Submitted by: Chair of the Assembly at the Request of the Mayor
Prepared by: Department of Health and Human Services
For Reading: May 10, 2011

CLERK'S OFFICE
APPROVED
Date: 5-10-11

ANCHORAGE, ALASKA
AR NO. 2011-133

A RESOLUTION OF THE MUNICIPALITY OF ANCHORAGE ADOPTING TECHNICAL REVISIONS TO THE ANCHORAGE CARBON MONOXIDE MAINTENANCE PLAN.

WHEREAS, the Anchorage Assembly approved revisions to the Carbon Monoxide (CO) Maintenance Plan on June 8, 2010 that deleted the commitment to continued operation of the Vehicle Inspection and Maintenance Program; and

WHEREAS, the State of Alaska has submitted the Carbon Monoxide Maintenance Plan to the Environmental Protection Agency (EPA) as an amendment to the State Implementation Plan in September 2010 where it is currently under review; and

WHEREAS, the Carbon Monoxide Maintenance Plan must include a motor vehicle emission budget to determine whether transportation plans and programs comply with air quality conformity requirements prescribed in federal regulations; and

WHEREAS, effective March 2, 2012, the EPA recently changed the model that must be used to estimate motor vehicle emissions for air quality conformity analyses from MOBILE6 to MOVES; and

WHEREAS, the carbon monoxide emission estimates produced by MOVES model are substantially higher than MOBILE6 and thus jeopardize the ability of Anchorage to demonstrate that it meets the current motor vehicle emissions budget which was developed with MOBILE6; and

WHEREAS, the proposed technical revisions to the Carbon Monoxide Maintenance Plan replace the MOBILE6-based emissions budget with one developed with MOVES and will remedy the conformity budget problem when the revised plan is approved by the EPA; and

WHEREAS, such amendments to the Maintenance Plan were prepared in accordance with the transportation planning process required under Section 114 of Title 23 of the United States Code and Section 110 of the Clean Air Act; and

WHEREAS, the amended Maintenance Plan was released for public comment and recommended for approval by the AMATS Air Quality Advisory Committee, and the AMATS Technical Advisory Committee; and

WHEREAS, the Anchorage Metropolitan Area Transportation Solutions (AMATS) Policy Committee recommended approval of the amended CO Maintenance Plan during their April 28, 2011 meeting; now, therefore,

THE ANCHORAGE ASSEMBLY RESOLVES:

Section 1. That the amended Carbon Monoxide Maintenance Plan be approved and forwarded to the Alaska Department of Environmental Conservation for inclusion in the State Implementation Plan for air quality and for approval by the Environmental Protection Agency.

Section 2. This resolution shall become effective immediately upon passage and approval by the Anchorage Municipal Assembly.

PASSED AND APPROVED by the Anchorage Assembly this 10th day of May, 2011.

Debbie Ossiander
Chair of the Assembly

ATTEST:

Barbara S Jones
Municipal Clerk

MUNICIPALITY OF ANCHORAGE

ASSEMBLY MEMORANDUM

No. AM 266-2011

Meeting Date: May 10, 2011

From: MAYOR

Subject: A RESOLUTION OF THE MUNICIPALITY OF ANCHORAGE ADOPTING TECHNICAL REVISIONS TO THE ANCHORAGE CARBON MONOXIDE MAINTENANCE PLAN.

The Environmental Protection Agency (EPA) recently replaced the MOBILE6 air pollution emissions estimation model with a new model called MOVES. Beginning March 2, 2012 MOVES must be used to model air pollutant emissions in air quality conformity determinations required for federally-funded transportation plans and programs. The current carbon monoxide (CO) motor vehicle emission budget, which is a required element of the Anchorage CO Maintenance Plan, was prepared using the MOBILE6 model. The MOVES model generates significantly higher CO emission estimates than MOBILE6. As a consequence, future transportation plans and transportation improvement programs in Anchorage are in jeopardy of exceeding the emissions budget and failing air quality conformity requirements. Transportation plans and programs that fail conformity cannot be approved. To remedy this problem a new MOVES-based emission budget has been computed and included as a revision to the CO Maintenance Plan. In the revised Plan projected motor CO emissions are now expected to meet the budget through at least 2023.

The emission inventory and maintenance projections included in the current CO Maintenance Plan were also re-computed with MOVES. Although the emissions projections from MOVES are numerically different than the current MOBILE6 projections, there is virtually no change in conclusions drawn about Anchorage's prospects for continued compliance with the federal CO standard. The probability of violating the standard in future years is estimated to be less than 1-in-100 whether projections from MOVES or MOBILE6 are used in the analysis. Aside from minor changes in the narrative and numerical changes to the emissions budget, emission inventory and maintenance projections, no other changes were made to the Plan.

These proposed technical revisions have been reviewed by the AMATS Air Quality Advisory Committee, Technical Advisory Committee and Policy Committee and all have recommended approval. No comments were received during the 30-day public comment period.

