continued use of the CAMP intersection modeling for the maintenance demonstration. Also, due to data limitations and associated technical difficulties with the intersection model, it is not possible to do intersection modeling at Speer and Auraria for the episode used in the maintenance demonstration (see Technical Support Document).

The modeling results for the maintenance demonstration are shown below in Table 4.3. The technical support document for this maintenance plan describes in detail the assumptions and methodologies used for all modeling work.

TABLE 4.3: DISPERSION MODELING RESULTS (PARTS PER MILLION) FOR THE 8-HOUR CARBON MONOXIDE STANDARD

	2006			2013		
	UAM[1]	CAL3[2]	TOTAL	UAM	CAL3	TOTAL
Max. Grid Cell (Contains CAMP -- see TSD)	8.1	NA	**8.1**	8.3	NA	**8.3**
Bdwy. & Champa[3]	7.59	1.12	**8.71**	7.88	1.08	**8.96**
Foothills & Arap.	0.9	4.8	**5.7**	0.9	4.7	**5.6**
1st & University	4.0	4.3	**8.3**	3.9	4.2	**8.0**
Hampden & Univ.	1.9	3.6	**5.5**	1.9	4.3	**6.2**
Parker & Iliff	2.7	3.2	**5.8**	2.6	3.0	**5.6**
Arapahoe & Univ.	1.3	3.6	**5.0**	1.3	3.9	**5.3**

1) UAM (Urban Airshed Model) column shows the background concentration at each site.
2) CAL3 (Intersection model) shows the intersection component of the concentration.
3) The use of two significant figures behind the decimal point for the Broadway & Champa intersection reflects the fact that the modeling done for this intersection was more detailed. It is necessary to display the result in this fashion to show that the value is below 9 parts per million as required by EPA.

1. Maintenance of Standard During Strategy Phase-In

In order to demonstrate that the region will stay in compliance with the carbon monoxide standard between 2002 and 2006 as the oxygenated gasoline and I/M program changes included in this maintenance plan are phased in, APCD generated mobile source emission inventories for each year during that period. Based on the modeling results for 2013, it was determined that the region will remain in compliance as long as mobile source emissions in the modeling domain remain below the 867 ton per day level shown in the modeling for 2013. The results of this analysis are shown below in Table 4.4.

TABLE 4.4: MAINTENANCE OF STANDARD DURING STRATEGY PHASE-IN

Year (Jan. 1)	Mobile Source Emission Inventory	Oxygen Content	Percent of Fleet Evaluated Using Remote Sensing	Transient Test Cutpoints- g/mi (CO/HC/NOx)[1]
2002	851	2.7%	Program Begins	20 /1.2/ 3.0
2003	850	2.6%	20%	20 /1.2/ 3.0
2004	827	2.0%	40%	20 /0.8/ 2.0
2005	850	1.9%	60%	20 /0.8/ 2.0
2006	846	1.5%	80%	10 /0.6/ 1.5

1) Current cutpoints are 20/2.0/4.0

D. MOBILE SOURCE CARBON MONOXIDE EMISSIONS BUDGET

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..."

The current mobile source emissions budget for the metro Denver carbon monoxide non-attainment area is 825 tons per day. This was the level of emissions estimated for the non-attainment area in the original attainment demonstration for 2001. *(Note: The 2001 mobile source emissions level of 875 tons per day shown in Table 4.2 is for the modeling domain, which is slightly larger than the non-attainment area.)*

As a result of higher VMT growth rates in central Denver, the 2013 maintenance demonstration indicates that the mobile source emissions budget must be lowered to 800 tons per day. This is the level of emissions estimated for the non-attainment area in the 2013 maintenance demonstration (based on 867 tons per day for the modeling domain).

This new mobile source carbon monoxide emissions budget of 800 tons per day for the metro Denver non-attainment area will be used to determine whether plans, programs, and projects comply with the SIP in the years 2002 and beyond. This new budget has been incorporated into the AQCC's Ambient Standards Regulation (See Appendix C) and will take effect for future transportation conformity determinations upon approval of this Maintenance Plan or upon a finding of adequacy by EPA, whichever occurs first.

The existing 825 ton per day mobile source emissions budget will continue to apply for year 2001 transportation conformity findings as long as the year 2001 is in the time frame of the transportation plan.

E. MONITORING NETWORK / VERIFICATION OF CONTINUED ATTAINMENT

Once the Denver metropolitan area has been redesignated to attainment status by EPA, the APCD will continue 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.

F. 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. A 3.1% oxygenated fuels program from November 8 through February 7, with 2.0% oxygen content required from November 1 through November 7.

b. 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 this Maintenance Plan.

c. 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

• 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.

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.

• 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 second value of 9.5 ppm or higher at the same monitor during any calendar year.

[1]The 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.

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.

G. SUBSEQUENT MAINTENANCE PLAN REVISIONS

As stated earlier, it is required that a maintenance plan revision be submitted to the EPA eight years after the original redesignation request/maintenance plan is approved - the purpose of this revision is to provide for maintenance of the NAAQS for an additional ten years following the first ten-year period. The State of Colorado commits to submit a revised maintenance plan eight years after redesignation to attainment, as required by the CAA and EPA. However, as discussed in the introduction, the RAQC and the State anticipate revising this plan as soon as possible after MOBILE6 or an equivalent tool is released by EPA. Therefore, it is likely that this plan will be revised in the next one to two years.