Alaska Department of Environmental Conservation

Amendments to:

State Air Quality Control Plan

Vol. II: Analysis of Problems, Control Actions
Section III.B: Anchorage Transportation Control Program

Adopted

January 2, 2004

(This page serves as a placeholder for two-sided copying)

Section III.B.1 – III.B.12 are repealed and readopted with the following:

> **Introductory Note:** In this document each reference to "CAAA" means the Clean Air Act Amendments of 1990, P.L. 101-549.

SECTION III.B ANCHORAGE CARBON MONOXIDE CONTROL PROGRAM

III.B.1. Planning Process

Background

Anchorage was first declared a nonattainment area for carbon monoxide (CO) on January 27, 1978. The Alaska Department of Environmental Conservation (ADEC) had recommended that the Environmental Protection Agency (EPA) designate a major portion of the Anchorage urban area as a nonattainment area for CO. The EPA accepted this recommendation, and in 1982 the Municipality of Anchorage (MOA) prepared a carbon monoxide attainment plan which was incorporated as a revision to the State of Alaska Air Quality Control Plan. The State of Alaska Air Quality Control Plan serves as the State Implementation Plan (SIP) for air quality. A primary goal of the Anchorage CO plan was to attain the National Ambient Air Quality Standard (NAAQS) by December 31, 1987.

Anchorage, however, failed to achieve attainment by the December 31, 1987 deadline mandated in the 1977 Clean Air Act Amendments (CAAA). The Clean Air Act was amended again in November 1990. When these amendments were published, the EPA designated Anchorage as a "moderate" nonattainment area for CO and required the submission of a revised air quality plan to bring Anchorage into attainment with the NAAQS by December 31, 1995. The MOA prepared a revised air quality attainment plan that was approved by the Anchorage Metropolitan Area Transportation Solutions (AMATS) Policy Committee and Anchorage Assembly in December 1992. It was later approved by the EPA as a revision to the Alaska SIP in 1995. However, two violations* of the NAAQS were measured in 1996. As a consequence, on July 13, 1998, the EPA reclassified Anchorage from a "moderate" to a "serious" nonattainment area for CO.

Anchorage has not violated the NAAQS since 1996. Upon review of Anchorage CO monitoring data, EPA determined that Anchorage had attained the NAAQS. This finding was published in a July 12, 2001 Federal Register Notice (Federal Register Vol. 66, No.134, pages 36476-36477, effective August 13, 2001). However an "attainment finding" in and of itself is not sufficient to redesignate an area to attainment. The CAAA establishes additional planning requirements that must be satisfied before the EPA administrator can reclassify an area to attainment. The two most significant requirements are the submission and EPA approval of an attainment plan, and subsequently, a maintenance plan. The first of these requirements, the attainment plan, has been completed. It demonstrates that Anchorage achieved the emission reductions necessary to attain the CO NAAQS by the December 31, 2000 deadline stipulated in the CAAA for serious CO nonattainment areas. It was adopted by the Anchorage Assembly on September 25, 2001 and incorporated by the ADEC as a revision to the Alaska SIP. The EPA approved this revision effective October 18, 2002.

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* Three exceedances of the NAAQS were measured at both the Seward Highway site and Benson site. Because the NAAQS allows one exceedance of the NAAQS per year at each site, three exceedances at a site constitute two violations.

The document contained herein was prepared to fulfill the second requirement necessary for reclassification to a CO attainment area, the completion and EPA approval of a maintenance plan. It shows that CO emissions in Anchorage will remain at a level that assures continued attainment of the NAAQS through calendar year 2023. Included in Section III.B.11 of this maintenance plan is a request that the EPA Regional Administrator reclassify Anchorage from serious CO nonattainment to an area that is in attainment with the NAAQS.

EPA approval of this maintenance SIP makes it enforceable under federal law. To ensure that there is adequate participation by local elected officials and citizens in this planning process, the CAAA contain specific mandatory attainment planning provisions. These requirements, and MOA's response to them, are discussed below.

Local Planning Process

The Anchorage air quality maintenance plan was prepared in accordance with the provisions of sections 110(a)(2)(M) and 174 of the CAAA (42 U.S.C. 7410(a)(2)(m) and 42 U.S.C. 7504), which require the consultation and participation of local political subdivisions and local elected officials. Under section 174 (42 U.S.C. 7504), the revised plan submitted to EPA as a formal SIP amendment must be prepared by "an organization certified by the State, in consultation with elected officials of local governments." Such an organization is required to include local elected officials and representatives of the following organizations:

- the state air quality planning agency (i.e., ADEC);
- the state transportation planning agency (i.e., Alaska Department of Transportation & Public Facilities (ADOT/PF)); and
- the metropolitan planning organization (MPO) responsible for the Continuing, Cooperative, and Comprehensive (3C) transportation planning process for the affected area.

In 1976, the governor designated the MOA as the MPO for the Anchorage urbanized area. Consequently, the MOA conducts the 3C transportation planning process required under federal regulation, in cooperation with ADEC and ADOT/PF, through the AMATS planning group. In 1978, the governor designated MOA as the lead air quality planning agency in Anchorage. Based on this designation, MOA has continued its role as the lead air quality planning agency in the Anchorage area for the preparation of this plan. The air quality planning process is outlined in the AMATS Intergovernmental Operating Agreement for Transportation and Air Quality Planning. This agreement was last revised in August 2002 and became effective January 1, 2003. This operating agreement establishes the roles and relationships between governmental entities involved in the Anchorage air quality planning process.

Development of this plan required close coordination between air quality and transportation planning agencies in the community. This coordination was ensured through the oversight of the AMATS Policy Committee during plan development. AMATS is an on-going comprehensive transportation planning process for Anchorage. Cooperative efforts include 1) projecting future land use trends and transportation demands; 2) recommending long-range solutions for transportation needs; and 3) working together to implement the recommendations. The AMATS structure consists of a two-tiered committee system that reviews all transportation planning efforts within the area.

The *AMATS Policy Committee* provides guidance and control over studies and recommendations developed by support staff. Voting members of the Policy Committee are listed below.

- MOA Mayor;
- ADOT/PF Central Regional Director;
- MOA Assembly representative;
- MOA Assembly representative; and
- ADEC Commissioner or designee.

The *AMATS Technical Advisory Committee* (TAC) and member support staff analyze transportation and land use issues and develop draft recommendations for the Policy Committee. Voting members include the following:

- MOA Traffic Director;
- MOA Project Management and Engineering Director;
- MOA Planning Director;
- MOA Public Transportation Director;
- MOA Department of Health & Human Services representative;
- MOA Port of Anchorage Director;
- ADOT/PF Chief of Planning & Administration;
- ADOT/PF Regional Pre-Construction Engineer;
- ADEC representative;
- Alaska Railroad representative; and
- AMATS Citizen Air Quality Advisory Committee representative.

In addition, to help provide public input into the current air quality planning process by interested local groups and individual citizens, a third AMATS committee, the *Citizen Air Quality Advisory Committee* (CAQAC), was appointed by the Policy Committee. CAQAC is comprised of nine members. Committee membership has generally included at least one physician or health professional, a representative of the I/M industry, a representative of the environmental community, and a representative from the Municipal Planning and Zoning Commission.

Air Quality Goals and Objectives

The goals and objectives of the Anchorage air quality maintenance plan provide the basis upon which the plan is developed and provide direction for future policy decisions that may affect air quality. The goals and objectives of the plan must reflect the intent of the CAAA as well the values, views, and desires of the citizens of Anchorage and their elected officials.

The goals and objectives need to integrate land use, air quality and transportation planning concerns. For this reason, the goals and objectives of this plan are designed to complement goals and objectives identified in the Anchorage Bowl Comprehensive Plan and Anchorage Long Range Transportation Plan.

Primary Goals and Objectives:

1. Continued maintenance of the NAAQS for CO throughout the Municipality of Anchorage through 2023 and beyond.†
2. Prevention of significant deterioration of air quality within the Municipality of Anchorage.
3. Development and implementation of control measures necessary to maintain compliance with the NAAQS through 2023.
4. Identification of contingency measures to be implemented if violations of the NAAQS occur.
5. Establishment of a mobile source emission budget to be used in future conformity determinations of transportation plans and programs.

In addition to the primary goals and objectives, there are community goals and objectives that must be considered and striven for during the development and implementation of the plan.

Community Goals and Objectives:

1. Clear healthful air that is free of noxious odors and pollutants.
2. Protection of the health of the citizens of the Municipality of Anchorage from the harmful effects of air pollution.
3. Establishment of an effective public information and comment program to ensure that the citizens of the Municipality of Anchorage have an active role in air quality planning.
4. Minimization of the negative regulatory and economic impact of air pollution control measures on Anchorage citizens and businesses.
5. Implementation and support of an efficient transportation system that offers affordable, viable choices among various modes of travel that serve all parts of the community and aids in the achievement of the goals and objectives of the *State Air Quality Control Plan*.

Plan Development

This maintenance plan is a natural extension of a planning effort begun in early 1997 to develop the attainment plan. A considerable amount of local research was conducted to quantify the contribution of vehicle cold starts and warm up idling on ambient CO concentrations in Anchorage. Working with EPA Region 10, ADEC and the Fairbanks North Star Borough a number of studies were conducted in Anchorage and Fairbanks between 1997 and 2001. These studies, which are summarized later in this document, serve as the basis for much of this maintenance plan as well as the attainment plan which preceded it. MOA and ADEC staffs were convinced that before credible attainment and maintenance plans could be prepared, it was essential to understand the role that warm-up idling played in Anchorage CO violations. EPA Region 10 staff concurred with the need to conduct these studies. This maintenance plan incorporates the results of this research.

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† Section 175A of the Clean Air Act requires maintenance plans to provide for the maintenance of the national primary ambient air quality standard for at least ten years after redesignation. The Anchorage plan exceeds this minimum requirement and demonstrates maintenance for a 20-year period, 2004-2023. This period was selected because if coincides with the Anchorage Long Range Transportation Plan which provides transportation activity forecasts through 2023.

Public Participation Process

Section 110(a) of the CAAA (42 U.S.C. 7410(a)) requires that a state provide reasonable notice and public hearings of SIP revisions prior to their adoption and submission to EPA. To ensure that the public had adequate opportunity to comment on revisions to the Anchorage air quality attainment and maintenance plans, a multi-phase public involvement process, utilizing AMATS and the Anchorage Assembly was used.

***AMATS Citizen Air Quality Advisory Committee* –** The AMATS Citizen Air Quality Advisory Committee has held a number of public meetings on the maintenance plan beginning early in 2003. During a public meeting held August 18, 2003 they recommended that the AMATS Technical and Policy Committees adopt the plan.

***AMATS Technical and Policy Committees* –** After reviewing the recommendation of the AMATS Citizen Air Quality Advisory Committee, on August 28, 2003, the AMATS Technical Committee recommended that the AMATS Policy Committee adopt the plan. Subsequent to this recommendation, the AMATS Policy Committee met on September 11 and September 18 to review the plan. The Policy Committee adopted the plan on September 18, 2003.

***Anchorage Assembly* –** The Anchorage Assembly adopted the plan during its regular public meeting held on October 7, 2003. A copy of Assembly Resolution AR 2003-305 is included in the appendix, Volume III, Section III.B.12.

***ADEC hearings* –** The final opportunity for public involvement occurs at the state administrative level. Prior to regulatory adoption of SIP revisions, ADEC holds public hearings on the revisions in the affected communities. ADEC held a public hearing on the Anchorage maintenance plan on November 13, 2003. This provided another forum for the public to comment on the air quality plan prior to state adoption and submission to EPA.

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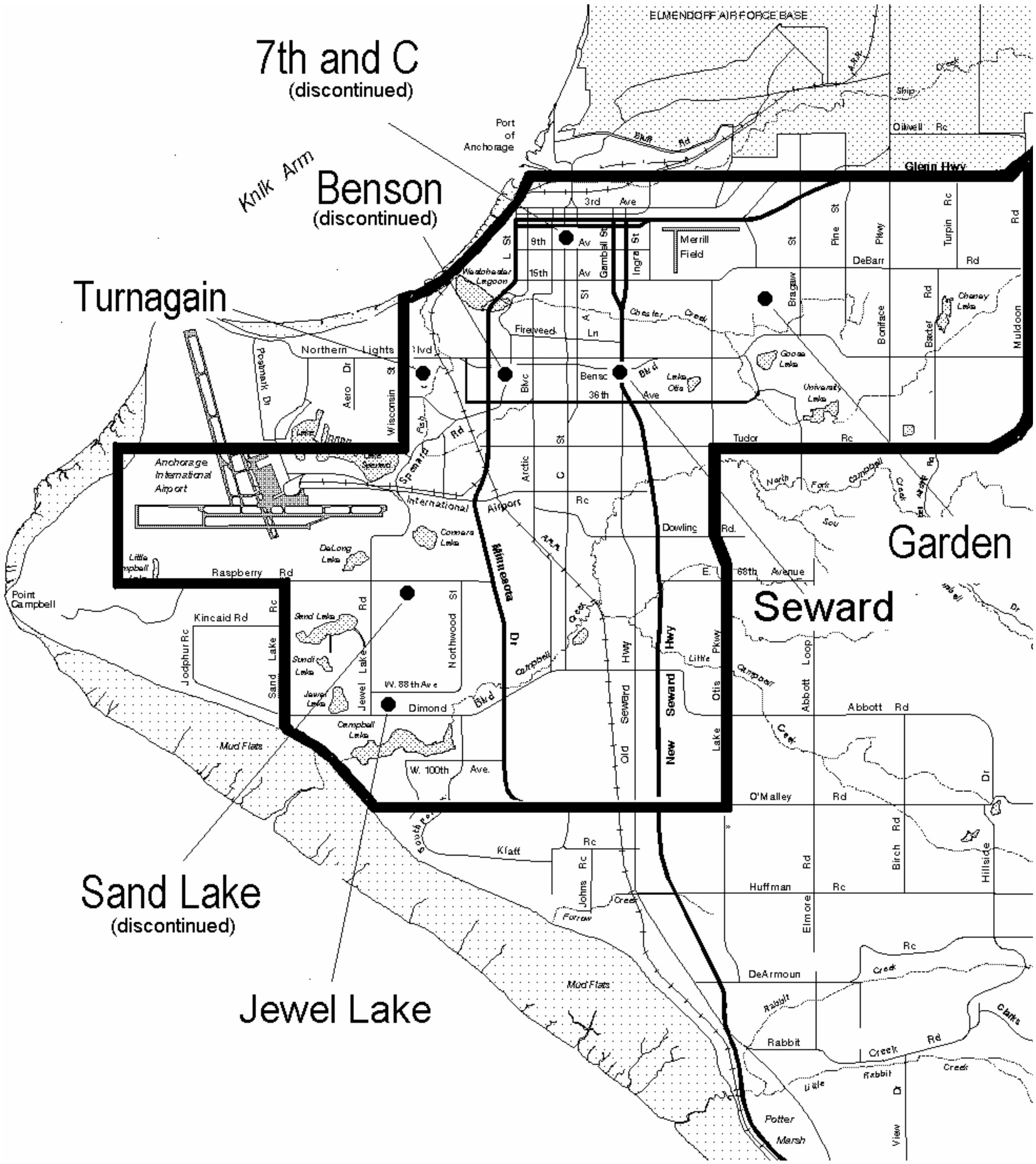
III.B. 2. Maintenance Area Boundary

Portions of the MOA were first identified as experiencing high levels of ambient carbon monoxide (CO) concentrations in the early 1970s. The nonattainment area within the MOA was first declared on January 27, 1978. A special monitoring study was then initiated in the MOA to measure CO concentrations at numerous locations. The specific objectives of the study were to determine the nonattainment area boundaries and to measure existing concentrations for use in demonstrating the extent of the problem as related to transportation. The results of that study were included in the *1979 State Air Quality Plan* and EPA reaffirmed the boundaries of the nonattainment area on November 6, 1991 (56 Fed.Reg. 56694, 56711)(40 C.F.R. 81.302, effective January 6, 1992).

The maintenance area boundary is shown in Figure III.B.2-1. This boundary is identical to the nonattainment boundary identified in previous attainment plans. The nonattainment boundary becomes the maintenance area boundary for the Municipality of Anchorage effective upon approval of this maintenance plan. Figure III.B.2-1 also shows the locations of CO monitoring stations in Anchorage. Monitoring at a number of these stations has been discontinued because measured values at these stations were low relative to other comparable sites in the network.

Figure III.B.2-1
MOA CO Monitoring Network and Maintenance Area Boundary



III.B.3. Nature of the CO Problem – Causes and Trends

Sources of CO – 2002 Design Year Emission Inventory

Section 187 of the CAAA (42 U.S.C. 7512a) requires serious CO nonattainment areas to submit an inventory of actual emissions from all sources in accordance with guidance developed by EPA. An emissions inventory has been prepared in accordance with the SIP Development Plan reviewed by the EPA in June 2003. A copy of this emission inventory, *Anchorage Carbon Monoxide Emission Inventory and Maintenance Projections*, is contained in Volume III, Appendix III.B.3.

The area inventoried includes the entire Anchorage nonattainment area including areas to the west and east of the inventory boundary. These areas were included because of the growth and development that have occurred there over the past two decades. Elmendorf Air Force Base and Fort Richardson are not included in the inventory area.

According to the latest inventory compiled for the Anchorage area, in the 2002 base year, 77% of winter season CO emissions in the nonattainment area were from motor vehicles.[1] A significant amount of resources and effort were devoted to accurately quantifying the impacts of warm-up idling because the EPA MOBILE model was poorly suited for estimating this component of motor vehicle emissions. The MOA collaborated with the Fairbanks North Star Borough and ADEC on a local research effort aimed at quantifying the contribution of cold weather warm-up idling on the emission inventory. This research suggests that cold starts and warm-up idling are a very important component of vehicle emissions. In the winter, many Anchorage drivers engage in extended warm-ups, particularly prior to their morning commute. A study conducted in Anchorage during the winter of 1998-99 indicated that the average warm-up period for morning commuters was 12 minutes.[2]

Area-wide, over the course of a 24-hour winter day, warm-up idling accounts for over a quarter of all vehicle emissions. In some residential areas, again, over a 24-hour winter day, idling accounts for almost half of all the CO emissions generated. Cold winter temperatures increase "cold start" emissions. When the EPA MOBILE6 model is run with Anchorage fleet characteristics, CO emissions at start up are almost three times greater at 20 °F than at 65 °F.

Other significant sources of CO in Anchorage include aircraft and residential wood burning. Estimated 2002 CO emissions sources in Anchorage are summarized in Table III.B.3-1. In addition to the 2002 inventory, inventories were prepared for 1996 and 2000. Emission forecasts were prepared for 2004, 2006, 2008, 2010, 2013 and 2023. These forecasts were used to develop the long term maintenance projections presented later in Section III.B.5.

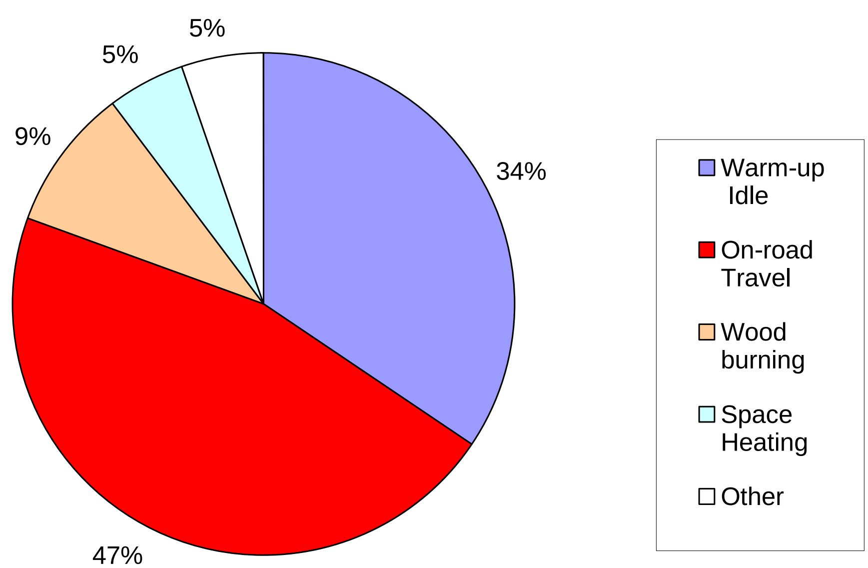
Grid-based inventories were developed for each year. These grid-based inventories provide separate estimates of emissions for the 772 one-half kilometer by one-half kilometer grid cells that make up the Anchorage inventory area. These grid-based estimates of emissions are further resolved by time-of-day. An estimate of the quantity of CO emitted during four time periods (6 a.m. – 9 a.m., 9 a.m. – 3 p.m., 3 p.m. – 6 p.m. and 6 p.m. – 6 a.m.) was provided for each grid cell. The results and methodology used to prepare these inventories is discussed in detail in the *Anchorage Carbon Monoxide Emission Inventory and Maintenance Projections*, in Volume III, Appendix III.B.3.