THE ADMINISTRATION RECOMMENDS THE APPROVAL OF THE ATTACHED RESOLUTION OF THE MUNICIPALITY OF ANCHORAGE ADOPTING TECHNICAL REVISIONS TO THE ANCHORAGE CARBON MONOXIDE MAINTENANCE PLAN.

Prepared by:	Benedicte Rider, Sr. Office Associate, Department of Health and Human Services
Approved by:	Diane Ingle, Director, Department of Health and Human Services
Concur:	George J. Vakalis, Municipal Manager
Respectfully submitted:	Daniel A. Sullivan, Mayor

Content ID: 010123

Type: AR_AllOther - All Other Resolutions

Title: A RESOLUTION OF THE MUNICIPALITY OF ANCHORAGE ADOPTING TECHNICAL REVISIONS TO THE ANCHORAGE CARBON MONOXIDE MAINTENANCE PLAN.

Author: pruittns

Initiating Dept: HHS

Date Prepared: 4/14/11 3:15 PM

Director Name: Diane Ingle

Assembly Meeting Date: 5/10/11

Workflow Name	Action Date	Action	User	Security Group	Content ID
Clerk_Admin_SubWorkflow	4/29/11 10:47 AM	Exit	Joy Maglaqui	Public	010123
MuniManager_SubWorkflow	4/29/11 10:47 AM	Approve	Joy Maglaqui	Public	010123
CFO_SubWorkflow	4/15/11 4:16 PM	Approve	Lucinda Mahoney	Public	010123
CFO_SubWorkflow	4/15/11 2:01 PM	Checkin	Nina Pruitt	Public	010123
HHS_SubWorkflow	4/14/11 4:27 PM	Approve	Diane Ingle	Public	010123
AllOtherARWorkflow	4/14/11 3:19 PM	Checkin	Benedicte Rider	Public	010123

Ref. AR 2011-133

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

Final Draft as Recommended by AMATS Policy Committee

April 28, 2011

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

Anchorage CO Maintenance Plan

Proposed technical revision to the State of Alaska Air Quality Control Plan

A reanalysis of the maintenance demonstration and motor vehicle emission budget with the new MOVES motor vehicle emission estimation model

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

Prepared by the
Municipality of Anchorage
Department of Health and Human Services

for submission to the
Alaska Department of Environmental Conservation
for inclusion in the
State Implementation Plan for Air Quality

Final Draft
April 28, 2011

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

<u>A note on the format and organization of this document.</u>

This document is organized and formatted to be consistent with the State of Alaska Air Quality Control Plan. This document is intended to replace Volume II., Section III.B of the plan and is organized accordingly.

This document is substantially the same as the CO Maintenance Plan adopted by the Anchorage Assembly on June 8, 2010 and submitted to the Environmental Protection Agency by the Alaska Department of Environmental Conservation for approval in September 2010. Nearly all the changes in this document are technical revisions related to the use of the new motor vehicle emissions model MOVES which has replaced the old AK MOBILE6 model used to produce the emissions estimates in the previous plan. Changes to the previously adopted plan are shown with revision marks (i.e., they have been tracked).

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

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 CO 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 re-designate an area to attainment. The CAAA establishes additional planning requirements that must be satisfied before the EPA administrator can reclassify an area to attainment. An attainment plan and subsequently, a maintenance plan must be submitted to EPA for approval. The attainment plan, which shows 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, was completed and approved by the Anchorage Assembly on September 25, 2001. ADEC incorporated the

* 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 constitutes two violations.

plan as a revision to the Alaska SIP which was later approved by the EPA effective October 18, 2002.

After the approval of the attainment plan, a maintenance plan was prepared. It showed that CO emissions in Anchorage would remain at a level that assures continued attainment of the NAAQS through calendar year 2023. The maintenance plan was approved by the Anchorage Assembly on October 7, 2003 and submitted to ADEC as a proposed revision to the Alaska SIP. ADEC obtained approval of this SIP revision by the EPA, effective July 23, 2004. With this approval, the EPA Regional Administrator reclassified Anchorage from serious CO nonattainment to an area that is in attainment with the NAAQS. The primary CO control measures committed for implementation in the 2004 maintenance plan were the Vehicle Inspection and Maintenance (I/M) Program, the Share-A-Ride / Vanpool Program, and the block heater promotion program.

In 2007 the Anchorage Assembly began debate on whether the I/M program should be continued in Anchorage. On November 6, 2007 they voted to discontinue the I/M Program. However, less than a year later, on July 15, 2008 they revoked this action and voted to continue I/M with some modifications. Principally, they wanted to remove I/M as a commitment in the SIP but retain it as a local prerogative that would not necessitate a further SIP revision if further local action resulted in changes or a discontinuation of the program.† They directed the Municipal Department of Health and Human Services to work with the State of Alaska to amend the SIP to remove the I/M Program as a primary control measure in the SIP and retain it as a local option or prerogative. As a local option, the Municipal Assembly would be free to make changes or discontinue the program without gaining prior approval from the State or EPA.

In response to the Assembly action, a SIP revision was prepared which deletes the commitment to I/M in the SIP while preserving the right of the MOA to continue the program as a "local option." Because it was considered a local option, the maintenance projections in the Plan assumed that I/M would be discontinued in 2011. The SIP demonstrated that Anchorage could continue to comply with the CO NAAQS if I/M were terminated.

On May 11, 2010 Anchorage Assembly decided to exercise its prerogative, consistent with what is provided for in the SIP revision, to terminate the I/M program. They stipulated that the program is to be terminated 180 days after the EPA administrator approved the required SIP amendment. Shortly thereafter they approved the SIP amendment enabling the termination of I/M. It was subsequently forwarded to the State of Alaska with a request that it be submitted to EPA for approval. On September 29, 2010, after the completion of public review and their approval process, the State submitted the amendment to EPA.

Since the submission of the September 2010 revision, the EPA has replaced the MOBILE6 motor vehicle emissions model used to prepare the emission inventory, maintenance

† Among other programmatic changes, they also extended the I/M testing exemption for new cars from four to six years.

† 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 15-year period, 2009-2023. The original maintenance plan covered the 20-year period 2003-2023.

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The MOA and ADEC decided to implement the changes mandated by the Assembly in a two-phase SIP revision. The first phase of the revisions makes the relatively straight-forward changes necessary to extend the new car I/M test exemption from four to six years. The Assembly adopted these revisions on May 26, 2009 and a revised SIP was submitted to ADEC shortly thereafter. This SIP revision also included an updated CO emission inventory and motor vehicle emission budget, and changes to the contingency measure provisions in the Plan. ¶

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projections and emission budget in the SIP with a new model called MOVES. The EPA has mandated MOVES for use in all attainment, maintenance and conformity budget determinations beginning March 3, 2012. As a consequence, the State and municipality decided to reanalyze the inventory, projections and emission budget in the SIP with the new MOVES model. This has resulted in some "technical revisions" to the SIP September 2010 revisions. Some of the tables, figures and projections have been amended to reflect new estimates provided by the MOVES model. Although the new MOVES modeling has resulted in numerical changes to the emission inventory and emission budget, the overall impact of this reanalysis on long term prospects for continued maintenance of the NAAQS or the ability to meet the conformity budget is insignificant. Other than changes to some of the tables and figures in the document, and some minor changes to the narrative, this document is unchanged from the September 2010 submission.

Deleted: Before these SIP revisions could proceed, however, it was necessary to determine whether Alaska statute or regulation prohibited the operation of a local I/M program not mandated in the SIP. MOA, ADEC and the Alaska Department of Administration's Division of Motor Vehicles (DMV) have worked together to examine the regulatory and operational issues associated with implementing a local option I/M program in Anchorage. They have concluded that a local option program is viable pending revisions to the Alaska Administrative Code and the execution of a memorandum of understanding between MOA, ADEC and DMV that lays out the roles and responsibilities of each entity in the operation of a local option I/M program in Anchorage.

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Deleted: 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 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 *Air Quality Advisory Committee* was appointed by the Policy Committee. The Air Quality Advisory Committee 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 participation 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 Implementation Plan for Air Quality.

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Plan Development

This maintenance plan is a natural extension of a research planning effort begun in early 1997. The MOA collaborated with EPA Region 10, ADEC and the Fairbanks North Star Borough on a number of research projects aimed at quantifying the contribution of vehicle cold starts and warm up idling on ambient CO concentrations in Anchorage and Fairbanks. These studies provided insights that were important in developing this plan and in preparing the attainment and maintenance plans that preceded it.

The most significant revisions proposed in this maintenance plan are the deletion of I/M as a primary CO control measure and the inclusion of I/M in the contingency plan. The contingency plan outlines the actions that will be taken if Anchorage violates the CO NAAQS in the future. The revised contingency plan can be found in Section III.B.7.

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 Air Quality Advisory Committee – The Air Quality Advisory Committee held a meeting to review the second phase of the revisions which delete I/M as a primary control measure in the SIP but retain it as a local option. A Revised Public Review Draft was released by the AMATS Technical Advisory Committee on March 18, 2010 for 45-day public comment. On May 6, 2010 the Air Quality Advisory Committee met to review the Revised Public Review Draft and to consider public comments received. During this meeting they recommended that the AMATS TAC and Policy Committees approve the Revised Public Review Draft of the Plan as drafted. The Committee met again on April 4, 2011 to review and approve technical revisions to the Plan related to reanalysis of the emission inventory, maintenance projections and emission budget using the new MOVES model.