Table III.B.3-1 Sources of Anchorage CO Emissions in 2002 Base Year (Area-wide)		
Source Category	**CO Emitted (tons per day)**	**% of total***
Motor vehicle – on-road travel	67.62	56.2%
Motor vehicle – warm-up idle	25.32	21.0%
Ted Stevens Anchorage International Airport Operations	11.84	9.9%
Merrill Field Airport Operations	1.03	0.9%
Wood burning – fireplaces and wood stoves	5.75	4.8%
Space heating – natural gas	3.56	3.0%
Miscellaneous (snowmobiles, snow removal, welding, etc.)	3.72	3.1%
Point sources (power generation, sewage sludge incineration)	1.45	1.2%
TOTAL	**120.29**	**100%**

* Total does not sum exactly to 100% due to rounding

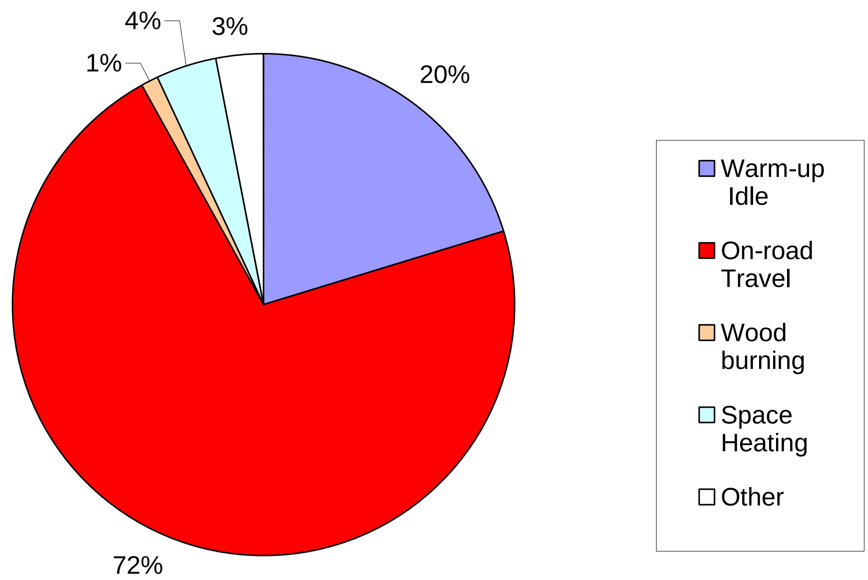
Micro-inventories were also prepared for one square kilometer areas surrounding three Anchorage monitoring stations. These micro-inventories provide added insight into the sources of CO in particular areas and are useful in developing appropriate localized control strategies. The results of these inventories are shown in Figures III.B.3-1(a-c). The pie charts illustrate the importance of warm-up idle emissions in the residential areas surrounding the Garden and Turnagain stations where they constitute more than a third of total emissions. Warm-up idle emissions are less significant at the Seward Highway station where land-use is largely commercial and cold starts are less prevalent.

Figure III.B.3-1(a) CO Emissions in the Area Surrounding the Garden Station



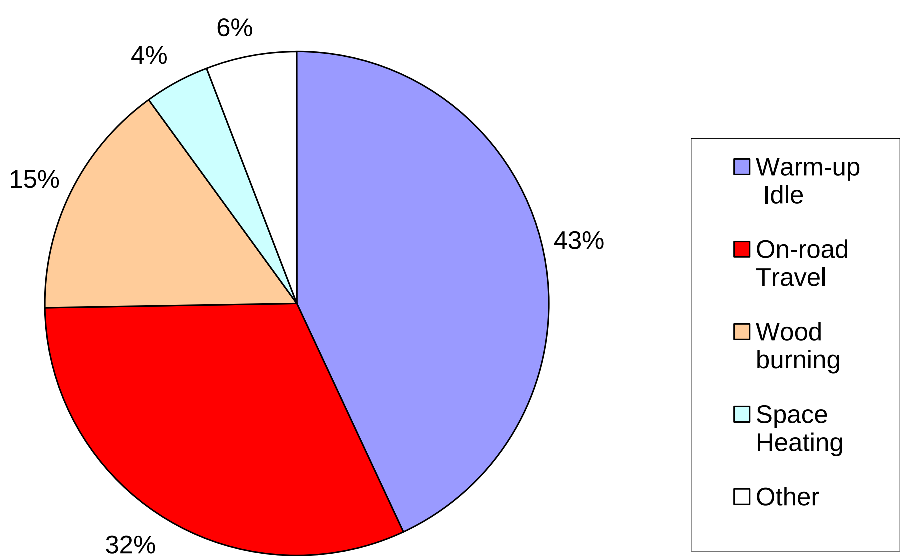
Total CO emissions in 1 km^2 grid = 1,052 lbs/day

Figure III.B.3-1(b) CO Emissions in the Area Surrounding the Seward Highway Station



Total CO emissions in 1 km^2 grid = 4,096 lbs/day

Figure III.B.3-1(c) CO Emissions in the Area Surrounding the Turnagain Station



Total CO emissions in 1 km^2 grid = 1,186 lbs/day

Future Periodic Inventories

Section 182 of the CAAA (42 U.S.C. 7511a) requires the submission of periodic emission inventories at three year intervals until an area is redesignated to attainment. A revised inventory will be prepared for year 2003 and submitted in 2004 if the MOA nonattainment area is not redesignated to attainment by the required submission date. Periodic inventories are not required for maintenance areas. CAAA Section 175A(b) requires the submission of a SIP revision eight years after redesignation as a maintenance area. An emission inventory will be prepared to support this SIP revision. The MOA and/or ADEC may choose to prepare an additional inventory(s) in the interim.

Causes of High CO Emissions in the Anchorage Nonattainment Area

Seventy-seven percent of the 2002 base year wintertime CO emissions in the MOA were from motor vehicles, due to the high volume of vehicle travel in the community and the magnitude of CO emitted under cold-start conditions. Most of these emissions are concentrated in the warm-up period when engine temperatures are low, the fuel mixture is rich and the vehicle's catalytic converter has not reached its light-off temperature. Anchorage's cold winter temperatures intensify this cold-start phenomenon.

Cold-start emissions may account for as much as two-thirds of the total CO emitted during a typical wintertime vehicle trip in Anchorage. These cold-start emissions have been discussed in detail in numerous technical reports, as well as in the last Anchorage attainment plan SIP submittal. Given this perspective and the fact that EPA has now adopted a cold-temperature CO standard, no detailed information on this subject is presented in the local air quality plan.

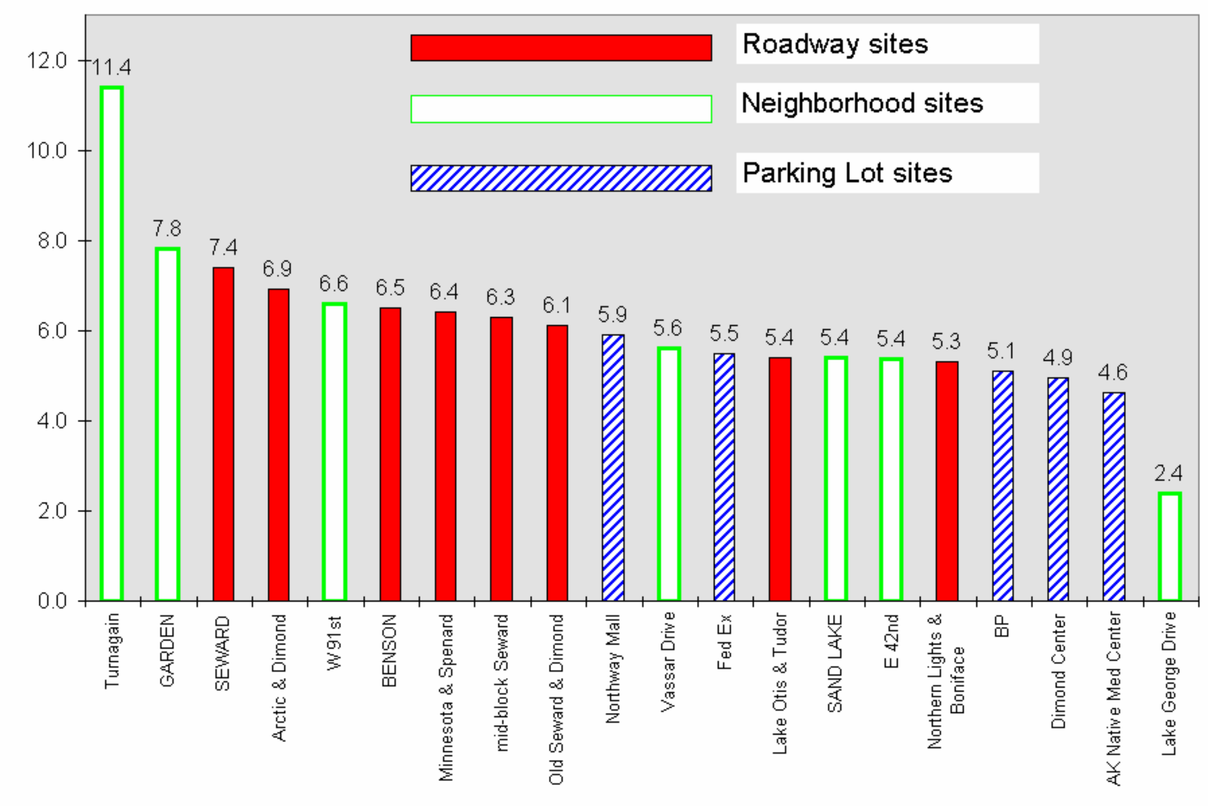
Summary of Local Research

Beginning in 1997, the MOA, in cooperation with the EPA, ADEC, and the Fairbanks North Star Borough, conducted a number of studies to advance the understanding of the causes of the winter season CO problem in Anchorage and Fairbanks. In particular, these studies focused on quantifying the contribution of cold-starts and warm-up idling on the problem. These studies are summarized below.

1997 – 1998 CO Saturation Monitoring Study

The MOA performed additional CO monitoring during the period December 4, 1997 - February 4, 1998. Sixteen temporary monitoring sites were established to assess how well the four station permanent network was characterizing the air quality near congested roadway intersections, in neighborhoods, and in parking lots. Monitoring was conducted at a total of 20 locations during the study period. Six sites were located near major roadway intersections, five in neighborhoods, and five in large retail or employee parking lots. The maximum 8-hour concentrations measured at each of the 20 sites in the study are compared in Figure III.B.3-2.

Figure III.B.3-2
Maximum 8-hour CO Concentrations Measured During
CO Saturation Monitoring Study (1997-98)



The highest 8-hour CO concentrations were found at neighborhood locations with relatively low traffic volumes. The Turnagain neighborhood site (at Turnagain Street and 31st Avenue) recorded the highest and second highest 8-hour concentrations in the study. The next highest site was the Garden permanent station, also located in a neighborhood. Vehicle cold starts and warm-up idling by morning commuters were implicated as the cause of the elevated CO observed in these neighborhoods.

The permanent station at Seward Highway recorded the highest concentration of any of the six roadway intersection sites. The study concluded that the permanent station at Seward Highway adequately characterizes the upper range of CO concentrations experienced near Anchorage's major roadways. Lower than expected concentrations were found near a number of congested intersections. For example, the highest concentration measured near the busy intersection of Lake Otis Boulevard and Tudor Road was about 50% lower than the Turnagain neighborhood site.

CO concentrations at the five parking lot sites were generally lower than those found in neighborhoods or near the major roadway intersections monitored during the study. This was somewhat surprising given the number of vehicle start ups that originated in these parking lots. Many of these start ups, especially in retail shopping parking lots, were likely to be "hot starts," however, meaning that engines were still warm from an earlier trip. Warmer engines emit considerably lower amounts of CO and this may account for the relatively low ambient concentrations observed.

Anchorage Winter Season Driver Idling Behavior Study (1997-98)

The MOA conducted a study between November 28, 1997 and January 31, 1998 aimed at quantifying the amount of warm-up idling performed by Anchorage drivers. Field staff observed 1,321 vehicle starts at diverse locations in Anchorage. Warm-up idling duration was documented for trips that began at homes, work places, and other locations including shopping centers, restaurants, and schools.

Transportation planning models typically categorize trips into three categories as follows:

- Home-based work (HBW) trips – Commute trips that involve travel directly from home to work or from work to home.
- Home-based other (HBO) trips – Trips that originate from home to some location other than work (e.g., shopping center, school, health club, doctor office, etc.) or the return trip from the "other" location if it returns directly home.
- Non home-based (NHB) trips – Trips that originate from some location other than home (e.g., work, shopping, etc.) and are not a HBW or HBO trip.

Field observations were used to estimate idle duration for each of the trip purpose categories described above. The longest warm-up idle times were associated with morning HBW trips. The average idle duration for these trips was over 7 minutes. About 35% of morning HBW trips involved vehicles parked overnight in heated garages. Idle duration for these vehicles averaged less than one minute. The average idle duration for vehicles parked outside was over 12 minutes. The average idle duration for evening HBW trips beginning at the workplace was 3.4 minutes. The shortest idle durations were associated with morning and midday NHB trips that began at sites other than work or home. Median idle time for these trips was less than one minute.

Engine soak times, the length of time that an engine sits in the cold between trips, were also estimated as part of the driver idling behavior study. Longer soak times result in colder engines and increased CO emissions. Data from a travel survey conducted by Hellenthal and Associates for the MOA in 1992 were used to estimate soak times by trip purpose and time of day. Results of the driver idling behavior study are shown in Table III.B.3-2.

TABLE III.B.3-2
Anchorage Winter Season Driver Behavior Study
Soak Time and Idle Duration by Time of Day and Trip Purpose

		Soak Time (hours)		Idle Duration (minutes)	
Time of Day	Trip Purpose	Average	Median	Average	Median
Morning 6:00 a.m. – 9:00 a.m.	HBW	11.9	12.8	7.3	5.7
	HBO	10.7	12.0	5.9	4.8
	NHB	1.1	0.1	0.8	0.6
Midday 9:00 a.m. – 3:00 p.m.	HBW	6.3	3.7	3.5	2.0
	HBO	6.6	1.7	2.0	1.2
	NHB	1.6	0.6	1.6	0.6
Evening 3:00 p.m. – 6:00 p.m.	HBW	6.8	8.2	3.4	1.2
	HBO	2.6	0.8	2.1	0.9
	NHB	3.0	0.8	3.1	0.8
Night 6:00 p.m. – 6:00 a.m.	HBW	5.8	4.5	3.0	1.2
	HBO	2.0	1.2	2.6	2.7
	NHB	2.0	1.0	1.5	1.3

Table III.B.3-2 shows that the longest soak times and idle durations are associated with morning HBW trips and HBO trips. Because most of these trips begin with a cold engine and involve long idles, it suggests that start up and idle CO emissions are likely to be greater than other trip types. Conversely, NHB trips, because they typically involve short soak times and idle durations, likely have relatively low start-up and idle CO emissions.

Alaska Drive Cycle Study

In 1996, EPA issued a final rule that revised the certification test procedure to account for the effects of aggressive driving conditions, high acceleration rates and air conditioning on motor vehicle emissions. The rule required manufacturers to control excess emissions produced under these previously unrepresented driving conditions and was phased-in between 2000 and 2002 model year vehicles. The rulemaking significantly impacted emission inventory estimates for all pollutants by increasing estimates for pre-2000 model year vehicles and dramatically reducing emissions from post 2000 model year vehicles. A review of the high-speed, high acceleration rates represented in the new driving cycles led to concern about how well they represented winter time driving conditions when snow, ice and darkness are the prevalent conditions in Anchorage and Fairbanks.

Under contract with ADEC, Sierra Research worked with transportation agencies in Anchorage and Fairbanks to select representative routes in those communities. Data were collected using a “chase car” equipped with a GPS system to collect second-by-second position measurements over each of the routes driven. The “chase car” followed and mimicked the behavior of randomly selected vehicles while driving over the route so that the collected data represented the operation of in-use vehicles. A total of 80 separate routes were driven in Anchorage and 79 routes in Fairbanks.

The position measurements in the collected data set were differentiated to produce speed estimates. Summary statistics were computed for each community and blended in proportion to each community’s share of their combined travel to produce an overall estimate of activity. The results showed that winter driving in Alaska had almost none of the high speed, high acceleration rate driving represented in EPA’s revised certification test procedure. As a result, a decision was made to not include the effects of these driving conditions on the emission inventories developed for both Anchorage and Fairbanks.

The collected driving data was used to develop a driving cycle representative of Alaska driving conditions. The approach used to develop the Alaska Driving Cycle was to select a mixture of driving patterns that best represented the overall speed acceleration frequency distribution of the collected dataset. Over 5,000 candidate cycles were created. Adjustments were made to minimize brake wear during decelerations and improve representation of constant speed activity. The resulting cycle was designed to mimic the federal test procedure (FTP) by establishing a cold start, hot start and stabilized mode of operation. Bag 1, the cold start, includes 2 minutes of idle activity and is 500 seconds long. Bag 3 is a repeat of Bag 1 with a hot start instead of a cold start. Bag 2 is 316 seconds long and represents operation between seconds 501 and 816.

Alaska Cold Temperature Vehicle Emission Studies

In the time since the attainment and maintenance planning process began in 1997, two significant studies have been undertaken to better understand the nature of vehicle emissions in Alaska’s cold winter climate. The MOA collaborated with ADEC and the Fairbanks

North Star Borough on the design of these studies, both of which were conducted by Sierra Research working under contract with ADEC.

During the winter of 1998-99, Sierra Research conducted a study to quantify emissions from Alaskan vehicles during cold start and idling. They equipped a large van with a modified Horiba IMVETS emissions test system that provided measurements of CO and hydrocarbon (HC) mass emissions on a second-by-second basis. The van could be driven from location to location to test a variety of vehicles representative of the fleet mix in both Anchorage and Fairbanks.

After an initial cold soak of four hours or more at ambient temperature, test vehicles were cold-started and mass emissions were measured for a period of twenty minutes subsequent to start-up. Testing was conducted at ambient temperatures that ranged from -6 °F to +23 °F in Anchorage and -36 °F to +14 °F in Fairbanks.

A second, follow-up vehicle emission study was conducted in Fairbanks during the winter of 2000-2001. For this study, Sierra Research procured a vehicle dynamometer that allowed vehicle emissions to be measured in simulated transient or travel mode. Sierra Research performed a gamut of tests on a sample of 35 vehicles selected to represent the Anchorage and Fairbanks fleet mix. These tests included a variety of soak and warm-up times designed to examine the influence of soak and idle times on CO emissions generated during the course of a vehicle trip. Transient mode emissions were evaluated with the dynamometer using the Alaska Drive Cycle to best reflect actual winter-season driving behavior in Anchorage. The emission reduction benefits of engine block heater use were also evaluated.

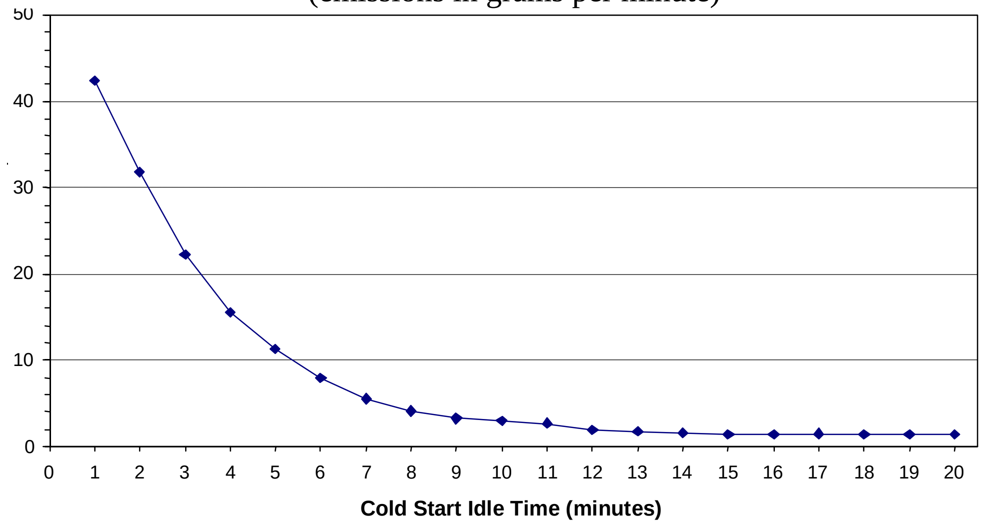
Key findings from these two studies are summarized below:

- *A large portion of CO emissions occur during warm-up idle.*
  In order to simulate a typical morning commute in Anchorage, CO emissions from cold-started vehicles were measured during the course of a 10-minute warm-up and a subsequent 7.3 mile drive. The warm-up idle accounted for 68% of the total CO emitted.

- *Emissions decrease dramatically during the course of a warm-up idle.*

  Testing showed that idle emissions drop significantly during the first five minutes, especially for newer model vehicles. Figure III.B.3-3 shows the decrease in emissions over time.

Figure III.B.3-3
Cold Start Idle Emission Rate vs. Time
(emissions in grams per minute)



- *Engine block heaters provide very significant reductions in cold start and warm-up idle emissions.*

  Test data showed that, during the first ten minutes of a warm-up idle, the use of an engine block heater reduced CO emissions by an average of 57%. Fuel consumption was reduced by 22% during this same ten-minute period.

- *Anti-idling programs appear to offer little promise of significant CO emission reductions.*

  Test data showed that on an overall trip basis, CO emissions actually increase when warm-up idle times are cut shorter than 10 minutes. When the idle time is cut to 5 minutes, Sierra Research found that overall trip emissions increased by an average of 8%, and by about 20% when the warm-up time was cut to 2 minutes. They also found that there was little or no air quality benefit from turning off a warmed-up vehicle if it was going to be started soon thereafter. For example, they found that turning-off a warmed vehicle during a short (60 minute or less) shopping errand provides no CO air quality benefit. The emissions from a vehicle left running were roughly comparable to a vehicle that was turned off and re-started at the end of the errand.

Influence of Meteorology on Ambient CO Concentrations

In Anchorage, CO concentrations are highest during the months of November through February. As a high-latitude community, with long winter nights and weak daytime solar insolation, Anchorage frequently experiences strong and persistent temperature inversions that trap CO close to the ground. In mid-winter, due to the short daytime period available for warming and the low sun angle, inversions often persist throughout the day. Inversion strengths as high as +5 °F per 100 foot rise in elevation have been measured. When winds are light, there is little vertical or horizontal dispersion of pollutants. Poor dispersion conditions, combined with high emission rates from motor vehicles started in cold temperatures create an environment particularly conducive to developing elevated CO concentrations.

Exceedances of the NAAQS tend to occur on days with low wind speeds, clear or partly cloudy skies, and cold temperatures. The average temperature during exceedances since 1990 is about 5° F. Exceedances are unusual on weekends, presumably because motor vehicle activity is lower than weekdays. Weather conditions on the 28 days when Anchorage exceeded the standard between 1990 and 2002 are summarized in Table III.B.3-3. The table shows only the maximum concentration site for each day exceeding the NAAQS. Other sites may also have been in excess of the health standard on those days.

Local Climatological Data from the National Weather Service observatory at Point Campbell on the Ted Stevens Anchorage International Airport were used to prepare Table III.B.3-3. It should be noted that Point Campbell is in the extreme western part of Anchorage, adjacent to Cook Inlet. Temperatures there are often moderated by the surrounding water body. Temperatures in east Anchorage, away from the inlet, can sometimes be 10 to 20° F lower. Wind speeds at Point Campbell can also be higher than areas to the east, particularly under a northerly wind regime. Thus, the wind speed and temperatures recorded at Point Campbell may not always accurately reflect conditions elsewhere in Anchorage.

Table III.B.3-3 Meteorological Conditions on Days When Anchorage Exceeded the NAAQS for CO (1990 – 2002)							
Date	**Day**	**8-Hour Avg. CO (ppm)**	**Site**	**Exceedance Time Period**	**Temp (°F)**	**Wind Spd (knots)**	**Cloud Cover (tenths)**
1/5/90	Fri	11.4	Seward	3p.m. – 11p.m.	8	2.7	2
1/9/90	Tue	9.6	Seward	10a.m. – 6p.m.	-7	4.7	5
1/29/90	Mon	9.8	Seward	4p.m. – 12a.m.	-11	3.3	3
2/14/90	Wed	10.2	Seward	5p.m. – 1a.m.	5	4.3	0
11/16/90	Fri	9.9	Seward	2p.m. – 10p.m.	21	3.0	8
11/21/90	Wed	9.9	Seward	4p.m. – 12a.m.	-3	0.0	2
11/26/90	Mon	11.6	Seward	4p.m. – 12a.m.	4	4.7	0
11/27/90	Tue	10.7	Seward	3p.m. – 11p.m.	-10	1.3	5
11/28/90	Wed	13.0	Seward	3p.m. – 11p.m.	-2	5.7	0
12/6/90	Thur	11.4	Seward	11a.m. – 7p.m.	27	4.3	10
12/31/90	Mon	9.6	Seward	11a.m. – 7p.m.	5	5.3	0
1/4/91	Fri	9.8	Seward	4p.m. – 12a.m.	7	0.0	4
1/5/91	Sat	9.7	Seward	5p.m. – 1a.m.	6	2.7	0
12/20/91	Fri	11.5	Seward	11a.m. – 7p.m.	9	4.0	0
1/1/92	Wed	10.8	Garden	4p.m. – 12a.m.	16	1.0	6
1/2/92	Thur	10.8	Garden	7a.m. – 3p.m.	19	1.3	10
12/7/93	Tue	9.7	Garden	7a.m. – 3p.m.	19	5.0	0
12/10/93	Fri	10.4	Seward	12p.m. – 8p.m.	22	4.0	10
12/13/93	Mon	10.0	Garden	7a.m. – 3p.m.	12	3.0	6
12/30/93	Thur	9.9	Seward	3p.m. – 11p.m.	16	2.3	0
11/30/94	Wed	11.3	Seward	11a.m. – 7p.m.	6	10.3	0
12/7/94	Wed	11.0	Seward	3p.m. – 11p.m.	-9	0.0	10
1/22/96	Mon	11.0	Benson	5p.m. – 1a.m.	-2	0.0	1
12/27/96	Fri	10.0	Seward	2p.m. – 10p.m.	8	2.4	0
12/31/96	Tues	10.8	Seward	11a.m. – 7p.m.	-7	2.7	0
1/5/98	Mon	9.5	Garden	8a.m. – 4p.m.	-1	4.8	0
1/6/99	Wed	10.1	Turnagain	11a.m. – 7p.m.	2	1.0	5
12/16/01	Sun	9.7	Turnagain	11a.m. – 7p.m.	-8	4.3	3

Diurnal Pattern in CO Concentrations

There is a distinct diurnal pattern in ambient CO concentration that corresponds to driving patterns in the vicinity of a monitoring site. Residential neighborhood sites like Turnagain and Garden typically experience their highest CO concentrations in the mid-morning following the morning commute and accompanying vehicle warm-up idle. Sites located near major traffic thoroughfares like the Seward Highway site typically exhibit their highest concentrations in the early evening hour corresponding with the evening rush hour.

Diurnal patterns at the Turnagain, Garden and Seward Highway stations are illustrated in Figures III.B.3-4 (a-c). The hourly averages shown are composites of the hourly averages measured on the 10 days when the highest 8-hour CO concentrations were observed at each site between 1998 and 2002. The distinctive diurnal patterns observed at all three sites implicate cold start emissions a significant source of emissions at all three sites.
At the Garden and Turnagain stations, which are located in the middle of residential areas, CO concentrations rise quickly in the early morning hours as commuters start their cars and

leave for work. They peak at about 10 a.m. and drop off substantially during the late morning and early afternoon. Concentrations build again somewhat in the evening hours but the evening peak is substantially lower than the morning peak.

At the Seward Highway station, located at the busy intersection of the Seward Highway and Benson Boulevard, hourly concentrations build slowly from 7 a.m. through 1 p.m., hold steady through the mid-afternoon hours, and then rise rapidly during the evening rush hour. CO concentrations peak in the early evening about 6 p.m. and decline in the later evening hours. Cold start emissions from evening commuters leaving from downtown and mid-town employment centers likely contribute to this evening peak.

Figure III.B.3-4 (a) Turnagain Residential Neighborhood Station
Diurnal Variation in Hourly CO Concentration

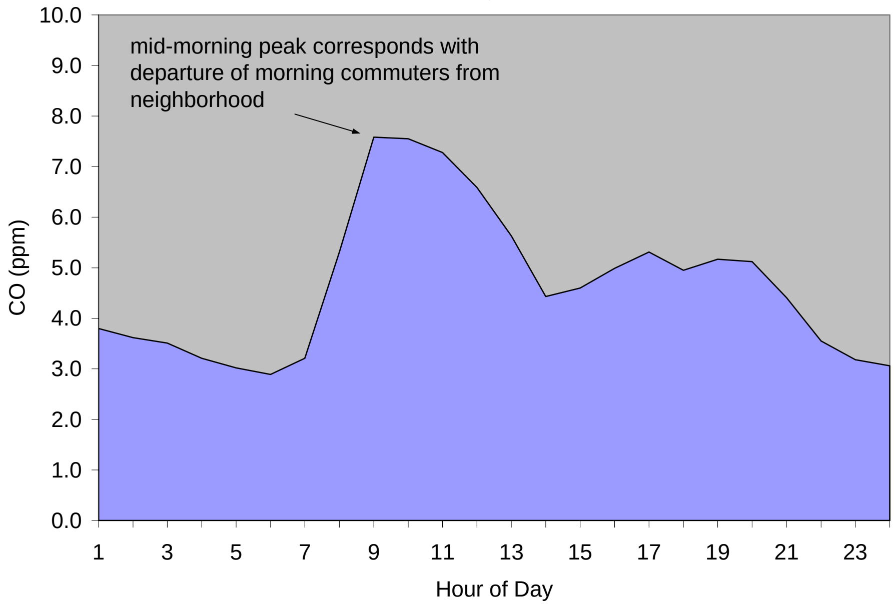


Figure III.B.3-4 (b) Garden Neighborhood Station
Diurnal Variation in Hourly CO Concentration

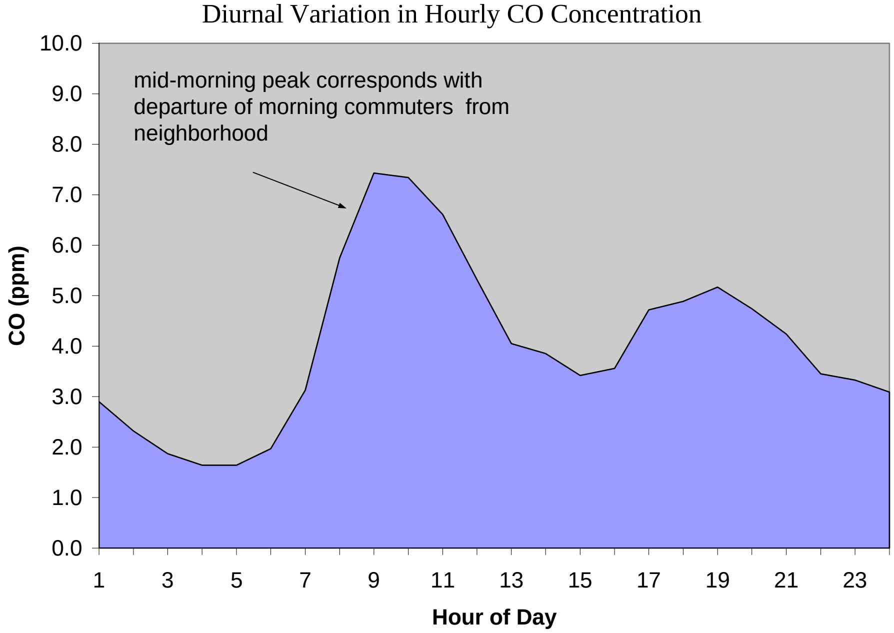
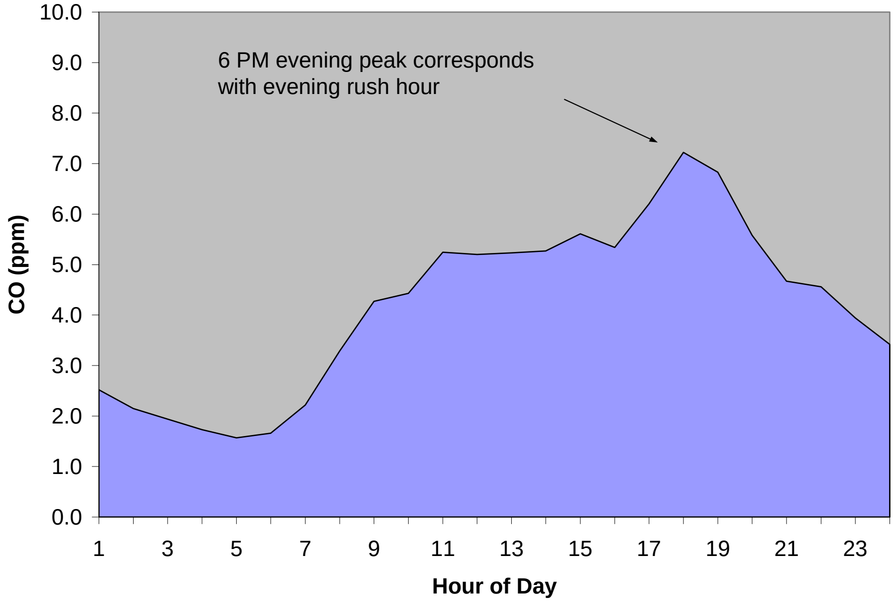


Figure III.B.3-4 (c) Seward Highway Station
Diurnal Variation in Hourly CO Concentration



Role of Mechanical Turbulence from Vehicle Traffic in Reducing Ambient CO Concentrations during Stagnation Conditions

As alluded to earlier in this document, the highest CO concentrations in Anchorage tend to occur in residential neighborhoods rather than major roadways where vehicle traffic volumes may be an order of magnitude greater. Although vehicle cold starts result in higher *per vehicle* emission rates in residential areas, total CO emissions in commercial areas in midtown Anchorage are greater due to the shear volume of vehicles traveling along its major roadways. If the ambient CO concentration in a particular area were solely a function of the quantity of emission produced there, CO concentrations near major roadways in midtown Anchorage should therefore be higher than residential areas. Ambient monitoring data indicate that this is not the case. This apparent conundrum is shown in Table III.B.3-4 where traffic activity, CO emissions and ambient CO concentrations in midtown represented by the Seward Highway monitor, are contrasted to those in the Turnagain residential area. The table shows estimated emissions, traffic activity and average vehicle speeds in the one square kilometer areas surrounding these two monitors.

TABLE III.B.3-4
Comparison of Traffic Volumes, CO Emissions and CO Concentrations in the Areas Surrounding the Turnagain and Seward Highway Sites

	Turnagain residential neighborhood	Seward Highway commercial area
Vehicle miles traveled per day within 1 km^2 grid surrounding monitor	10,266 miles	75,864 miles
Estimated average speed of vehicles traveling within 1 km^2 grid	20.9 mph	28.7 mph
Estimated CO emitted per day within 1 km^2 grid (2002)	1,186 lbs	4,096 lbs
Maximum 8-hour CO Concentration observed (1999 – 2002)	10.1 ppm	7.5 ppm
Median 8-hour CO Concentration observed (1999 – 2002)	1.6 ppm	2.5 ppm

As can be seen in Table III.B.3-4, CO emissions in the Seward Highway area are roughly four times greater than the Turnagain grid, yet the maximum CO concentration there is significantly lower than Turnagain. Although not shown here, a similar but less dramatic contrast can also be seen when Seward is compared to the Garden residential area. What explains this apparent incongruity?

In testimony given before a National Research Council committee assembled to review the CO problem in Fairbanks, Anchorage and other cold climate areas, the MOA posed the hypothesis that mechanical mixing from high-speed vehicle traffic may reduce ambient CO concentrations near major traffic thoroughfares on severe stagnation days.[3] Monitoring data support this hypothesis.

MOA hypothesizes that on a typical winter day when natural atmospheric mixing (i.e. wind, thermal convection, etc) is sufficient to keep CO concentrations low, the impact of mechanical mixing from vehicle traffic on overall mixing is less important and overall mixing conditions at Turnagain and Seward are more similar. Under these conditions (represented in Table III.B.3-4 by the median concentration) CO concentrations at Seward Highway are higher than Turnagain because CO emissions are greater. Indeed the median concentration at Seward (2.5 ppm) is approximately 60 % higher than Turnagain (1.6 ppm).

However, when a strong ground-based temperature inversion and lack of wind create very poor natural atmospheric mixing, the MOA hypothesizes that mechanical mixing from vehicle traffic becomes an important factor in determining consequent CO concentrations. The high volume and speeds of vehicle traffic near the Seward Highway site provide more mixing than the low speed, low volume traffic near Turnagain. The amount of mechanical energy provided by vehicles in the one square kilometer area surrounding Seward is roughly twenty times greater than Turnagain.[‡] Thus, under extreme meteorological conditions, when natural mixing is very low, vehicle traffic appears to be a much more important factor in dispersing CO at Seward than Turnagain. Consequently, under those conditions, concentrations at Turnagain are significantly higher than Seward (10.1 ppm vs. 7.5 ppm) even though CO emissions at Turnagain are four times lower.

‡ The amount of mechanical mixing created by a passing vehicle is proportional to $velocity^3$. This means that a vehicle traveling at the average speed in the Seward grid (28.7 mph) creates about 2.5 times more turbulence than a vehicle traveling at the average speed in the Turnagain grid (20.9 mph). The Seward grid has a traffic volume 7.4 greater than Turnagain. Therefore the mechanical turbulence created in the Seward grid is roughly twenty times greater than Turnagain (2.5 x 7.4 = 18.5).

Carbon Monoxide Trends

In 1983, CO levels in Anchorage exceeded the NAAQS at one or more monitoring sites on 53 days. During midwinter months in the early 1980's, a violation of the NAAQS was measured roughly one-in-four days. However CO concentrations have fallen dramatically over the past twenty years. No violations have been measured since 1996. Single exceedances of the NAAQS were measured in 1998, 1999 and 2001 but these are not considered violations because the NAAQS allows up to one exceedance per calendar year. No exceedances were measured in 1995, 1997, 2000, and 2002 and the first three months of 2003.

The highest and second highest 8-hour average for five Anchorage monitoring stations are tabulated by year, 1982 – 2002, in Table III.B.3-5. The number of days exceeding the NAAQS at each station is also tabulated. The table shows that dramatic declines in CO have occurred in Anchorage over the past 20 years.

Data from the 7th & C Street and Jewel Lake stations are not tabulated. Monitoring at 7th & C was discontinued in 1995 because concentrations there were the lowest in the network. The Jewel Lake station went into operation in October 2002 and less than a year of data are presently available. Thus far, it appears that CO concentrations at Jewel Lake are lower than the other three monitors currently in operation in Anchorage.

The trend in the second highest 8-hour average concentration or second maximum measured in each calendar year is often used to measure improvements in CO air quality and progress toward attainment of the NAAQS. The second maximum is statistically more robust (i.e., less prone to year-to-year fluctuation) than the first maximum, making it easier to discern long-term air quality trends. The second maximum is also a direct measure of compliance with the NAAQS. A community is considered to be in compliance if the second maximum at all monitoring stations is below 9.5 ppm.