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AMATS Technical and Policy Committees –The AMATS Technical Advisory Committee recommended approval of the the revisions during their meeting on May 13, 2010. They forwarded their own recommendation for approval to Policy Committee. The AMATS Policy Committee met on May 27, 2010 and forwarded their recommendation for approval to the Anchorage Assembly. Upon the recommendation of the AMATS Technical Committee, the Policy Committee approved MOVES-related technical revisions to the Plan on April 28, 2011.

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Anchorage Assembly –On June 8, 2010 the Assembly adopted Plan revisions which delete the commitment to I/M and make it a local option and directed that it be forwarded to ADEC for inclusion in the SIP. A copy of Anchorage Assembly Resolution (AR) 2010-174, adopting this CO Maintenace Plan, is included in the Volume III, Appendix to Section III.B.1. The Assembly approved MOVES-related technical revisions to the Plan on May 10, 2011.

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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 CO Maintenance Plan on August 2, 2010. This provided another forum for the public to comment on the air quality plan prior to state adoption and submission to EPA. No public comments were received. ADEC held a public hearing on MOVES-related technical revisions to Plan on ____________.

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III.B. 2. Maintenance Area Boundary

Portions of the MOA were first identified as experiencing high levels of ambient CO concentrations in the early 1970s. The nonattainment area within the MOA was first declared on January 27, 1978 after the completion of a monitoring study that measured CO concentrations at numerous locations. The results of that study were included in the 1979 State Air Quality Plan. EPA reaffirmed the boundaries of the nonattainment area on November 6, 1991 (56 Fed.Reg. 56694, 56711)(40 C.F.R. 81.302). These same boundaries serve as the Anchorage CO Maintenance Area contained within the boundary described as follows:

Beginning at a point on the centerline of the New Seward Highway five hundred (500) feet south of the centerline of O'Malley Road; thence,

Westerly along a line five hundred (500) feet south of and parallel to the centerline of O'Malley Road and its westerly extension thereof to a point on the mean high tide line of the Turnagain Arm; thence,

Northwesterly along the mean high tide line to a point five hundred (500) feet west of the southerly extension of the centerline of Sand Lake Road; thence,

Northerly along a line five hundred (500) feet west of and parallel to the southerly extension of the centerline of Sand Lake Road to a point on the southerly boundary of the Ted Stevens Anchorage International Airport property; thence,

Westerly along said property line of the Ted Stevens Anchorage International Airport to an angle point in said property line; thence,

Northerly along said property of the Ted Stevens Anchorage International Airport to an angle point in said property line; thence,

Easterly, along said property line and its easterly extension thereof to a point five hundred (500) feet west of the southerly extension of the centerline of Wisconsin Street; thence,

Northerly along said line to a point on the mean high tide line of the Knik Arm; thence,

Northeasterly along the mean high tide line to a point on a line parallel and five hundred (500) feet north of the centerline of Thompson Street and the westerly extension thereof; thence,

Easterly along said line to a point five hundred (500) feet east of Boniface Parkway; thence,

Southerly along a line five hundred (500) feet east of and parallel to the centerline of Boniface Parkway to a point five hundred (500) feet north of the Glenn Highway; thence,

Easterly and northeasterly along a line five hundred (500) feet north of and parallel to the centerline of the Glenn Highway to a point five hundred (500) feet east of the northerly extension of the centerline of Muldoon Road; thence,

Southerly along a line five hundred (500) feet east of and parallel to the centerline of Muldoon Road and continuing southwesterly on a line of curvature five hundred (500) feet southeasterly of the centerline of curvature where Muldoon Road becomes Tudor Road to a point five hundred (500) feet south of the centerline of Tudor Road; thence,