Table III.B.3-5

Summary of CO Data from Anchorage Monitoring Stations (1980 –2002)

	Benson (microscale) 2902 Spenard Road			Garden (neighborhood) 3000 E 16th Street			Sand Lake (neighborhood) 3426 Raspberry Road			Seward (microscale) 3002 New Seward Highway			Turnagain (neighborhood) 3201 Turnagain Street		
Year	**max**	**2nd max**	**# days ≥9.5**	**max**	**2nd max**	**# days ≥9.5**	**max**	**2nd max**	**# days ≥9.5**	**Max**	**2nd max**	**# days ≥9.5**	**max**	**2nd max**	**# days ≥9.5**
1980	27.4	26.3	39	17.1	16.8	21	14.0	14.0	6	--	--	--	--	--	--
1981	17.4	16.2	33	12.6	11.2	7	12.6	11.3	5	--	--	--	--	--	--
1982	21.6	18.1	30	15.6	13.9	14	16.6	11.9	3	--	--	--	--	--	--
1983	20.2	16.0	48	19.6	18.0	24	11.5	11.4	7	--	--	--	--	--	--
1984	17.3	17.1	27	13.0	12.9	6	12.6	11.6	5	--	--	--	--	--	--
1985	12.6	12.4	9	12.7	12.2	4	9.2	8.9	0	--	--	--	--	--	--
1986	12.4	11.7	5	10.5	8.8	1	8.1	7.6	0	--	--	--	--	--	--
1987	9.8	8.6	1	10.7	9.5	1	8.1	6.3	0	--	--	--	--	--	--
1988	11.4	10.4	3	11.8	10.5	2	8.5	8.4	0	12.3	11.8	9	--	--	--
1989	9.8	9.6	2	14.0	13.1	2	10.0	8.4	1	14.0	12.2	5	--	--	--
1990	9.5	9.4	1	9.8	9.0	1	8.8	8.0	0	13.0	11.6	11	--	--	--
1991	9.5	8.1	0	8.9	8.4	0	6.7	6.4	0	11.5	9.8	3	--	--	--
1992	9.0	8.8	0	10.9	10.8	2	7.1	7.0	0	10.4	9.5	2	--	--	--
1993	8.2	7.6	0	10.0	9.7	2	8.8	5.1	0	10.4	9.9	2	--	--	--
1994	8.4	8.3	0	9.4	8.6	0	5.8	5.7	0	11.3	11.0	2	--	--	--
1995	9.2	7.6	0	8.4	7.4	0	6.7	6.3	0	9.0	8.4	0	--	--	--
1996	11.0	9.6	3	8.9	8.7	0	7.7	6.9	0	10.8	10.5	3	--	--	--
1997	7.1	6.8	0	7.3	7.1	0	5.9	4.9	0	7.3	7.0	0	--	--	--
1998	9.3	8.2	0	9.5	8.4	1	--	--	--	9.4	7.9	0	8.1*	7.7*	0*
1999	6.6	5.9	0	8.2	7.8	0	--	--	--	7.5	6.5	0	10.1	7.6	1
2000	5.2	4.7	0	5.8	5.4	0	--	--	--	5.2	4.8	0	7.2	5.5	0
2001	6.2	5.7		6.1	5.7	0	--	--	--	5.4	5.2	0	9.8	7.7	1
2002	--	--	--	4.7	4.6	0	--	--	--	5.4	4.7	0	6.4	5.8	0

* Incomplete year of data. In 1998 Turnagain station began operations in mid-October.

Annual second maximum concentrations recorded at the four sites with the longest continuous data records (Benson, Garden, Sand Lake and Seward Highway) are plotted in Figures III.B.3-5(a-d). Available data from each site during the twenty year period 1983 -2002 are plotted. During this period, the annual second maximum CO concentration declined by nearly 0.5 ppm per year at each station. During the 20-year period, concentrations at the Benson station declined by 68% and by 61% at the Garden station.

Figure III.B.3-5(a)
Trend in 2nd Maximum 8-hour Concentration at Benson Station (1983 - 2001)

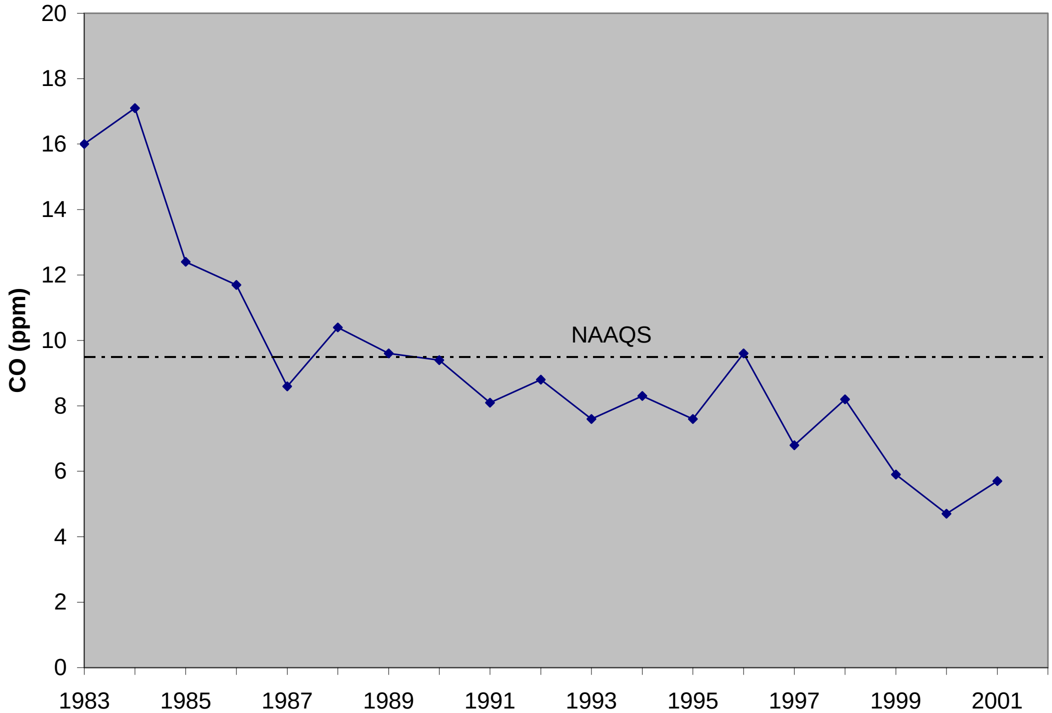


Figure III.B.3-5(b)
Trend in 2nd Maximum 8-hour Concentration at Garden Station (1983 - 2002)

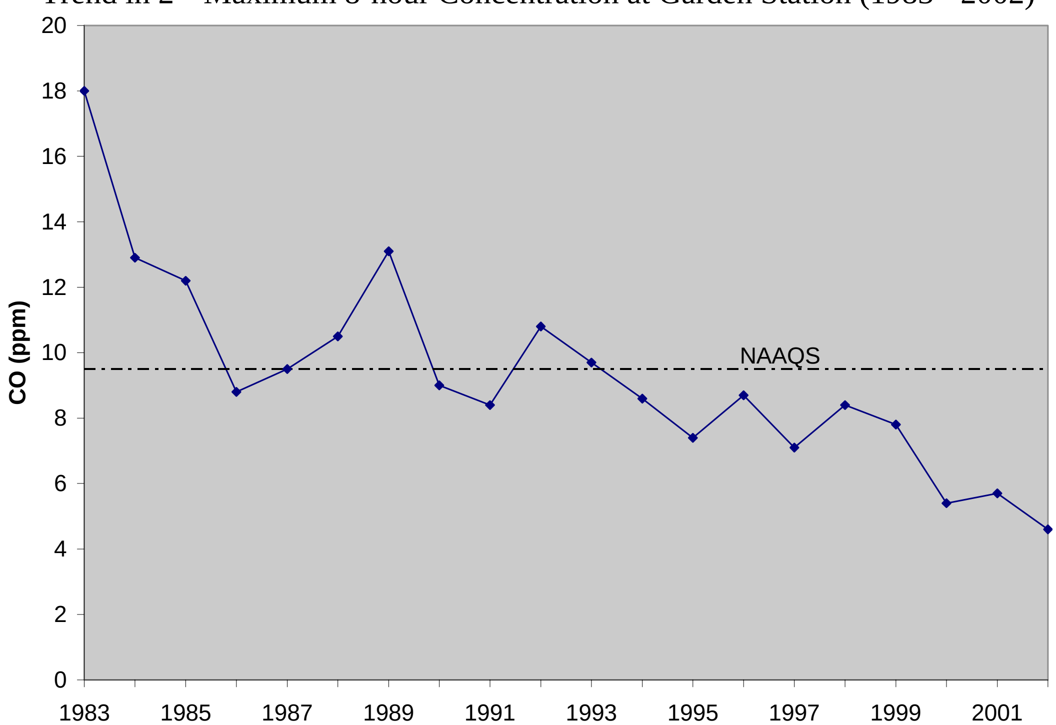


Figure III.B.3-5(c)
Trend in 2nd Maximum 8-hour Concentration at Sand Lake Station (1983 - 1997)

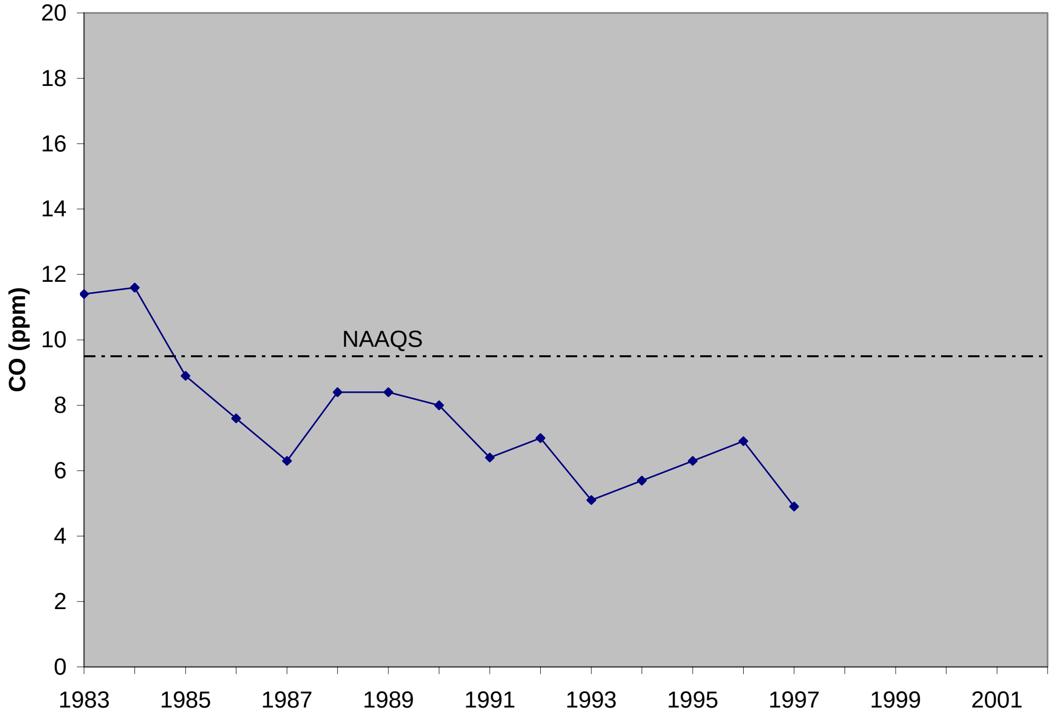
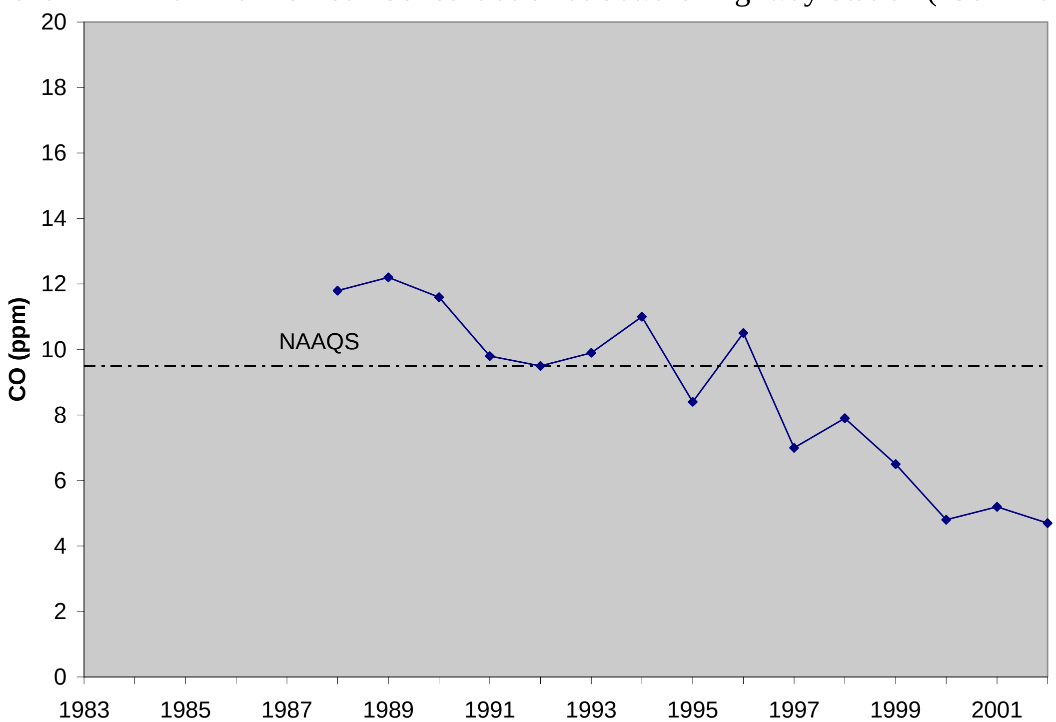


Figure III.B.3-5(d)
Trend in 2nd Maximum 8-hour Concentration at Seward Highway Station (1987- 2002)



Population Growth

Located in a state that has been historically subject to short-term cycles of economic booms and recessions, the Anchorage area has enjoyed a slowing, but stable pattern of long-term population growth in recent years. Over the last 50 years, Anchorage has increased in population an average of about 46,000 persons for each of the last five decades. However, the growth in the 1990's and the first few years in the new millennium has been slower than the growth that occurred during economic booms in the early 1970s and then again in the early 1980s. Table III.B.3-6 summarizes historic growth.

Table III.B.3-6

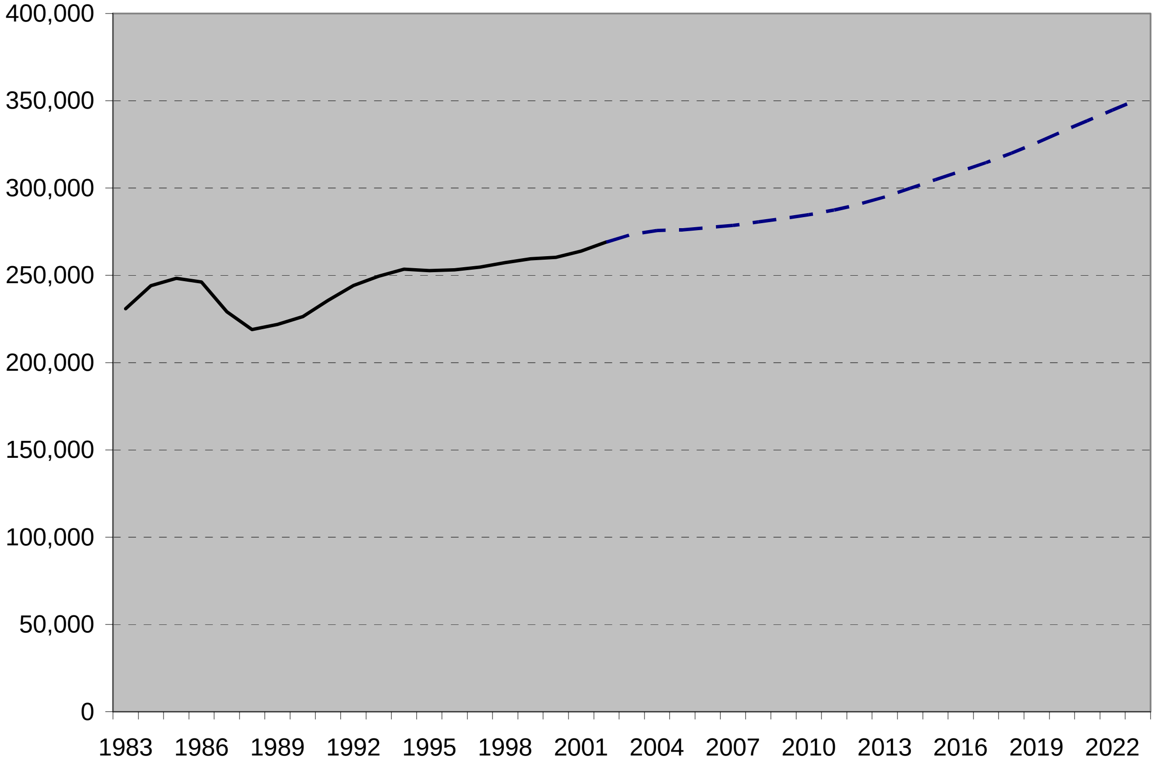
Historic Population Growth in Anchorage, Alaska

Year	Anchorage Population		Year	Anchorage Population
1950	30,060		1990	226,338
1960	82,833		1991	235,626
1970	126,385		1992	244,111
1980	174,431		1993	249,440
1981	187,761		1994	253,503
1982	204,226		1995	252,729
1983	230,847		1996	253,234
1984	244,030		1997	254,752
1985	248,263		1998	257,260
1986	246,139		1999	259,391
1987	229,117		2000	260,283
1988	218,979		2001*	263,940
1989	221,870		2002*	269,070

Sources: U.S. Census, Alaska Department of Labor (ADOL).
* ADOL estimate, January 28, 2003 news release

The University of Alaska Institute of Social and Economic Research (ISER) periodically prepares population growth forecasts for Anchorage. The most recent forecast was published in October 2001. These forecasts were used in the preparation of the CO emission inventory projections contained in this maintenance plan. ISER estimates a future annual population growth rate of less than 1% per year between 2000 and 2010. Between 2010 and 2025, the estimated growth rate increases to 1.6% per annum. The historic population trend and growth forecast for Anchorage is presented in Figure III.B.3-6. ISER estimates that the Anchorage population will grow from 273,400 in 2003 to 350,700 in 2023, the last year covered in the maintenance plan.

Figure III.B.3-6
Historic Anchorage Population Growth and Forecast
1983 - 2023



III.B.4. Carbon Monoxide Monitoring Program

Although emission projections are used to track reasonable further progress (RFP), it is actual ambient air quality monitoring data that determine whether or not an area meets the NAAQS. The difficulty with using ambient monitoring data to assess trends is the fluctuation in pollution concentrations caused by daily, weekly, and yearly variations in meteorological conditions, traffic levels, and other factors. However, it is important to monitor and compare ambient air quality concentrations to modeled emission projections to determine if the projections are reasonable and credible. Section 110(a)(2)(B)of the CAAA (42 U.S.C. 7410(a) (2) (b)) requires that each implementation plan submitted to EPA provide for the establishment and operation of "appropriate devices, methods, systems, and procedures necessary to monitor, compile, and analyze data on ambient air quality."

The Anchorage CO monitoring network is currently comprised of four sampling stations. The MOA uses TECO48 CO analyzers at each station (Figure III.B.4-1). These instruments meet all specifications required by the Environmental Protection Agency (EPA) for ambient CO monitoring and are designated by the EPA as a "reference method" for CO.

Figure III.B.4-1

TECO 48 CO Analyzer with Strip Chart Recorder
and Data Acquisition System at Benson Monitoring Station

The monitoring network is operated 24 hours a day from October 1 through March 31. Hourly averages of CO levels are provided from each station in the network. These data are uploaded to a central computer every weekday. Data are submitted to EPA on a quarterly basis to be included in a nationwide air quality database known as AIRS (Aerometric Information and Retrieval System). CO monitoring is conducted in conformance with guidelines established in federal regulations. Calibrations are performed regularly in accordance with EPA guidance and instrument manufacturer recommendations. Third party instrument performance audits are conducted by EPA and/or ADEC quarterly.

The locations of the stations in the CO monitoring network are described in Table III.B.4-1. The purpose of this network is to characterize the range of CO exposures experienced by Anchorage residents. Monitoring stations are located in neighborhoods (to characterize residential exposures) and near busy mid-town intersections (to characterize CO exposures in areas with heavy traffic). By analyzing pollution concentration trends over time, CO monitoring stations can also serve to assess the effectiveness of strategies designed to reduce air pollution emissions and improve air quality. Each monitoring station was selected in accordance with guidelines established by the EPA. As more has been learned about the nature of the CO problem in Anchorage, more emphasis has been placed on monitoring CO levels in neighborhoods. In 2001 the MOA decommissioned a long running monitor station at Spenard Road and Benson Boulevard (known as the Benson site) in favor of placing a new monitor in a residential area in the Jewel Lake area in southwest Anchorage.

Table III.B.4-1

Description of Anchorage CO Monitoring Sites

Location	Site Description
7th & C Street (discontinued)	This station was located mid-block between 6th and 7th Avenue on C Street. Monitoring began here in 1973 and was discontinued in 1995. The last exceedance at this site was recorded in 1990.
Benson (discontinued)	Monitoring began at this micro-scale site on the southwest corner of Spenard Road and Benson Blvd in 1978. The CO data collected here are similar, but of slightly lower magnitude, to data collected at the Seward Highway station. This station was decommissioned in December 2001.
Garden	Monitoring began at this neighborhood location at 16th and Garden Street in 1979. On occasion, concentrations at this "neighborhood-scale" site exceed those measured at micro-scale monitors located near major traffic corridors.
Sand Lake (discontinued)	Monitoring began at this neighborhood-scale site in 1980 and was discontinued in March 1998. This station was located on Raspberry Road approximately 0.3 miles east of Jewel Lake Road in west Anchorage. The last exceedance was recorded here in 1989.
Seward Highway	Monitoring began at this micro-scale site, located on the southwest corner of the intersection of Benson Blvd. and Seward Highway, in October of 1987. Over the past 15 years, this station has recorded the most exceedances of the NAAQS. This site last violated the NAAQS in calendar year 1996 when three exceedances were measured.
Turnagain	Monitoring began at this neighborhood-scale station in October 1998. It was established as a result of a special saturation monitoring study conducted in the winter of 1997-98. CO concentrations measured here were the highest of the twenty sites monitored during the study. Turnagain exceeded the NAAQS once in 1999 and 2001. Thus far no more than one exceedance per year has been observed here and this site remains in compliance with the NAAQS.
Jewel Lake	Monitoring began here in October 2002. Although monitoring data are limited, it appears that CO concentrations here are lower than the other three sites (Garden, Seward Highway, and Turnagain) currently in operation.

The locations of the monitoring sites are shown on the maintenance area boundary map (Figure III.B.2-1) in Section III.B.2.

Continued Monitoring

The Clean Air Act Section 110(a)(2)(B) (42 U.S.C. 7410(a)(2)(B)) requires implementation plans to provide for the "establishment and operation of appropriate devices, methods, systems, and procedures necessary to monitor, compile, and analyze data on ambient air quality…." The MOA is committed to the continued operation of this network. Periodic saturation studies have been conducted by the MOA to assess the adequacy of the monitoring network. The most recent study in 1997-98 resulted in the establishment of a new neighborhood monitoring site, called Turnagain Station, in west Anchorage. Any changes to the monitoring network are discussed in advance with the ADEC and EPA Region 10. The EPA Administrator has final authority on the placement of monitoring sites.

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III.B.5 Transportation Control Strategies

Attainment Plan Control Measures

The MOA and ADEC have implemented a number of CO control measures as result of previous attainment plans. These include the vehicle inspection and maintenance (I/M) program, the Share-A-Ride and Vanpool programs, the ethanol-blended gasoline program, and public awareness and incentive programs that encourage the use of engine block heaters to reduce cold start CO emissions. The current status of these programs is described in the sections below. The CO reduction effectiveness of these programs was estimated for calendar year 2002 using a MOBILE6-based modeling approach.

Vehicle Emissions I/M Program

Program Description – The MOA I/M program was implemented in July 1985 as a primary control measure in the 1982 air quality attainment plan. The MOA administers the program in cooperation with the ADEC. The basic design includes a decentralized test and repair program with both idle and 2500 rpm tests. These basic elements of the program design have remained unchanged since 1985. According to a recent independent evaluation by Sierra Research, the Anchorage I/M program was rated among the best decentralized programs in the country.[4]

The original program included an annual testing requirement for light duty vehicles, model year 1975 or newer. The program now includes a biennial-testing requirement for vehicles 1968 and newer. Originally only vehicles registered within the MOA were required to participate in the program. Vehicles that commute to the MOA on a regular basis now must also comply with I/M requirements. ADEC is implementing an enforcement program, using Congestion Mitigation / Air Quality funding authorized in Anchorage's latest transportation improvement program, to identify commuting vehicles that may be evading I/M requirements.

Cut points. CO emission cut points in Anchorage are generally more stringent than the federal warranty limit of 1.2%. Cut points by vehicle category are:

Vehicle Type	Model Year	CO Standard
Light-duty gasoline vehicles	1981-1993	1.0%
Light-duty gasoline vehicles	1994 and newer	0.5%
Light-duty gasoline trucks	1984-1993	1.0%
Light-duty gasoline trucks	1994 and newer	0.5%
Heavy-duty gasoline trucks	1994 and newer	1.0%

Anchorage has also implemented a hydrocarbon cut point of 220 ppm for 1994 and newer vehicles.

Test Equipment and Procedures. Beginning in January 2000, BAR90 test analyzer systems in the MOA were replaced with emission inspection systems with BAR97-grade hardware. Although these systems do not perform functional gas cap or loaded mode testing, the BAR97 upgrade provides significant improvements in measurement accuracy particularly at lower concentrations of CO. The new systems include dilution correction capability that reduces the possibility of a vehicle being falsely passed due to accidental or intentional dilution of the exhaust gas being analyzed. The new emission inspection system also includes an enhanced Internet-based communications system and Vehicle Information Database (VID) that facilitates the proper identification of the vehicle being tested. This system also provides for on-line oversight and scrutiny of the mechanics conducting emission tests. Presumably, these upgrades have resulted in an overall improvement in the identification of vehicles requiring repair, improved the quality of the emission tests, and consequently reduced CO emissions. In addition, an advisory On Board Diagnostics (OBD) program was implemented on January 1, 2000. If a tested vehicle had an OBD failure, vehicle owners were notified and advised to obtain additional diagnosis and possibly repair. Mandatory OBDII testing was implemented on July 1, 2001, ahead of the EPA mandated implementation date.

Improvements in Enforcement Effectiveness - Working with ADEC, the MOA recently implemented a number of changes to improve the effectiveness of enforcement against program evaders. ADEC conducted parking lot surveys in Anchorage[5] that suggested that 10% of the vehicles operating in Anchorage may be evading I/M requirements. Since 1996, the MOA has stepped up efforts to identify these evaders and gain their compliance. In calendar year 2002, the MOA issued 6,884 notices of violation (NOVs) and 476 citations. In contrast, in calendar year 1996, when Anchorage last violated the NAAQS, 2,600 NOVs and 36 uniform citations were issued.[6] In addition, starting in January 2000, in cooperation with ADEC, the MOA implemented a windshield sticker program that allows for easier and more obvious identification of vehicles that may be evading I/M requirements. The windshield sticker program supplements the registration denial program already in place. The windshield sticker program is discussed in 18 AAC 52.020 and 18 AAC 52.025.

Enhancements in Mechanic Training and Certification - Mechanic training and certification has been a part of the MOA I/M program since its inception. I/M mechanics are required to complete classroom and hands-on training and pass a test prior to being certified to perform tests in the MOA program. More recently, the MOA worked in consultation with ADEC to implement an additional technician training and certification program (TTC). TTC was included as a contingency measure in the MOA element of the SIP. Violations in 1996 triggered this measure. The MOA worked with ADEC to develop a comprehensive 40-hour training course. In addition, 8 additional courses were conducted, most of which focused on vehicle diagnostics and repairs for vehicles with advanced electronic control systems.

Estimated CO Reduction – A MOBILE6-based method CO model was used to estimate the CO reduction benefits of the I/M program in 2002. Modeled benefits of the MOA program exceed the basic I/M performance standard stipulated in the CAAA. In 2002, the I/M program reduced area-wide CO emissions in Anchorage by an estimated 13.8 tons per day, about 13% of total vehicle emissions. Attributes of the MOA program are summarized in Table III.B.5-1.

Table III.B.5-1

Attributes of Anchorage I/M Program (Year 2002)

Program Element	**Year 2002 Anchorage Program**
Network type	Decentralized
Start date	July 1, 1985
Inspection frequency	Biennial
Model year coverage	1968 and newer
Vehicle type coverage*	LDGV, LDGT1, LDGT2, HDGV
Tailpipe test type	Two-speed idle
Emission cut points	More stringent than federal limits
Under hood inspection	Comprehensive visual and functional checks
Pre-1981 stringency	23%
Waiver rate	0%
Compliance rate	90%
Assumed program effectiveness (relative to centralized)	85%
OBDII checks	Implemented July 2001
% Reduction in vehicle emissions (2002)	12.9%
Estimated CO Reduction in Year 2002	13.8 tons per day

*LDGV = light-duty gasoline vehicles, LDGT = light-duty gasoline trucks, HDGV = heavy-duty gasoline trucks.

Ethanol-blended Gasoline Program

Program Description – The CAAA mandated the use of oxygenated fuel in all CO nonattainment areas during the portion of the year prone to CO violations. The State of Alaska adopted the first regulations implementing this requirement in July 1992. These regulations required the use of oxygenated gasoline in the MOA between November 1 and March 1. These regulations did not specify which type of oxygenate (e.g., ethanol or methyl tertiary butyl ether) had to be used to meet the requirement. Fuel suppliers in Alaska opted to utilize MTBE to meet the requirement during the winter of 1992-93.

Soon after the introduction of MTBE, the MOA and the ADEC began receiving complaints about odor, nausea and other possible health effects from concerned citizens in the MOA. Concern in the MOA and Fairbanks about MTBE was sufficient to prompt the Commissioner of ADEC, the Governor, and the Alaska Congressional Delegation to request an evaluation of complaints associated with the introduction of MTBE. These requests led to an epidemiological study by the Centers for Disease Control and Prevention with the collaboration of the Alaska Department of Health and Social Services and ADEC. In July of 1993, the EPA sponsored a workshop in Falls Church, Virginia to discuss preliminary findings from the Fairbanks study. A subsequent meeting was held in December 1993 in Research Triangle Park, North Carolina where the Alaska Division of Public Health and the Center for Disease Control and Prevention recommended additional MTBE health studies, but these studies were never funded. Based on citizen complaints received during the winter of 1992-93 and unresolved health issues related to the use of MTBE in gasoline, the MOA opted to terminate the MTBE oxygenate program. In August 1993, the MOA Assembly adopted a resolution not to implement MTBE during the winter of 1993-94 and placed a moratorium on its use until scientific studies could demonstrate that MTBE did not have an adverse impact on public health. MTBE has not been used in the MOA since.

In January 1995, the MOA began using ethanol instead of MTBE to meet the oxygenate requirement. The introduction of ethanol was met with few complaints. Ethanol-blended gasoline has been used each subsequent winter in Anchorage through the winter of 2002-2003.

Estimated CO Reduction – The CO reduction benefit of the ethanol-blended gasoline requirement in 2002 was estimated using a MOBILE6-based modeling method. According to the model, 2002 CO emissions were reduced by 9.0 tons per day, about 9% of total mobile source emissions. Emission benefits from this program have been declining over time due to the increasing proportion of vehicles with fuel injection and computer-controlled adaptive learning systems.

Share-A-Ride/ Vanpool Programs

Program Description – Carpooling was first identified as a CO control strategy in the 1982 MOA air quality plan. Early efforts to encourage carpooling were largely ineffective until the program was reorganized in 1987. The number of carpoolers participating in the program grew from 188 in 1987 to 419 in 2002.[7] In addition to promoting and coordinating carpools among private vehicle owners, the MOA-run Share-A-Ride program has purchased vans for use in a growing van pooling program that serves long distance commuters from the Mat-Su Valley, Eagle River, and Girdwood. Congestion Mitigation and Air Quality funding from the Federal Highway Administration was used to purchase eight vans at the beginning of the program in 1995. By 2002, a total of 21 vans were operating, serving a total of 270 vanpoolers.[8] Transit marketing has been an on-going program within the municipality. Television, radio and print media have been used to advertise the advantages of using the People Mover public transportation system.

Estimated CO Reduction – In the year 2002, based on program statistics, the carpooling and vanpooling components of the Share-A-Ride program eliminated approximately 500 cold starts and 5,000 miles of travel per day from the Anchorage roadway network. This resulted in an estimated CO reduction of 0.2 tons per day, approximately 0.2% of the total motor vehicle emission inventory.

Promotion of Engine Block Heater Use Prior to Vehicle Cold Starts

Program Description - Testing performed as part of the Alaska Cold Start and Idle Emission Study during the winters of 1998-99 and 2000-2001 showed that the use of an engine block heater reduced CO emissions by an average of 57% over the course of a 10-minute cold start and idle.[9] Survey data show that over three-quarters of the vehicles in the MOA are equipped with block heaters.[10] Because cold starts and warm-up idling make up such a large portion of Anchorage's CO emissions, particularly in residential neighborhoods, significant reductions could be realized if motorists were convinced to use their engine block heaters prior to their morning commute.

Beginning with the winter of 1999-2000, television commercials, radio advertising, and newspaper inserts have been used to promote the advantages of using a block heater. In addition to reducing air pollution, using a block heater results in easier start-ups, reduced engine wear-and-tear, and a shorter time for the heater and defroster to work. All of these advantages have been emphasized in campaigns over the past several winters.

In addition, the MOA and ADEC have provided additional incentives to encourage residents to plug-in. Over 3,000 free programmable electrical timers, designed to turn block heaters on two-to-three hours prior to the morning commute have been distributed to Anchorage residents over the past several winters. During the winter of 2002-2003, residents who owned vehicles without block heaters could have them installed for a nominal charge of $25. They also received a timer and extension cord as part of the plug-in package.

Annual telephone surveys suggest that the public awareness and incentive programs have had a positive effect on block heater usage. Residents who have taken advantage of the programmable timers and/or block heater installations have a greater inclination to plug-in. Among the general populace, even those who have not received incentives, survey data suggest that plug-in rates have increased as a result of TV, radio and print media advertising.

Estimated Reduction - Telephone surveys[11,12,13] were conducted at the conclusion of each winter's campaign to assess the success of the campaign among Anchorage residents. Over 70% of survey respondents stated that they had seen or heard the television or radio ads. Survey results suggest that plug in rates increased from about 10% before the campaign began in October 1999 to about 20% by the end of the winter of 2000-2001. Survey results for the winter of 2002-2003 were confounded by an extremely mild winter. Although the survey suggested that residents had a greater inclination to plug-in when temperatures fell below 20 ºF, they had little opportunity to act on this inclination because of the mild weather. Most winters the daily minimum temperature routinely falls below 20 ºF. In 2002-2003, however, the temperature fell below 20 ºF on less than one-third of the days. Because telephone polling is done only when the temperature falls below 20 ºF it was difficult to determine plug-in rates from the survey data. The MOA and ADEC also suspected that some residents may have fallen out of the habit of plugging-in after long periods of mild weather. For that reason, the plug-in rate for morning commuters in 2002 was conservatively estimated to be 20%, unchanged from 2000-2001.

In 2002, on an area-wide basis, the use of engine block heaters is estimated to result in an overall CO reduction of 1.5 tons per day. This amounts to a 1.8% reduction in area-wide vehicle emissions. The impact of block heater use in residential areas is greater because cold start emissions are a more significant part of total emissions. For example, in the one square kilometer area surrounding the Turnagain monitor, plugging-in reduces total vehicle emissions by an estimated 5.3%. Approximately half of this reduction is attributed to an increase in plug-in rates between 1999 and 2001.

Combined Impact of Control Programs on Base Year 2002 CO Emissions

In the year 2002, the combined reduction of the four CO control programs described above was 24.5 tons per day. Reductions are summarized in Table III.B.5-2

Table III.B.5-2
Combined Reduction from Locally Implemented CO Control Programs in Anchorage (2002)

Control Program	**CO Reduction (tons per day)**
I/M program	13.8
Ethanol blended gasoline	9.0
Share-A-Ride / Vanpool Programs	0.2
Engine block heater usage	1.5*
Cumulative Benefit of Control Measures	**24.5**
% Reduction in Motor Vehicle Emissions	**21%**

* Approximately half of the reduction from block heater usage (0.75 tons per day) is attributed to increased plug-in rates from public awareness and promotional programs.

Stationary Source Program

The CAAA section 172 (c) requirements for nonattainment areas do not apply to maintenance areas. The requirements for reasonable further progress, identification of certain emissions increases and other measures needed for attainment do not apply, because these measures only have meaning for areas not attaining the standard. Under this maintenance plan, the requirements of CAAA Part D, New Source Review (NSR) no longer apply as they did under nonattainment. Upon redesignation to maintenance, the prevention of significant deterioration (PSD) program replaces the NSR program requirements for major stationary sources. Section 302 of the CAAA (42 U.S. C. 7602) defines a major stationary source as any stationary facility or source of air pollutants that directly emits, or has the potential to emit, 100 tons per year of any pollutant.

Given the long twenty year timeframe evaluated in this maintenance plan, a growth allowance has been applied to stationary source emissions. Stationary source emissions increase in proportion to projected population growth. This is a conservative assumption; no future improvements in CO emission control technology for these sources have been assumed.

Permits for construction and operation of new or modified major stationary sources within the maintenance area must be approved through the PSD program. Within the MOA, ADEC is responsible for issuing construction and Title V operating permits. ADEC has incorporated the requirements for PSD in 18 AAC 50, Article 3.

Control Measures to be Implemented during the 2004 – 2023 Maintenance Plan Period

Section III B.6 contains an analysis of Anchorage maintenance prospects during the 2004-2023 maintenance plan period. This analysis indicates that the ethanol-blended gasoline program is no longer necessary for continued compliance with the NAAQS. Moreover, modeling indicates that the CO reductions provided by this control measure decline rapidly over time. (See discussion in Section III B.6.) For these reasons, the State does not intend to implement the ethanol-blended gasoline program during the 2004-2023 maintenance plan period. Although the ethanol-blended gasoline program will cease to be a primary measure in the Anchorage plan, it will remain as a contingency measure as required by Section 175A.(d) of the CAAA. This section states that contingency measures are to be implemented "to correct any violation of the standard, which occurs after the redesignation of the area as an attainment area."

The I/M, Share-A-Ride and Engine Block Heater Promotion Programs will continue indefinitely. The CAAA require the submission of a plan revision eight years after redesignation as an attainment area. The MOA intends to submit a subsequent plan revision to ADEC for incorporation in the SIP to meet this requirement. When the revision is submitted, the efficacy and need for these control programs will be re-evaluated. The MOA may opt to re-evaluate the need for these control programs before the mandated 8-year revision. If so, a plan revision will be submitted at that time.

Section III.B.6 will discuss prospects for continued compliance in Anchorage during the 2004-2023 maintenance plan period. The projections presented in Section III.B.6 suggest that first few years (2004, 2005, and 2006) of the planning period will have the highest emissions and therefore the greatest probability of exceeding the NAAQS. For this reason the control programs included in this maintenance plan play an important role in ensuring continued compliance. Estimated benefits from control programs included in the maintenance plan are presented in Table III.B.5-3 for calendar year 2004.

Table III.B.5-3
Projected Reductions from Locally Implemented CO Control Programs in Anchorage (2004)

Control Program	**CO Reduction (tons per day)**
I/M program	13.9
Share-A-Ride / Vanpool Programs	0.2
Engine block heater usage	1.4*
Cumulative Benefit of Control Measures	**15.5**
% Reduction in Motor Vehicle Emissions	**17%**

* The engine block heater benefit was computed assuming no increase in the block heater plug-in rate from base year 2002. This is a conservative assumption; beginning in the fall of 2002, the MOA and ADEC have been offering incentives and promotions to encourage "plugging in." These include providing block heater installations for $25 (about 15% of actual cost) and free timers. During the winter of 2002-2003 approximately 2,000 block heaters were installed and 2,000 free timers were distributed to Anchorage residents who already had block heaters. The program is slated to continue through 2006.

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III.B.6 Modeling and Projections

EPA, based on its regulatory guidance, prefers to use dispersion modeling techniques to demonstrate attainment and maintenance of air quality standards in State Implementation Plans. In May of 2002, representatives from the Municipality of Anchorage, Fairbanks North Star Borough and the Alaska Department of Environmental Conservation met with EPA Region 10 staff to discuss the modeling techniques and approaches to be used in maintenance demonstrations in Anchorage and Fairbanks. Meeting participants reviewed the results of an area wide modeling feasibility analysis performed by a consultant on behalf of ADEC and MOA[14], and concluded that currently available area wide dispersion models lack the capability to adequately address the meteorological extremes encountered in Anchorage and Fairbanks. Also, the existing meteorological database in Anchorage and Fairbanks may not have the microscale meteorological parameters needed for adequate model performance for regulatory purposes. Therefore, after evaluating several options, the participants settled on the use of a probabilistic rollback approach in the maintenance demonstration.

Probabilistic Rollback Modeling / Maintenance Demonstration

The probabilistic rollback modeling procedure entails regression analyses of observed second 8-hour maximum CO concentrations at the Garden and Seward Highway monitoring stations in Anchorage.[§] Using commonly accepted statistical techniques, the CO trend and upper-bound 90th percentile prediction interval were computed for each site. In theory, 90% of observed second maximum concentrations should fall below this interval. In this probabilistic analysis, the upper-bound 90th percentile prediction interval values for 2002 serve as the design value (DV) for each site. Previous attainment demonstrations evaluated attainment prospects on an area-wide basis; this plan will evaluate maintenance prospects for three individual “micro-inventory areas.” These micro-inventory areas are the three separate one square kilometer areas surrounding the Garden, Seward Highway and Turnagain monitoring stations. The computed DV from each monitoring station is then used along with gridded emission inventory projections to evaluate prospects for maintaining the NAAQS at each site. The probabilistic method used in this plan provides a more rigorous assessment of attainment or maintenance prospects than what is legally required to demonstrate maintenance of the NAAQS.