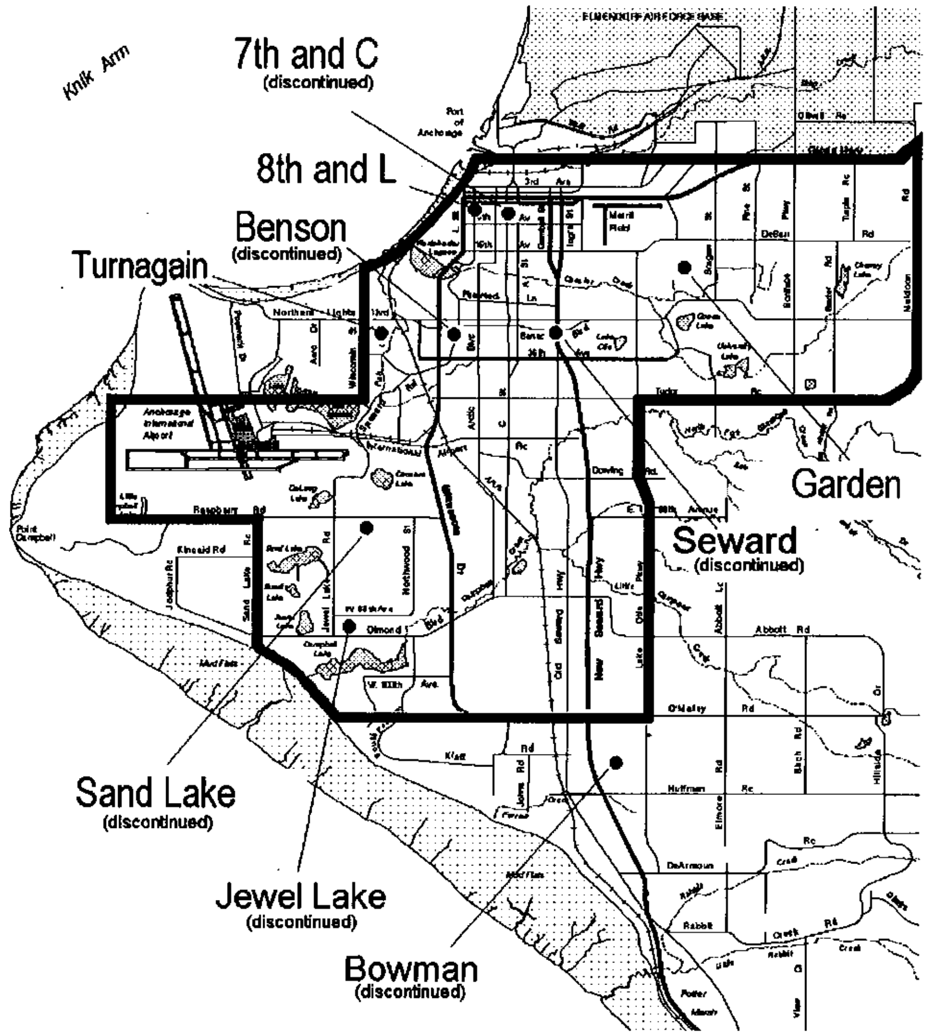
Westerly along a line five hundred (500) feet south of the centerline of Tudor Road to a point five hundred (500) feet east of the centerline of Lake Otis Parkway; thence,

Southerly, southeasterly, then southerly along a line five hundred (500) feet parallel to the centerline of Lake Otis Parkway to a point five hundred (500) feet south of the centerline of O'Malley Road; thence,

Westerly along a line five hundred (500) feet south of the centerline of O'Malley Road, ending at the centerline of the New Seward Highway, which is the point of the beginning.

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 and it became the maintenance area boundary for the Municipality of Anchorage on July 23, 2004 when the the EPA approved the original Anchorage 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 – 2007 Area-wide Base 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. This emission inventory, *Anchorage Carbon Monoxide Emission Inventory and Projections 2007 – 2023,* is contained in the Appendix to Section III.B.3. Motor vehicle emission estimates in the inventory and projections have been updated with the MOVES model.

The area inventoried includes the entire Anchorage maintenance area including areas to the west and east of the inventory boundary. These areas are included because of the growth and development that have occurred there over the past three 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 for base year 2007, almost 80% of winter season CO emissions in the maintenance area were from motor vehicles.[1] The MOVES model suggests that start emissions account for about two-thirds of all motor vehicle emissions.§ This result is consistent with local research conducted by Sierra Research on behalf of the ADEC, MOA, and Fairbanks North Star Borough which aimed at quantifying the contribution of cold weather warm-up idling on the emission inventory. This research indicated that cold starts and warm-up idling were very important components of overall 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] As a consequence, in Anchorage, a large portion of CO emissions occur in residential areas where these morning commute trips start.

Other significant sources of CO in Anchorage include aircraft and residential wood burning. Estimated 2007 CO emissions sources in Anchorage are summarized in Table III.B.3-1. In addition to the base year 2007 inventory, emission forecasts were prepared for 2009, 2011, 2013, 2015, 2017, 2019, 2021 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 200 one square kilometer grid cells that make up the Anchorage inventory area. These grid-based estimates of emissions were further resolved by time-of-day. An estimate of the quantity of CO emitted during the AM peak traffic period (7 AM – 9 AM), the PM peak (3 PM - 6 PM) and off peak periods (6 PM- 7 AM and 9 AM – 3 PM) was provided for each grid cell. The results and methodology used to prepare these inventories is discussed in detail in the Appendix to Section III.B.3.

§ In MOVES start emissions are defined as "the addition to running emissions caused by the engine start." If a vehicle spends a substantial time warming up, most of these emissions occur while the vehicle is stationary, before the trip begins.