The probabilistic rollback procedure consists of 5 basic steps:

1. Compute the base year 2002 DV using the 90th percentile prediction interval.
2. Compile the 2002 base year CO inventory and determine the quantity of emissions generated in the one square kilometer area surrounding each monitoring station during a 24-hour “design day.” A design day is defined at a winter weekday when a CO violation is most likely to occur. Modeling assumptions (i.e. ambient temperature, traffic activity, etc.) reflect conditions on the design day.

§ There were insufficient data available to perform this type of analysis for the Turnagain station. The first full year of operation there was 1999 and only four data points (the second maximum concentrations for calendar years 1999-2002) were available to for the regression analyses. In contrast, 15 years of data were used to perform this analysis for Garden and Seward Highway. The MOA, ADEC, and EPA agreed that the highest second maximum concentration measured at the Turnagain site during the past three calendar years should serve as the DV. This is the traditional method of determining the DV, and it was utilized in all previous Anchorage air quality plans.

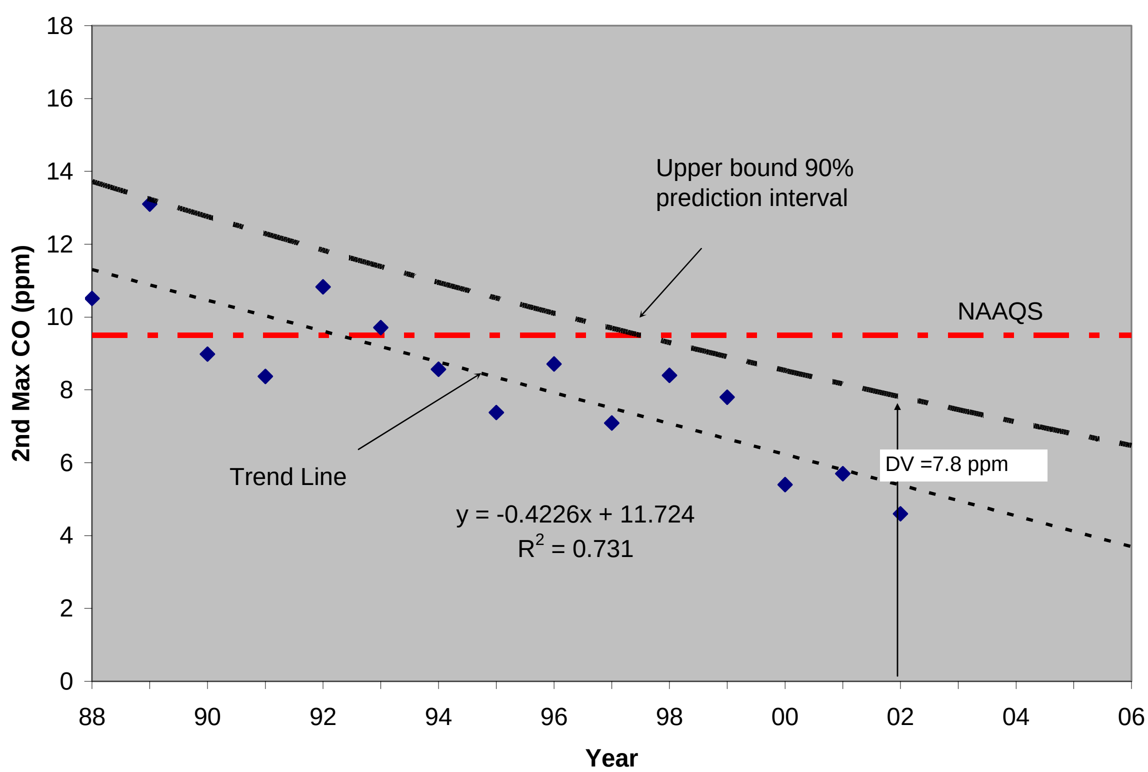
3. Using the rollback equation, 2002 DV and assumed background CO concentration, determine the emission reduction required to achieve attainment or, conversely, the increase in emissions that can occur and still maintain attainment of the NAAQS.
4. Using the rollback equation, compute the quantity of emissions that can be generated within each grid on a design day and still remain in compliance with the NAAQS.
5. Using the best available data and assumptions regarding growth in population, vehicle miles traveled and trip starts within each grid, project the quantity of CO emissions generated on a design day in 2004, 2006, 2008, 2010, 2013 and 2023 to assess whether compliance of the NAAQS will be maintained throughout the 2004-2023 maintenance plan period at the Garden, Seward Highway and Turnagain stations.

A description of how this procedure was applied in the one square kilometer areas surrounding the Garden, Seward and Turnagain monitoring stations follows.

Step 1: Computation of DVs for Garden, Seward Highway and Turnagain Monitoring Stations

The probabilistic approach referred to above was used to compute the DV for the Garden and Seward Highway monitors. Results of the statistical procedure employed to compute the DV for the Garden station are illustrated in Figure III B.6-1.

Figure III.B.6-1
Computation of Probabilistic DV at Garden Station



A plot of the second 8-hour maximum concentrations measured at Garden between 1988 and 2002 is shown in Figure III B.6-1. The best fit trend line and upper bound 90th percentile prediction interval is also shown. The best fit trend line was determined by linear regression (R^2 = 0.73). The DV for base year 2002 is the computed value of 90th percentile prediction interval in 2002. At Garden this value is 7.8 ppm.

An identical approach was used to compute the 2002 DV for the Seward Highway station. Like Garden, the analysis was performed on 15 years of data collected between 1988 and 2002. The 2002 DV for the Seward Highway station is slightly lower than Garden. The computed DV is 7.1 ppm.

A different approach was used to determine the DV at the Turnagain station because only four years of second maximum data were available from this site. Although it is possible to compute a probabilistic DV with a limited sample size (i.e. N = 4), the 90th percentile prediction interval would be very large and the computed DV would not be statistically robust.** For this reason, the EPA, ADEC and MOA agreed that the DV at Turnagain should be the highest second maximum value observed at Turnagain in the past three calendar years (2000, 2001, or 2002). In the past three years the highest second maximum was 7.7 ppm and was observed in calendar year 2001. This value serves as the DV for Turnagain in this analysis.

There is some evidence that the Turnagain DV would be higher if more years of data were available and the DV was computed using the probabilistic method. When the past four years of data from Turnagain are compared to Garden on a rank-paired basis, the highest 8-hour average CO concentrations measured at Turnagain are 15 to 20% higher. This suggests that the 7.7 ppm DV assumed for Turnagain may be an underestimation of the 90th percentile DV. However, even if the DV at Turnagain is underestimated, EPA, ADEC and MOA believe that there is a sufficient margin of safety built into the maintenance demonstration process to provide 90% assurance of compliance. A preliminary analysis confirms that on-going compliance can be demonstrated at Turnagain with a DV equal to 9.2 ppm. This value is 18% higher than the DV at Garden and nearly 20% higher than the highest second maximum concentration ever measured at Turnagain.

Base year 2002 DVs are summarized for each monitoring station in Table III.B.6-1. Note that all DVs are below the 9 ppm NAAQS.

Table III.B.6-1
Year 2002 DVs at Garden, Seward Highway and Turnagain Monitoring Stations

Monitoring Station	2002 DV	Method of Computation
Garden	7.8 ppm	Probabilistic, 90th Percentile Prediction Interval
Seward Highway	7.1 ppm	Probabilistic, 90th Percentile Prediction Interval
Turnagain	7.7 ppm	2nd Highest 8-hour Maximum in 2000, 2001, 2002

** The computed DV would be 11.9 ppm using the probabilistic method. The highest observed second maximum in the past four years, 7.7 ppm, is more than 50% lower.

Step 2: Computation of Micro-area Emission Inventories for the Garden, Seward Highway and Turnagain Monitoring Stations

A gridded emission inventory comprised of 772 one-half by one-half kilometer grids was prepared for base year 2002 using an approach analogous to that used in the *Year 2000 Anchorage Carbon Monoxide Attainment Plan.* These 772 grids encompass all of the currently defined nonattainment area. The mobile source portion of these inventories was based on transportation activity outputs (e.g., volumes, speeds, number of trip starts) from the Anchorage Transportation Model.[††] These estimated transportation activity levels were used in conjunction with a "hybrid" MOBILE6 emission factor model to estimate mobile source CO emissions. MOBILE6 was used to estimate on-road travel emissions and locally-developed cold start emissions data from two studies conducted by Sierra Research were used to estimate warm-up idle emissions. MOBILE6 was run with supplemental FTP speed correction factors disabled to better simulate winter season driving behavior in Alaska. The Sierra Research studies used as the basis for mobile source modeling are discussed in more detail in Section III.B.3.

The Anchorage Transportation Model was also useful in providing key information for the area source inventory. The transportation model provided estimates of demographic parameters (population, employment, and housing stock) for each of the grids that were utilized to estimate area source activity (e.g. non-road sources, space heating, industrial activity, and electricity generation, fireplace and woodstove emissions). For example, the quantity of CO emitted from fireplace and woodstoves in a specific grid was proportional to the number of households in that grid. Other area source types, like commercial space heating emissions, were assumed to be a function of the amount of employment in each grid.

Micro-area inventories for the one square kilometer area surrounding the Garden, Seward Highway and Turnagain monitors were compiled by summing the CO emission estimates from the four one-half kilometer by one-half kilometer grids nearest each site. An aerial photo of the one square kilometer area surrounding the Turnagain station, along with some of the key activity parameters used to estimate emissions, is shown in Figure III.B.6-2.

†† The Anchorage Transportation Model was developed using the TransCad transportation demand model, calibrated to actual traffic counts in 1994. The most recent population and employment projections, developed by the University of Alaska Institute of Social and Economic Research, are used to estimate future year transportation activity levels.

Figure III.B.6-2 One Square Kilometer Area Surrounding Turnagain Station

Key Parameters and Activity Levels within 1 km^2 Turnagain Grid

Population = 2,814
Trip Starts per day = 5,945
Vehicle Miles Traveled per day = 10,266 miles

CO emissions compiled for the one square kilometer areas surrounding the Garden, Seward Highway and Turnagain station are shown in Table III.B.6-2.

Table III.B.6-2

Estimated Year 2002 CO Emissions in One Square Kilometer Areas Surrounding Garden, Seward Highway and Turnagain Monitoring Stations (all emissions in tons per day)

	Vehicle Emissions					
	Warm-up Idle	On-road Travel	Fireplaces & Woodstoves	Natural Gas Space Heating	Other	**TOTAL**
Garden	0.18	0.24	0.05	0.03	0.03	**0.53**
Seward Highway	0.41	1.47	0.02	0.08	0.06	**2.05**
Turnagain	0.26	0.19	0.09	0.02	0.02	**0.59**

(some rows may not sum precisely to total due to rounding)

Note that total CO emissions in the area surrounding the Seward Highway monitor are substantially higher than the Garden and Turnagain grids yet the DV at Seward Highway is the lowest of the three sites. The MOA hypothesizes that mechanical turbulence from high speed vehicle traffic in the area surrounding the Seward Highway station lowers ambient concentrations through mixing and dilution. A more extensive discussion can be found in Section III.B.3.

Step 3: Use Rollback Equation to Calculate Allowable Emission Increases at Each Monitoring Station

In previous Anchorage attainment demonstrations the rollback equation has been used to determine how much emissions must be reduced from design year levels to achieve compliance with the NAAQS. The required reduction was determined from the rollback calculation:

$$\%\ \text{reduction required} = \frac{DV - ppm_{std}}{DV - ppm_{bkg}} x100$$

where:

$DV =$ Computed design value for the design year
$ppm_{std} =$ 8-hour NAAQS for CO (9 ppm)
$ppm_{bkg} =$ background CO concentration

In these previous attainment demonstrations the DV has always been greater than the 9 ppm NAAQS. However in this maintenance demonstration, the DVs for all three monitoring stations are below 9 ppm. For example, the rollback equation for the Garden station, with a DV of 7.8 ppm, is:

$$\text{\% reduction required} = \frac{7.8 - 9.0}{7.8 - ppm_{bkg}} x100$$

From the equation above, it is evident that the % reduction required will be negative, meaning emissions can increase by some amount and compliance with the NAAQS can still be maintained. The equation above can be re-written as follows:

$$\text{\% allowable emission increase} = \frac{9.0 - 7.8}{7.8 - ppm_{bkg}} x100$$

The background concentration (ppm_{bkg}) in the above equation has not yet been defined. The background value yielding the lowest allowable increase in emissions to maintain compliance is zero. Note in the equation above, if the assumed background concentration is increased, allowable emissions increase. Thus the most conservative assumption for background, zero, was utilized in this maintenance demonstration. The allowable increase in emission at Garden is calculated as follows:

$$\text{\% allowable emission increase} = \frac{9.0 - 7.8}{7.8 - 0.0} x100 = 15.4\%$$

Thus, at the Garden station, emissions can increase from 2002 levels by 15.4% and still maintain compliance with the NAAQS. The DVs at the other two monitoring stations (Seward Highway and Turnagain) are also below the NAAQS. Allowable emission increases were calculated in like manner using their specific DVs. The allowable emission increase at Seward Highway is 26.8%, and at Turnagain, 16.9%.

Step 4: Calculate Quantity of CO Emissions that can be Generated in the One Square Kilometer Area Surrounding Each Monitoring Station and Still Attain the NAAQS

If the allowable emission increase at each monitoring station is known from Step 3, the quantity of CO that can be emitted in the one square kilometer areas surrounding the Garden, Seward Highway and Turnagain grids can be readily calculated from the 2002 gridded emission inventory. The results of these computations are shown in Table III.B.6-3.

Table III.B.6-3 Allowable Emissions in One Square Kilometer Area Surrounding the Garden, Seward Highway and Turnagain Monitoring Stations			
Monitoring Station	**2002 Emissions (tons per day)**	**Allowable Emission Increase**	**Allowable Emissions in 1 km^2 area surrounding monitoring station (tons per day)**
Garden	0.53	15.4%	**0.61**
Seward Highway	2.05	26.8%	**2.60**
Turnagain	0.59	16.9%	**0.69**

Again, the reader may note that allowable emissions in the heavy commercial area surrounding Seward Highway Station are roughly four times greater than those in the two residentially-oriented sites at Garden and Turnagain. The MOA hypothesizes that high volume and high speed vehicle traffic in the area surrounding Seward Highway mix and dilute CO emissions, resulting in lower ambient CO concentrations. The mixing provided by vehicle traffic is particularly important when natural atmospheric mixing from wind and/or convection is minimal. A more detailed discussion can be found in Section III.B.3.

Step 5: Prepare CO Emission Projections for 2004-2023 and Assess Prospects for Continued Compliance with the NAAQS

Prospects for continued compliance with the NAAQS during the 2004-2023 maintenance plan period were assessed by preparing emission projections for a design day in 2004, 2006, 2008, 2010, 2013, and 2023. The Anchorage Transportation Model was run for analysis years 2003, 2013, and 2023. Although mobile and area source activity levels in intervening years were interpolated, mobile source emission factors were estimated by running MOBILE6 for each and all years evaluated. Depending on the type of source, area source activity levels were projected to grow in proportion with housing stock and/or employment.

As was the case with the 2002 base year runs, MOBILE6 was run with supplemental FTP speed correction factors disabled to better reflect winter driving behavior in Anchorage. MOBILE6 was run with the assumption that the ethanol-blended (oxygenated) gasoline program would be terminated prior to 2004, the first year of the maintenance plan period. Runs for subsequent years also assumed that there would be no oxygenated gasoline program.

Cold start / warm-up idle emission were estimated using data collected by Sierra Research in testing programs conducted in 1998-99 and 2000-2001. These data provide a “snapshot” of warm-up idle emission rates in the year 2000. The effect of new emission control technology and fleet turnover on future emissions was estimated by running MOBILE6 at 2.5 miles per hour and computing the emission rate in grams per hour.[‡‡] The relative change in this MOBILE6 idle emission rate relative to the year 2000 was applied to the Sierra Research data to project idle emission factors through 2023.

‡‡ This method of estimating idle emissions is recommended in the *Users Guide to MOBILE6*.

Data collected by Sierra Research indicate block heater usage reduced emissions by 86 grams per cold start in the year 2000. In order to estimate block heater benefits in the future, the benefit in the year 2000 was discounted in proportion with the overall decline in idle emissions predicted by MOBILE6 (i.e., as idle emissions decline, the absolute benefit of plugging-in also declines). For example, the projected plug-in benefit falls from 86 grams in 2000 to 46 grams per cold start in 2013. Although the MOA and ADEC intend to continue and enhance current efforts to increase plug-in rates, plug-in rates were conservatively assumed to remain at year 2000 levels throughout the maintenance plan period.

Figures III.B.6-3(a-c) show projected emissions and prospects for continued compliance with the NAAQS at the Garden, Seward Highway and Turnagain stations. The incremental increase in emissions resulting from the elimination of ethanol beginning in 2004 is shown in the figures as well. In theory, for the Garden and Seward Highway stations, the probability of maintaining compliance with the NAAQS in any given year is 90% or greater if emissions remain below the allowable emission levels identified in the figures below. The probability of continued compliance at Turnagain was not computed because of limited data.

It is apparent that projected emissions in the areas surrounding all three monitoring sites will remain below allowable emission levels even with the elimination of the ethanol program. Thus, long term compliance seems likely at all three sites. It also appears that the likelihood of violating the NAAQS diminishes over time, particularly after 2006. Low sulfur gasoline is slated for introduction in 2007 and significant CO emission reductions are anticipated.

Figure III.B.6-3(a) Maintenance Prospects at the Garden Station through 2023

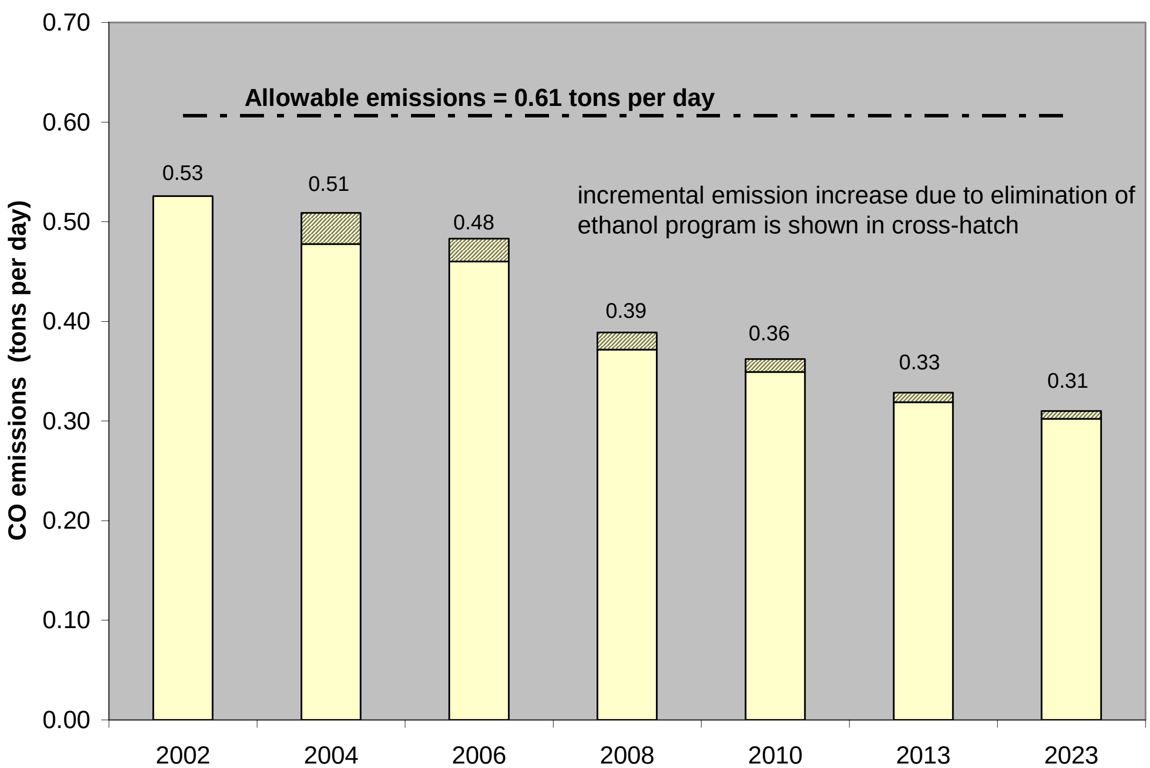


Figure III.B.6-3(b) Maintenance Prospects at the Seward Highway Station through 2023