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Deleted: Because a large portion of these motor vehicle emissions are produced from cold engines and warm-up idling, a significant amount of resources and effort were devoted to accurately quantifying these impacts. The EPA MOBILE model is 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.[3] ¶
¶
Over the course of a 24-hour winter day, warm-up idling is estimated to account for nearly a quarter of all vehicle emissions generated in the Anchorage bowl. In some residential areas, 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. ¶
¶

Table III.B.3-1

Sources of Anchorage CO Emissions in 2007 Base Year (Area-wide)

Source Category	CO Emitted (tons per day)	% of total
Motor vehicle – running emissions	40.5	25.4%
Motor vehicle – start emissions	84.8	53.4%
Motor vehicle – extended idling by combination long-haul trucks	0.3	0.1%
Ted Stevens Anchorage International Airport Operations	12.4	7.8%
Merrill Field Airport Operations	0.7	0.4%
Wood burning – fireplaces and wood stoves	6.2	3.9%
Space heating – natural gas	3.8	2.4%
Miscellaneous (railroad, marine, snowmobiles, snow removal, portable electrical generators, welding, etc.)	9.3	5.8%
Point sources (power generation, sewage sludge incineration)	1.3	0.8%
TOTAL	**159.3**	**100%**

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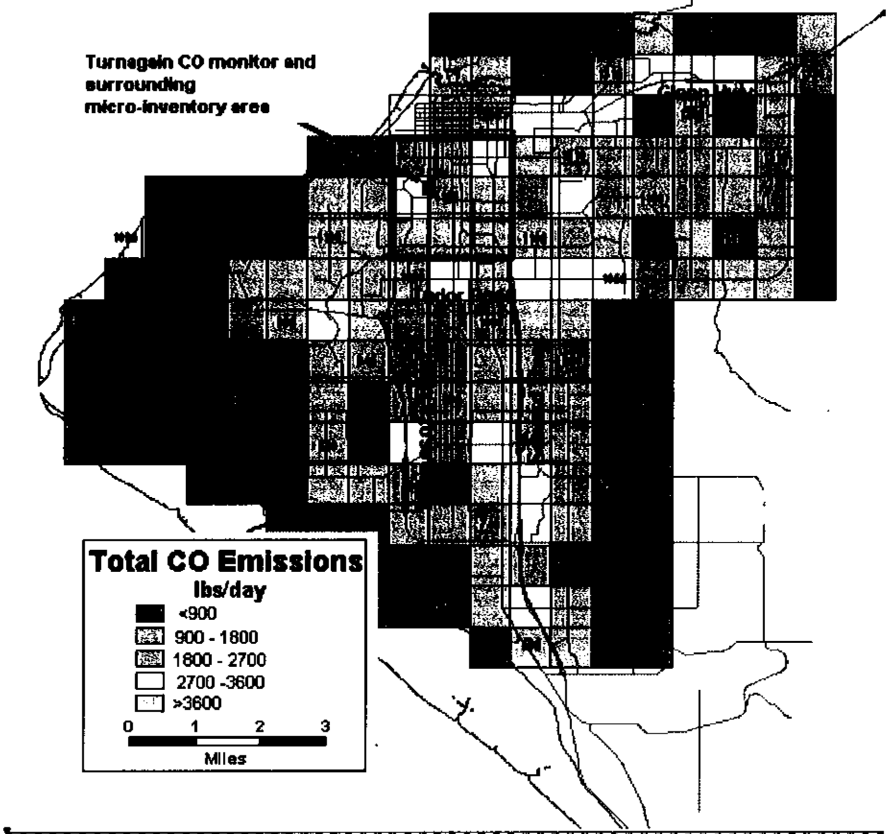
Analysis of CO Emissions Sources in Turnagain Area

In addition to the area-wide inventory discussed above, a micro-inventory was also prepared for the nine square kilometer area surrounding the Turnagain monitoring station in west Anchorage. The Turnagain station exhibits the highest CO concentrations of the current monitoring network; it has been shown to be approximately 20% higher than the next highest site. Analysis of historical CO data from over twenty monitoring locations in Anchorage suggests that the CO concentrations measured at this site are representative of the highest concentrations in Anchorage.[4] This micro-inventory provides added insight into the sources of CO in this particular area and is useful in developing appropriate localized control strategies. The boundaries of this nine square kilometer micro-inventory area are shown in Figure III.B.3-1 (a). This is one of the most densely populated and heavily trafficked areas of Anchorage. It also includes residential neighborhoods where vehicles are parked outside at night resulting in a prevalence of cold starts and warm-up idling. As can be seen in the figure, gridded inventory results suggest that CO emissions in this area are among the highest in the Anchorage bowl.

Figure III.B.3-1 (a)
CO Emissions Distribution in Anchorage
(Turnagain Micro-inventory Boundary noted with Red Border)



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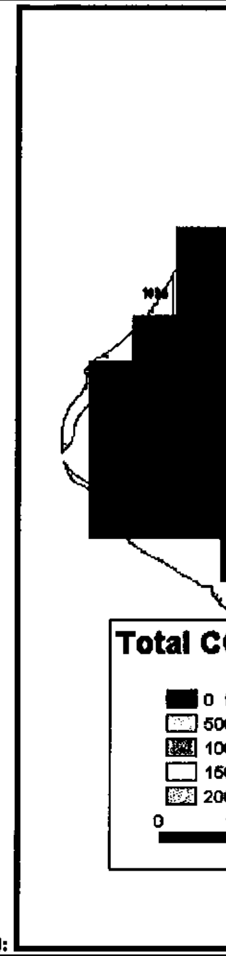

A breakdown of CO emissions in the Turnagain area is shown in Figure III.B.3-1 (b). Total estimated CO emissions during a 24-hour winter weekday were estimated to be 10.20 tons per day in 2007.