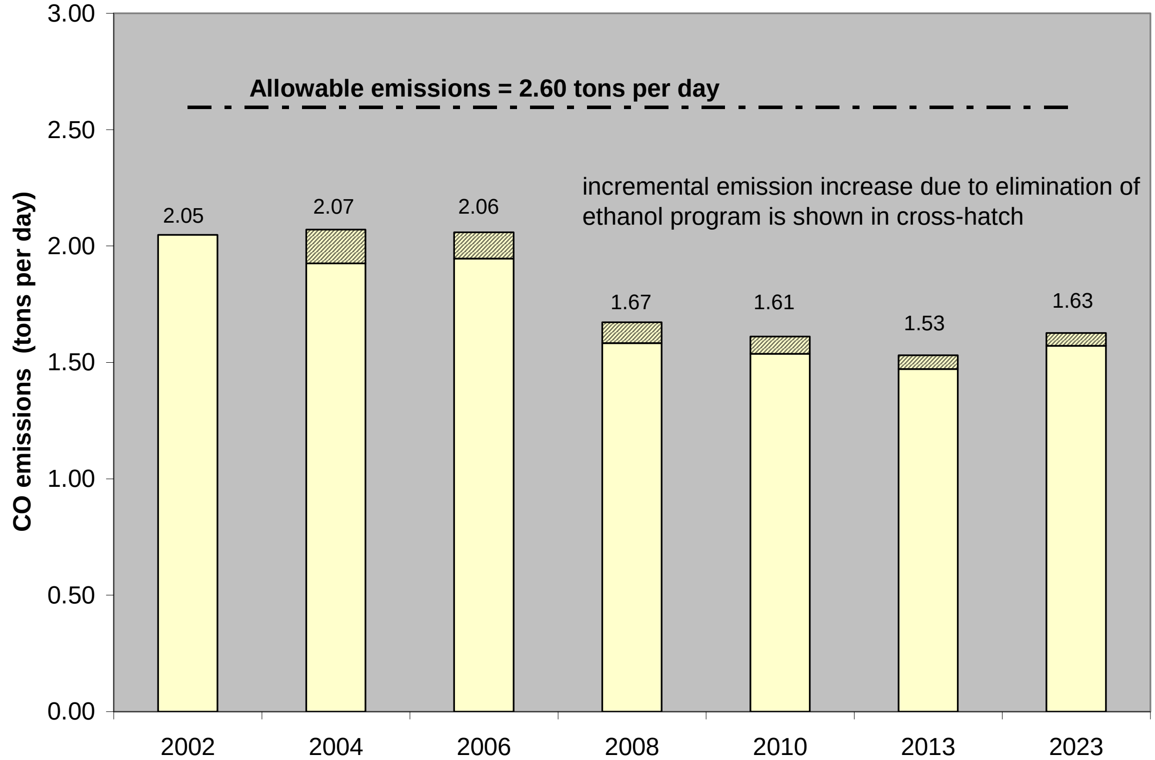
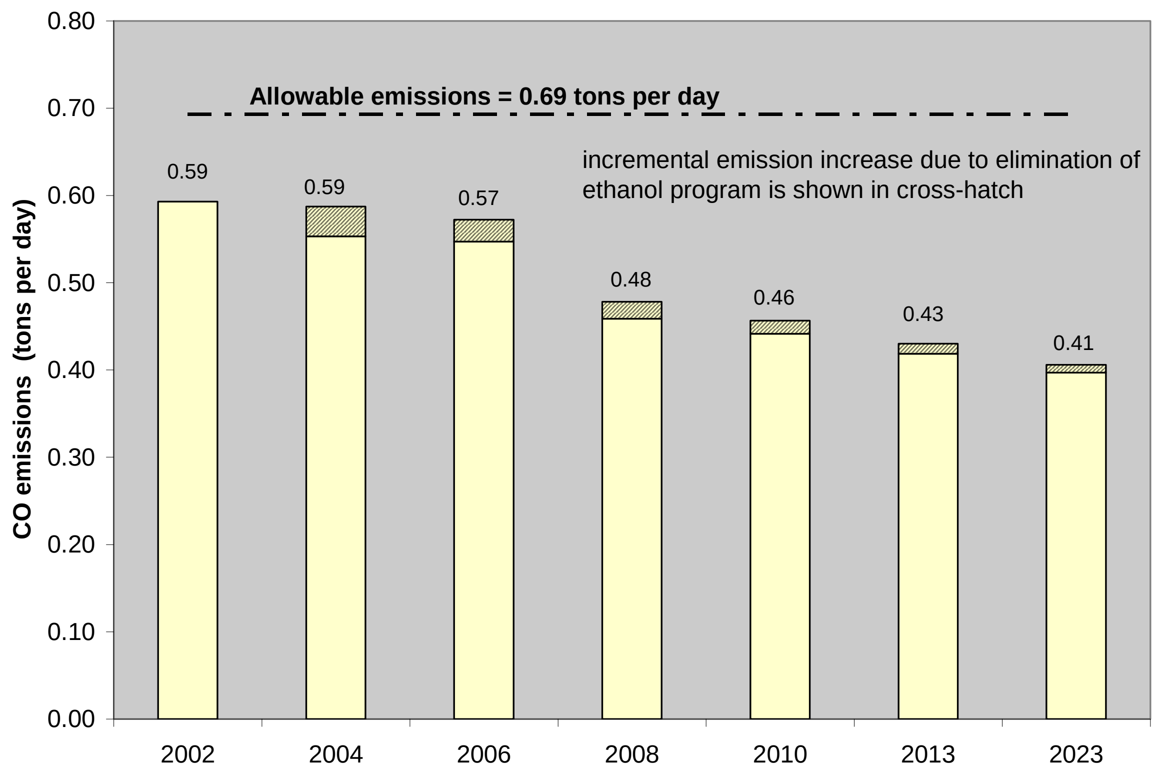


Figure III.B.6-3(c) Maintenance Prospects at the Turnagain Station through 2023



Effect of Eliminating Ethanol-blended Gasoline Requirement on Maintenance Prospects

The figures in the previous sub-section illustrate the impact of eliminating the ethanol-blended gasoline requirement on long term prospects for compliance. MOBILE6-based hybrid modeling methodology was used to project emissions with and without the current ethanol-blended gasoline requirement. It is clear from the previous figures that ethanol is not required for continued attainment of the NAAQS. It is also evident that the benefits of the program decline over time. The effect of eliminating the ethanol program on emissions in the Garden micro-inventory area is shown in Table III.B.6-4. The estimated percent increase in total emissions is 6.6% in 2004 and 3.0% in 2013. Similar increases are projected for the Seward Highway and Turnagain areas.

Table III.B.6-4

Increase in CO Emissions in the Garden Micro-Inventory Area Resulting from the Elimination of the Ethanol-blended Gasoline Program

	Projected Emissions with Ethanol (tons per day)	Projected Emissions without Ethanol (tons per day)	% increase in total CO emissions
2002	0.526	--	--
2004	0.477	0.509	6.6%
2006	0.460	0.483	5.0%
2008	0.372	0.389	4.6%
2010	0.349	0.362	3.8%
2013	0.319	0.328	3.0%
2023	0.302	0.310	2.5%

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III.B.7 Contingency Plan

The CAAA Section 175A(d) requires maintenance plans to “contain such contingency provisions as the Administrator deems necessary to assure that the State will promptly correct any violation of the standard which occurs after the redesignation of the area as an attainment area.” In addition this same section of the Act requires an area to “implement all measures with the respect to the control of the air pollutant concerned which were contained in the State implementation plan for the area before redesignation of the area as a nonattainment area.”

Therefore, the ethanol-blended gasoline program must be re-implemented if a violation of the NAAQS occurs. ADEC regulation would reinstate the oxygenated gasoline requirement if a violation were measured at one or more monitoring stations.

The maintenance projections presented in the previous section of this plan suggest that the greatest risk of violating the NAAQS is in the first few years (2004-2006) of the maintenance plan period. The MOA is using Congestion Mitigation / Air Quality (CMAQ) funding to implement a number of new programs in the next few years that should help ensure that violations will not occur. Transit service was expanded in July 2003 and additional route enhancements are slated to begin in 2004 and continue through 2006. Ridership is projected to increase by 5 to 10% as a result. If this ridership increase is realized, a CO emission reduction of 0.1 to 0.2 tons per day would be expected.

The engine block heater and public awareness program will continue with a renewed focus on the residential areas most likely to violate the NAAQS. These programs are slated to continue at least through 2006. Gridded emission inventory data have been used to target those neighborhoods with the highest warm-up idle emissions. MOA and ADEC plan to focus incentives and public awareness programs on these areas. Modeling suggests that emissions reductions of up to 5% are possible in some neighborhoods.

The CO reductions expected from transit service expansion, block heater promotion and public awareness programs were not included in the maintenance projections presented in Section III.B.6 and the anticipated air quality benefits from these programs are not necessary to demonstrate maintenance. Thus, the implementation of these contingency measures provides an added measure of assurance of continued compliance with the NAAQS.

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III.B.8 Anchorage Emergency Episode Plan

The CAAA section 127 (42 U.S.C. 7427) requires that all state implementation plans include measures to provide public notification when the NAAQS has been exceeded, advise the public of the health hazards associated with the pollution, and enhance public awareness of the measures that can be taken to reduce air pollution. The MOA air pollution episode plan is outlined in municipal code and meets the requirements of Section 127 (42 U.S.C. 7427). Local ordinance AMC 15.30.060 requires the director of the MOA Department of Health and Human Services to publish and distribute copies of an Air Pollution Episode Plan that prescribes the specific actions to be taken at each stage of notification. Such a plan was developed and published by the MOA in October 1993. A copy of the plan and ordinance is included in Volume III, Appendix III.B.10.

Three levels of notification are outlined in AMC 15.30.060 related to the level of air pollution predicted or measured in the air. For CO these levels are as follows:

- *Level 1 – Alert* – Declared when the 8-hour average CO concentration has reached or is predicted to reach 9 ppm.
- *Level 2 – Warning* – Declared when the 8-hour average CO concentration has reached or is predicted to reach 15 ppm.
- *Level 3 – Emergency* – Declared when the 8-hour average CO concentration has reached or is predicted to reach 30 ppm.

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III.B.9 Assurance of Adequacy

Under the CAAA Section 110(a)(2)(E) (42 U.S.C. 7410(a)(2)(E)) each SIP must provide the necessary assurances that ADEC or the general purpose local government designated for such purposes by the State (e.g., MOA), will have "adequate personnel, funding, and authority" under State or (as appropriate) local law to carry out the SIP. The CAAA also states that the SIP must provide necessary assurances that, where ADEC has relied on a local government for the implementation of any plan provision, ADEC has responsibility for ensuring adequate implementation of such plan provisions.

ADEC has the responsibility for implementing a number of the control measures contained in the current plan. ADEC is responsible for enacting and enforcing necessary state regulations requiring the participation of out-of-area commuter vehicles in an I/M program. ADEC is also responsible for implementing the oxygenated gasoline program in the MOA.

Local Legal Authority

The State of Alaska has delegated authority for air pollution control within the Municipality to MOA under AS 46.14.400 (formerly AS 46.03.210). AS 46.03.210 allowed local municipalities to establish air pollution control programs within their jurisdictions by August 5, 1974. In the MOA, air pollution control powers are exercised under the South Central Clean Air Ordinance, codified in Anchorage Municipal Code (AMC), Chapters 15.30 and 15.35. A copy of AS 46.14.400 is included in Volume III, Appendix III.A, and copies of AMC 15.30 and 15.35 are included in Volume III, Appendix III.B.11.

AS 46.14.400, AS 28.10.041(a)(10), and AS 29.04 authorize the MOA to implement a motor vehicle emissions inspection program. The MOA Assembly initially enacted the authority for the MOA I/M program in March 1984 in local ordinance AMC 15.80. Copies of AS 28.10.041, AS 29.04, and AMC 15.80 are also included in Volume III, Appendix III.B.11.

Adequate Local Personnel and Funding

The MOA I/M program is designed to be financially self-supporting. An $18 fee is charged for each Certificate of Inspection. These fees are currently sufficient to support the MOA's administration of the I/M program and support a large portion of the air pollution monitoring, planning, and enforcement activities performed by the Anchorage Air Pollution Control Agency (AAPCA). Budget and staffing are reviewed annually by the MOA administration and the Anchorage Assembly. During fiscal year 2002, the I/M program budget was approximately $1.8 M.

I/M fees also partially support public outreach activities including a block heater promotion campaign. Although federal Congestion Mitigation and Air Quality (CMAQ) funds were used to purchase television, radio, and print media advertising, MOA funding for staff support for the campaign came largely from I/M program revenues. CMAQ funds were also used to support the Share-A-Ride Program and more recently, to subsidize block heater installations and expand transit service.

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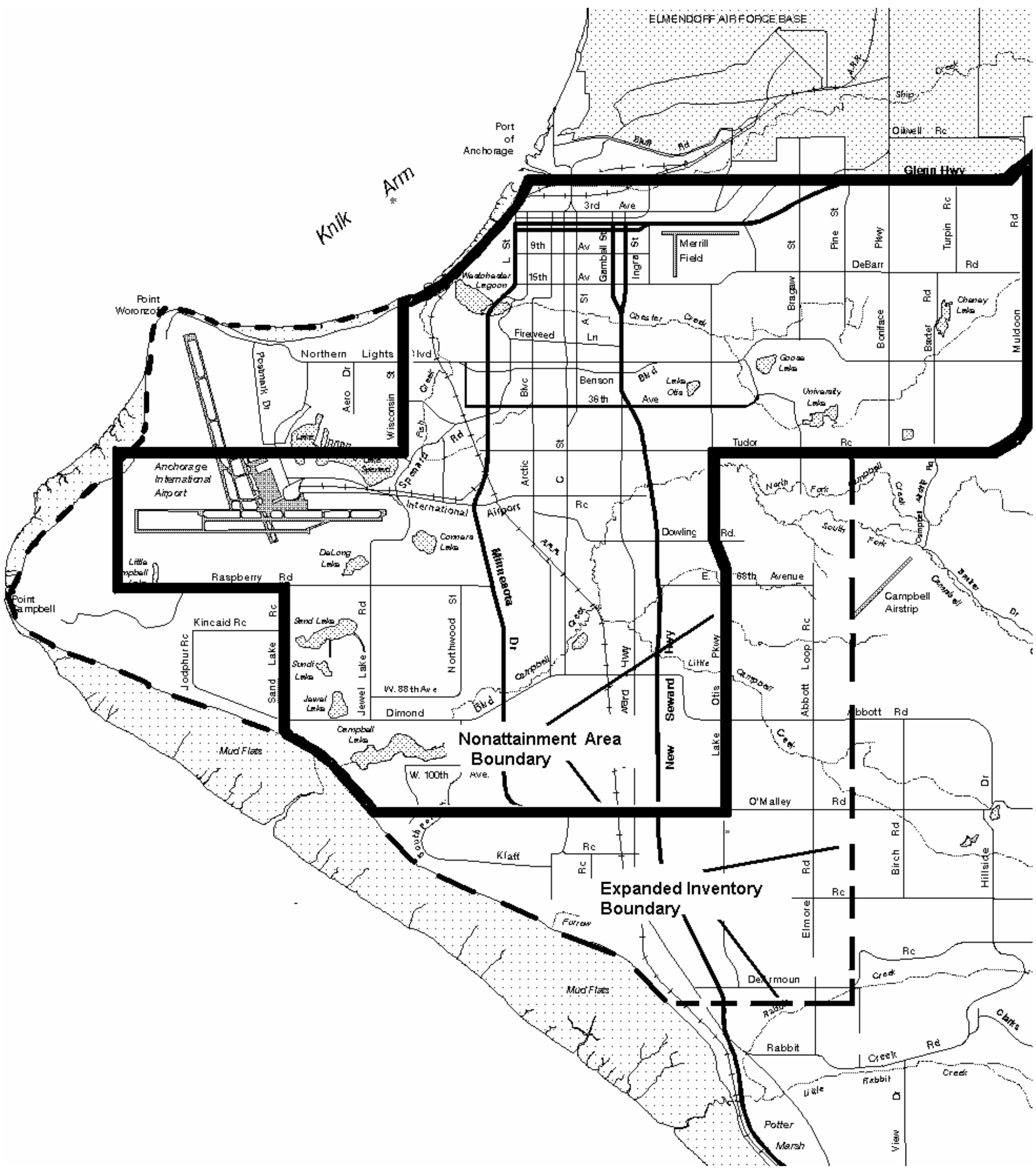
III.B.10 Motor Vehicle Emissions Budget

Before any regional transportation plan can be adopted or amended, the emissions from the transportation network proposed in the plan must be shown to be less than the motor vehicle emission budget established in the SIP. The motor vehicle emissions budget presented here applies during the period 2004 and beyond.

Motor Vehicle Emission Budget Inventory Area

The motor vehicle budget is compiled on an area-wide basis. The area encompassed by "expanded inventory boundary" noted in Figure III.B.10-1 will be used to establish the emission budget. Future conformity determinations will evaluate emissions in this same area.

Figure III.B.10-1 Expanded Emission Inventory Area Used to Compute Emission Budget



Methodology Used to Establish Motor Vehicle Emission Budget

The 2002 Anchorage CO emission inventory was presented earlier in Section III.B.3 of this report. This 24-hour inventory was compiled from separate time-of-day (morning, midday, evening and night) estimates of activity and emissions throughout the day. While this methodology provides valuable insight into the nature of CO emissions, it is complex and computationally intensive. A transportation model post processor is used to provide the motor vehicle activity data (e.g. VMT, speed, trip purpose, number of starts, etc.) The post-processor provides separate estimates of this activity for each time of day and for each of the 772 one-half kilometer grids that comprise the inventory area. The post-processor modeling runs required to do this for a single analysis year can exceed 12 hours. To reduce computational time and resources, a modified approach was used to establish the motor vehicle emission budget.

The transportation model post-processor can be run so that motor vehicle activity data are provided on an aggregate, 24-hour basis. When run in this mode, post-processing time is reduced considerably. To prepare the emissions budget, CO emissions in design year 2002 were re-computed using this 24-hour aggregate approach. Key parameters used in the computation of emissions but not provided by the post-processor (e.g. assumed average warm-idle duration, engine block heater plug-in rates) were also estimated on a 24-hour basis rather than for a specific time period. Aggregated, 24-hour estimates of these parameters are compared to the time-of-day estimates used to prepare the emissions inventory in Tables III.B.10-1(a-c). These parameters should be used in regional conformity determinations unless new survey data support alternative assumptions.

Table III.B.10-1(a)
Assumed Average Soak Time by Trip Type (hours)

Type of Trip	6 am – 9 am	9 am – 3 pm	3 pm – 6 pm	6 pm – 6 am	24-hour aggregate
HBW-W	12	5	3	3	6
HBW-O	5	5	5	5	5
HBO-H	12	3	2	2	3
HBO-O	1	1	1	1	1
NHB	1	1	1	1	1
Truck	2	2	2	2	2

Table III.B.10-1(b)
Assumed Average Idle Duration by Trip Type (minutes)

Type of Trip	6 am – 9 am	9 am – 3 pm	3 pm – 6 pm	6 pm – 6 am	24-hour aggregate
HBW-W	7	3	3	3	3
HBW-O	3	3	3	3	3
HBO-H	7	3	2	1	3
HBO-O	1	1	1	1	1
NHB	1	1	1	1	1
Truck	3	3	3	3	3

Table III.B.10-1(c) Assumed Engine Block Heater Plug-in Rate by Trip Type (% plugged-in before trip start)					
Type of Trip	**6am – 9 am**	**9 am – 3 pm**	**3 pm – 6 pm**	**6 pm – 6 am**	**24-hour aggregate**
HBW-W	20	6	0	0	15
HBW-O	0	0	0	0	0
HBO-H	12	6	0	0	6
HBO-O	0	0	0	0	0
NHB	0	0	0	0	0
Truck	0	0	0	0	0

When results from 24-hour aggregate modeling are compared to an inventory compiled from the separate time-of-day estimates, differences are very small. In 2002, this difference amounts to less than 0.3%. Total CO emissions computed using the 24-hour aggregate method are 120.5 tons per day. The estimate using the time-of-day method was 120.3 tons per day.

The emission budget is computed from the aggregate 24-hour inventory using the rollback calculation for design year 2002. The Garden site DV will be used because it has the highest DV among three monitoring stations evaluated. It therefore provides the most stringent motor vehicle emission budget. The DV used in the rollback calculation is 7.8 ppm.

The rollback calculation can be used to compute the “emission carrying capacity” of the budget area. As was the case in the maintenance demonstrations presented earlier in this document, the emission carrying capacity of the area will be greater than estimated actual emissions in 2002 because the DV is below the NAAQS.