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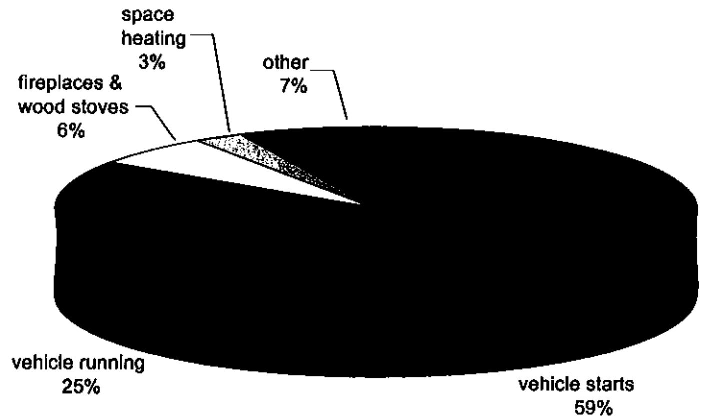
Figure III.B.3-1 (b)
24-Hour CO Emissions in the 9 km² Area Surrounding the Turnagain Station
Base Year 2007 Inventory



Total CO emissions = 10.20 tons per day

Evidence suggests that CO emissions from the Ted Stevens Anchorage International Airport, located approximately two kilometers west of the Turnagain monitoring site, have little effect on ambient CO concentrations in the Turnagain area. CO monitoring at the airport itself suggests that concentrations there are relatively low. The Winter 1997-98 CO Saturation Monitoring Study showed that maximum 8-hour CO concentrations measured at the airport (near the Fed Ex facility on Postmark Drive) were less than half those measured at the Turnagain station (see Figure III.B.3-2). CO sampling conducted in conjunction with the Ted Stevens Anchorage International Airport Air Toxics Study in January and February 2002 showed that sites along the airport perimeter had mean and maximum concentrations about four times lower than the Turnagain station.** Although total CO emissions from the airport are significant (12.4 tons per day in 2007), they are spread out over a large area so that the CO emissions density (amount emitted per square kilometer/day) is relatively low. The emission density in some one-kilometer grids immediately surrounding the Turnagain monitor is four or more times greater than the airport (see Figure III.B.3-1 (a).

Future Periodic Inventories

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

** These perimeter sites included locations in Kincaid Park and Little Campbell Lake just south of the airport and near the end of North Runway north of the airport. The Concourse B site was not included in the comparison because it was heavily influenced by automobile CO emissions. It was located close to the passenger pick-up and drop-off area at the concourse. Mean and maximum 8-hour CO concentrations there were about 20% below the Turnagain station.

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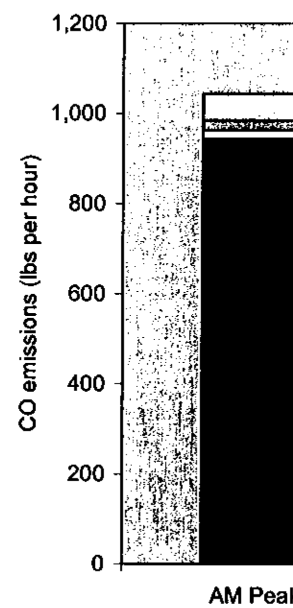
Figure III.B.3-1(c)
CO Emission Rate by Time-of-Day in Area Surrounding the Turnagain Station¶
Base Year 2007 Inventory ¶



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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.

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.

CO Saturation Monitoring Study (1997-98)

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)

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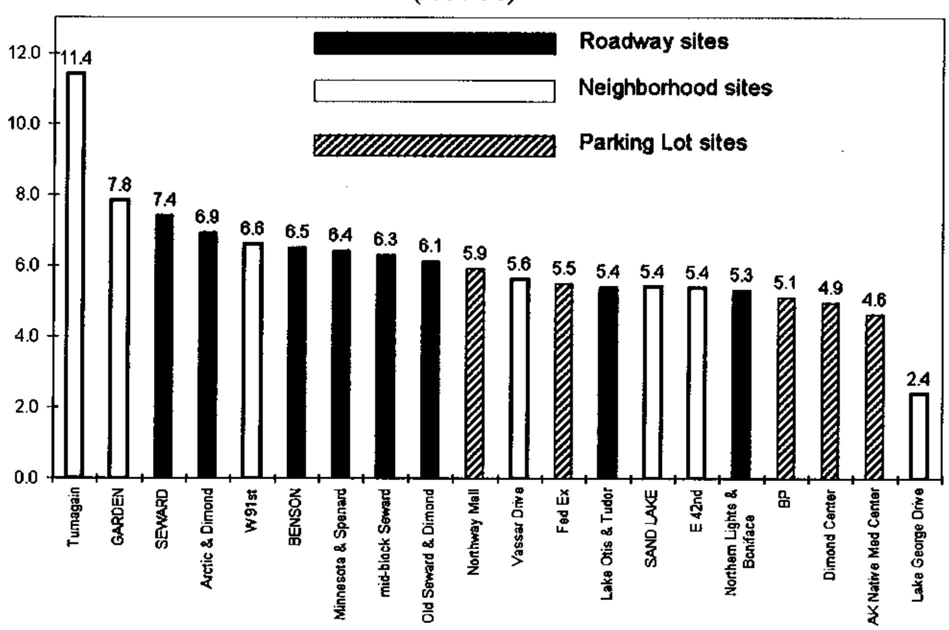