Key assumptions used in the computation of the emission carrying capacity are shown in Table III.B.10-2

Table III.B.10-2 Key Assumptions Used in Computation of Emission Carrying Capacity		
Parameter	**Value**	**Rationale**
Design Value (2002)	7.8 ppm	Highest DV among three monitoring stations evaluated (from Garden station)
Background Concentration	0.0 ppm	Yields most conservative carrying capacity. Section III.B.6 contains detailed discussion of 0.0 ppm background concentration.
Area-wide CO Emissions (2002)	120.5 tons per day	Estimated CO emissions from all sources in budget area

The allowable area-wide emission increase, based on the Garden DV is:

$$\% \text{ increase in emissions allowed } = \frac{ppm_{std} - DV}{DV - ppm_{bkg}} x100 = \frac{9.0 - 7.8}{7.8 - 0.0} x100 = 15.4\%$$

The emission carrying capacity is then:

emission carrying capacity = (Area-wide CO Emissions in 2002) x (1+ 0.154)

= (120.5 tons per day) x 1.154 = 139.1 tons per day

The motor vehicle budget in 2002 is the computed emission carrying capacity less emissions from sources other than motor vehicles. In 2002, emissions from other sources (e.g. aircraft, fireplaces and woodstoves, space heating, point sources and "nonroad" sources) were 27.4 tons per day. The motor vehicle budget available in 2002 is therefore:

2002 motor vehicle budget = emission carrying capacity – emissions from sources other than motor vehicles

= 139.1 tons per day – 27.4 tons per day = 111.7 tons per day

Emissions from aircraft, fireplaces and woodstoves, and other sources are projected to increase as Anchorage grows. As emissions from these other sources increase and take a greater proportion of the emission carrying capacity, the motor vehicle budget shrinks over time. The motor vehicle emission budget is presented Table III.B.10-3. The table also shows projected increases in these other CO emission sources effects the motor vehicle emission budget through 2023.

Table III.B.10-3 Motor Vehicle Emission Budget									
	Stevens Int'l Airport	Merrill Field	Fire-places & Wood stoves	Space Heating	Point Sources	Other	**Non-Vehicular Sources TOTAL**	Emission Carrying Capacity	**Motor Vehicle Emission Budget**
2002	11.84	1.03	5.75	3.56	1.45	3.72	27.3	139.1	**111.7**
2003	12.06	1.05	5.82	3.59	1.47	3.72	27.7	139.1	**111.4**
2004	12.28	1.08	5.89	3.62	1.48	3.73	28.1	139.1	**111.0**
2005	12.50	1.10	5.93	3.63	1.50	3.75	28.4	139.1	**110.7**
2006	12.72	1.12	5.96	3.65	1.51	3.76	28.7	139.1	**110.4**
2007	12.94	1.14	5.99	3.66	1.52	3.77	29.0	139.1	**110.0**
2008	13.16	1.16	6.03	3.67	1.53	3.79	29.3	139.1	**109.7**
2009	13.38	1.18	6.06	3.68	1.55	3.80	29.7	139.1	**109.4**
2010	13.60	1.20	6.09	3.69	1.56	3.82	30.0	139.1	**109.1**
2011	13.82	1.22	6.13	3.71	1.57	3.84	30.3	139.1	**108.8**
2012	14.04	1.24	6.16	3.72	1.58	3.86	30.6	139.1	**108.5**
2013	14.26	1.26	6.20	3.73	1.60	3.88	30.9	139.1	**108.1**
2014	14.48	1.27	6.32	3.79	1.62	3.95	31.4	139.1	**107.6**
2015	14.70	1.28	6.44	3.84	1.65	4.01	31.9	139.1	**107.1**
2016	14.92	1.30	6.56	3.90	1.68	4.07	32.4	139.1	**106.6**
2017	15.14	1.31	6.68	3.96	1.70	4.14	32.9	139.1	**106.1**
2018	15.36	1.32	6.80	4.01	1.73	4.20	33.4	139.1	**105.6**
2019	15.58	1.34	6.92	4.07	1.76	4.26	33.9	139.1	**105.1**
2020	15.80	1.35	7.05	4.12	1.78	4.33	34.4	139.1	**104.6**
2021	16.02	1.37	7.17	4.18	1.81	4.39	34.9	139.1	**104.1**
2022	16.24	1.38	7.29	4.24	1.84	4.45	35.4	139.1	**103.6**
2023	16.46	1.39	7.41	4.29	1.86	4.52	35.9	139.1	**103.1**

Note: Some rows may not total exactly because of rounding. Totals are rounded to one significant digit beyond the decimal.

Emission budgets for years beyond 2023 are to be computed through linear extrapolation in accordance with the following equation:

Mobile Source Emission Budget (tons per day) = -0.4038 x (Year - 2023) + 103.34

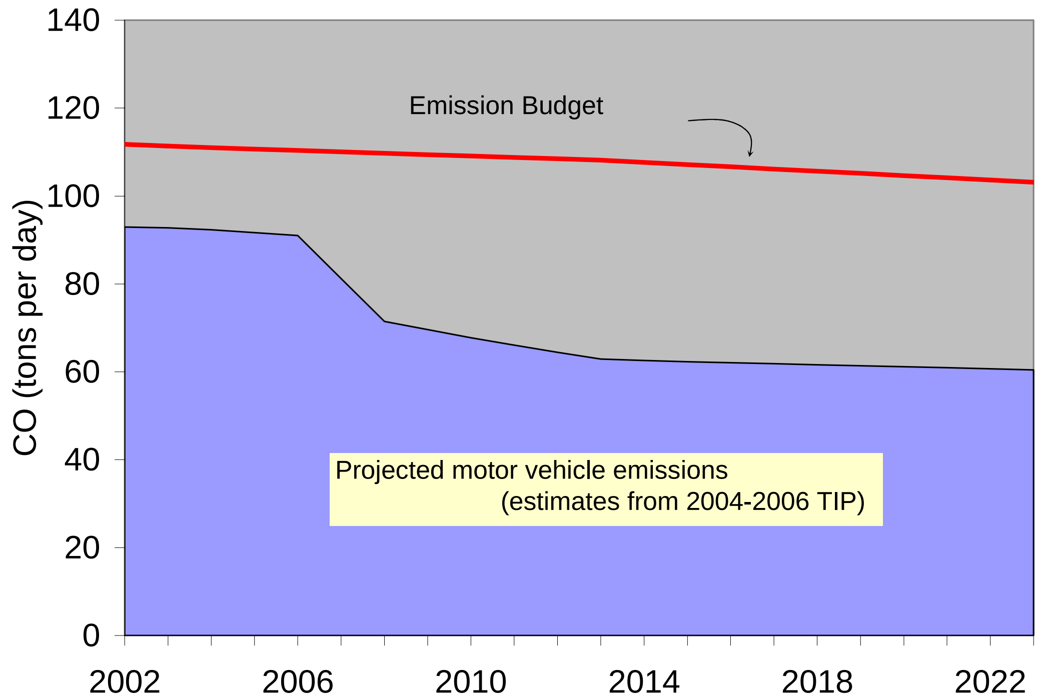
The mobile source budget for year 2040 would therefore be:

2040 Mobile Source Emission Budget = -0.4038 x (2040 - 2023) + 103.34 = 96.5 tons per day

Long Term Prospects for Meeting Conformity Budget

A preliminary analysis of long term prospects for meeting the conformity budget were evaluated using the travel activity projections and transportation network assumptions contained in the current 2004-2006 Anchorage Transportation Improvement Program. This analysis was performed using the regional conformity determination methodology described in the previous sub-section. The analysis suggests that, barring major changes in population or employment growth projections, motor vehicle emissions from Anchorage transportation network will remain below the motor vehicle emission budget during the 2004 – 2023 period. Projected motor vehicle emissions are compared to the budget in Figure III.B.10.2.

Figure III.B.10-2. Projected Motor Vehicle Emissions vs. Budget 2004 - 2023



Regional Conformity Determination Methodology

The motor vehicle emission budget was prepared using a "hybrid" method that combined locally collected idle test data with the MOBILE6 model run with supplemental FTP speed correction factors disabled. This same hybrid approach was used to prepare the maintenance demonstrations for the Garden, Seward Highway, and Turnagain areas. It will also be employed in future regional conformity analyses.

This MOBILE6-based hybrid method provides a means to model the impact of extended initial idling of vehicles prior to travel and the use of "plug-in" heaters to keep the engine warm while parked for long periods to aid in cold start driveability. Because the hybrid method used to estimate motor vehicle emissions in the MOA is unique and somewhat unconventional, it is necessary to delineate a method to compute emissions for use in future TIP and project conformity determinations.

To address subsequent use of this hybrid approach within the conformity process, the following steps are being incorporated into the conformity procedures for the MOA transportation plans and projects. The additional steps set out in the section are to be used in conjunction with the applicable requirements for conformity found in Volume II, Sections III.I and III.J of this plan and 18 AAC 50.720.

The emission calculations of a project, program, or plan must be consistent with the methodology used to establish the motor vehicle emissions budget. For regional emissions analyses (e.g., Long-Range Transportation Plans or Transportation Improvement Programs) computations of mobile source emissions will use the same hybrid method used in developing the emission budget. In a regional conformity determination, mobile source emissions resulting from the plan or program must be compared to the applicable emissions budget established in the SIP. All regionally significant projects must be specifically modeled in the conformity analysis.

The computation of motor vehicle emissions relies on VMT, speed, and operating mode outputs provided by the Anchorage Transportation Model and post processing software. The model and post-processor provide 24-hour aggregate estimates of motor vehicle activity (e.g., vehicle starts, vehicle speed, and VMT by trip purpose). Currently, these post-processor outputs are utilized in a separate Excel spreadsheet. This spreadsheet contains MOBILE6 emission factors used to estimate travel emissions and idle emission factors that are based on local test data. The user must provide estimates of average soak times, idle duration and plug-in rates by trip purpose. Base year 2002 assumptions are shown in Tables III.B.10-1 (a-c). Any deviation from these base year assumptions should be discussed and approved through the interagency consultation process outlined in 40 CFR 93.105.

Changes to the Anchorage Transportation Model may necessitate modifications in the manner in which regional mobile source emissions are calculated. Significant changes should be documented and then discussed and approved through the interagency consultation process.

Project-Level Conformity Methodology

In project-level analysis, conformity determinations cannot be made by comparing localized project emissions to a regional emissions budget. Instead, a project-level conformity analysis consists of performing hot-spot dispersion modeling to determine whether a project will cause or contribute to any new violations of ambient standards or increase the frequency or severity of existing violations. This hot-spot modeling requirement applies to non-attainment and maintenance areas for each pollutant. Thus, in Anchorage, hot-spot CO modeling must be performed in project-level conformity determinations. Inputs to the hot-spot modeling include link-specific vehicle emission factors for roadway segments in the project vicinity. For project-level analyses, these emission factors will be developed in one of two ways, depending on the type of project. Through the interagency consultation process, a project will be put into one of two tracks as follows:

1. Projects that are **not** significantly impacted by changes in off-network emissions (e.g., projects that are not likely to affect the amount of initial idling and/or engine block heater use in the project area) will follow a more routine approach to computing emission impacts using MOBILE6 with supplemental FTP speed correction factors disabled. Off-network emissions will not be directly modeled in the analyses of these projects, as they do not change as a result of the project. For these types of projects, off-network emissions are accounted for in the background concentration input in CAL3QHC.

2. Those projects that **are** significantly impacted by changes in off-network emissions (e.g., projects that are likely to affect the amount of initial idling and/or engine block heater use in the project area) will follow a process that incorporates both the off-network

emissions and the on-road "traveling" emissions. This will require a hybrid approach similar to that used in developing the emission budget and adapted to represent roadway link-specific emission factors in the vicinity of the project.

The interagency consultation process will be the key means of ensuring that projects are placed in the correct track for calculation of emission impacts. The interagency consultation process will also be important in ensuring that appropriate analyses of project emission impacts are conducted under the two scenarios listed above. Moreover, it is important that the interagency agency process be used to develop guidance so that consistent methodologies are utilized in project-level analyses. Hot spot modeling is often required in project-level conformity determinations. When possible, the interagency consultation process should be used to develop written guidance regarding modeling inputs and assumptions. As always, conformity determinations will be subject to the applicable public review requirements. This provides the public an opportunity to comment on the approach that is taken for the conformity determination for each plan, program, and project.

General Conformity

For projects requiring general conformity determinations, it is also important to consider the impacts of off-network motor vehicle emissions (e.g., idle emissions). Interagency consultation shall be used to determine whether off-network mobile source emissions are significant and what analysis of these emissions is appropriate for determining general conformity.

Finding of Adequacy of Mobile Source Emissions Budget

For an emissions budget to be found adequate by EPA, the revisions to the air quality control plan that establishes the budget must:

- be endorsed by the Governor (or a designee), 40 C.F.R. 93.118(e)(4)(i);
    - Prior to submittal to EPA, this plan is filed by the Lieutenant Governor as state regulation.
- be subject to a public hearing, 40 C.F.R. 93.118(e)(4)(i);
    - The Department of Environmental Conservation held a public hearing in Anchorage on these plan revisions on November 13, 2003. The certification of a public hearing is included in Volume III, Appendix III.B.10.
- be developed through consultation among federal, state, and local agencies, 40 C.F.R. 93.118(e)(4)(ii);
    - Federal, state, and local agencies were consulted on the motor vehicle emissions budget. A summary of the interagency process is included in Section III.B.1 of this plan. Comments received from other agencies were incorporated into the plan.
- be supported by documentation that has been provided to EPA, 40 C.F.R. 93.118(e)(4)(ii) ;

- This section (III.B.10) of the maintenance plan contains documentation supporting the motor vehicle emission budget.
-

- address any EPA concerns received during the comment period, 40 C.F.R. 93.118(e)(4)(ii);

  - Preliminary comments on the motor vehicle emissions budget were received from EPA Region 10 staff via email and phone conversations. Modifications were made to this section of the plan to address those suggestions.

- clearly identify and precisely quantify the revised budget, 40 C.F.R. 93.118(e)(4)(iii);

  - This section clearly identifies the motor vehicle emissions budget for Anchorage.

- show that the motor vehicle emissions budget, when considered together with all other emissions sources, is consistent with the requirements for maintenance of the NAAQS, 40 C.F.R. 93.118(e)(4)(iv);

  - The motor vehicle emissions budget is established based on the Anchorage CO emission inventory. The budget when considered with all other emission sources is consistent with the requirements for maintenance of the NAAQS. In particular, see Sections III.B.3, III.B.5, and III.B.6.

- demonstrate that the budget is consistent with and clearly related to the emissions inventory and the control measures in the plan revision, 40 C.F.R. 93.118(e)(4)(v);

  - The motor vehicle emissions budget is established based on the Anchorage CO emission inventory and control measures included in the plan. In particular, see Sections III.B.3, III.B.5, III.B.6, and III.B.7. See, also, the *Anchorage Carbon Monoxide Emission Inventory and Maintenance Projections* contained in Volume III, Appendix III.B.3.

- explain and document revisions to the previous budget and control measures, and include any impacts on point or area sources, 40 C.F.R. 93.118(e)(4)(vi); and

  - A discussion of how the emission budget was derived is contained in this section. The budget provides for growth in point and area sources.

- address all public comment on the plan's revisions and include a compilation of these comments, 40 C.F.R. 93.118 (e)(5).

  - Comments on the plan revisions were received from one individual. These comments are compiled and addressed in a response-to-comments document included in Appendix III.B.12. The Anchorage Assembly adopted the plan during its regular public meeting held on October 7, 2003. This resolution is also included in Appendix III.B.12.

Federal law requires all regional transportation plans and significant transportation projects to conform to the SIP for air quality. All significant, federally funded projects, such as airport improvements and construction of major buildings, also must conform to the SIP.

The process used to determine whether a transportation plan or project is in conformance with the SIP is known as “transportation conformity.” The process used to assess the conformity of other federally funded projects is called “general conformity”.

ADEC regulations are consistent with federal requirements for conformity. Requirements for transportation conformity and general conformity are found in 18 AAC 50.700 through 18 AAC 50.735. The current SIP addresses transportation conformity in Volume II - Sections III.I, and general conformity in Volume II - Section III.J.

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III.B.11 Redesignation Request

The department and the Municipality of Anchorage are requesting redesignation of the Anchorage carbon monoxide serious nonattainment area to attainment of the CO NAAQS. Section 107(d)(3)(E) of the CAAA requires the U.S. EPA administrator to make five findings prior to granting a request for redesignation:

1. The U.S. EPA has determined that the NAAQS has been attained;
2. The applicable implementation plan has been fully approved by U.S. EPA under section 110(K);
3. The U.S. EPA has determined that the improvement in air quality is due to permanent and enforceable reductions in emissions;
4. The state has met all applicable requirements for the area under Section 110 and Part D; and
5. The U.S. EPA has fully approved a maintenance plan, including a contingency plan, for the area under Section 175A, which includes as contingency measures all contingency measures that were contained in the most recently approved State Implementation Plan.

Information necessary for EPA to make these five findings follows:

Attainment of the Standard

According to EPA guidance, the demonstration of attainment with the CO standard must rely on three complete, consecutive years of quality-assured air quality monitoring data collected in accordance with 40 CFR 50, Appendix K. The Anchorage CO nonattainment area has not experience any exceedances during the most recent three-year period, 2000-2002. An expanded discussion of Anchorage CO air quality data is included in Section III.B.3.

Approved Implementation Plan

As discussed in Section III.B.1, the department revised its State Implementation Plan in response to the moderate nonattainment designation in 1994. When Anchorage was unable to achieve attainment by the 1995 deadline, the department submitted revisions to meet the requirements of its serious nonattainment redesignation. The attainment plan revisions were approved through the AMATS process, incorporated into state regulations and submitted to EPA for findings of adequacy and budget approvals. The attainment plan became effective on October 18, 2002.

Permanent and Enforceable Emission Reductions

CO reductions leading to attainment of the federal standards are the result of local control actions that were implemented beginning in 1978. Additionally, the MOA adopted the I/M technician training and certification program contingency measure in the moderate plan as backup should violations occur. This measure was triggered in 1996. Section III.B.5 contains an expanded discussion of existing control action implementation. Section III.B.6 contains a discussion of long-term prospects for attainment aided by the reductions resulting from the continued implementation of the vehicle inspection and maintenance program, the Rideshare and Vanpooling program, and engine block heater program.

Section 110 and Part D Requirements

Section 110 and Part D of the CAAA address implementation of SIPs and SIP requirements for nonattainment areas. EPA's finding of adequacy and budget approval of the MOA Serious Area SIP on October 18, 2002, demonstrates compliance with the Section 110 and Part D requirements.

Approved Maintenance Plan

The department in conjunction with the MOA submits its Maintenance Plan concurrently with this redesignation request. The department requests that EPA expeditiously review the Plan and, if determined to meet the provisions of the CAAA, approve the Maintenance Plan as a part of the redesignation process.

References

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[1] "Anchorage Carbon Monoxide Emission Inventory and Year 2000 Attainment Projections," Air Quality Program, Municipality of Anchorage, September 2001.

[2] "Winter Season Warm-up Driver Behavior in Anchorage," Air Quality Program, Municipality of Anchorage, June 2001.

[3] "The Ongoing Challenge of Managing Carbon Monoxide Pollution in Fairbanks, Alaska," National Research Council, May 2002.

[4] "United States Motor Vehicle Inspection and Maintenance Programs," prepared by Sierra Research for the U.S. EPA, July 2001.

[5] "Anchorage I/M Compliance Rate Study," ADEC Air and Water Quality Program, March 1999.

[6] Personal communication, Keith Beeson, Anchorage I/M Program Administrator, July 16, 2003.

[7] Personal communication, Sandy Clark, junior administrative officer, Share-A-Ride Program, to Steve Morris, Municipality of Anchorage, Air Quality Program on July 17, 20031

[8] *Ibid.*

[9] "Fairbanks Cold Temperature Vehicle Testing: Warm-up Idle, Between Trip Idle, and Plug-in," prepared for the Alaska Department of Environmental Conservation by Sierra Research, Inc., Report No. SR01-07-01, July 2001.

[10] "Anchorage Public Opinion Survey, February 2000," Ivan Moore Research, February 2000.

[11] *Ibid.*

[12] "Anchorage Air Quality Survey January – February 2001," Ivan Moore Research, April 2001.

[13] "Anchorage Air Quality Survey January – February 2002," Ivan Moore Research, April 2002.

[14] "CO Dispersion Model Feasibility Study: Fairbanks and Anchorage, Alaska," prepared for the Alaska Department of Environmental Conservation by Systems Applications International, Inc. / ICF Consulting, June 14, 2002.