The highest 8-hour CO concentrations were found at neighborhood locations with relatively low traffic volumes. The Turnagain neighborhood site (at Turnagain Street and 31st Avenue) recorded the highest and second highest 8-hour concentrations in the study. The next highest site was the Garden permanent 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.

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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 (2000)

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.

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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 (1998 – 2001)

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.

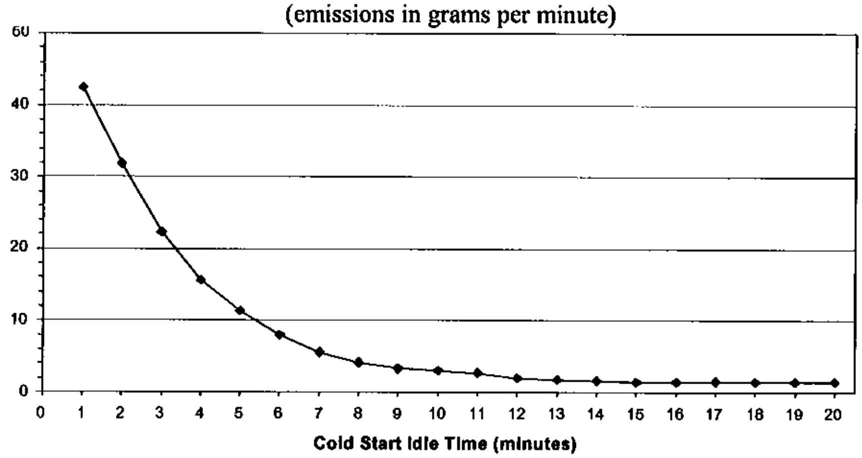
A second, follow-up vehicle emission study was conducted in Fairbanks during the winter of 2000-2001. For this study, Sierra Research procured a vehicle dynamometer that allowed vehicle emissions to be measured in simulated transient or travel mode. Sierra Research performed a gamut of tests on a sample 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.

Anchorage I/M Evaluation Study (2006)

During the winter of 2005-2006, under contract with the MOA, Sierra Research conducted dynamometer emissions testing on over 200 vehicles in order to quantify the CO emission reductions provided by I/M under "real world" conditions in Anchorage.[5] This testing simulated the driving behaviors and temperatures experienced in the winter when CO concentrations are the highest. Vehicles were recruited from owners whose vehicles had recently failed an I/M test in one of Anchorage's 80 privately-operated I/M testing facilities. Vehicles were tested both before and after repair to determine the CO reduction provided by the repair.

Some key findings:

- *The I/M Program is projected to reduce CO emissions from the Anchorage vehicle fleet by approximately 12% in 2010.††*
  This reduction was reasonably consistent with emissions reductions predicted by the EPA model MOBILE6 but about twice what is estimated using the MOVES model.
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- *The I/M Program is less effective in reducing cold start / warm-up idle emissions than reducing emissions from warm vehicles.*
  CO reductions resulting from I/M repairs were more than three times greater during the warm or "running" phase of the Alaska Drive Cycle (ADC) than during the 10 minute idle period following a cold start.
- *The I/M Program is less effective at reducing emissions from newer vehicles.*
  Because newer vehicles emit less CO, I/M repairs on these vehicles yield less benefit. On average, repairing a model year 1996 or newer vehicle that has failed I/M reduces CO by about 5 grams per mile. The repair of model year vehicles between 1990 and 1995 produces an average emission reduction nearly five times greater, about 24 grams per mile.

†† This is the estimated aggregate benefit of I/M. Based on emission testing of over 200 vehicles, Sierra Research estimated that I/M reduction from a *single* cycle of I/M testing and repair to be 5.1% among the fleet subject to I/M. When the effects of multiple I/M testing and repair cycles, seasonal waivers, and pre-inspection repairs were considered, the overall CO reduction benefit for the Anchorage fleet as a whole was estimated to be 12.1%.

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.

The highest CO concentrations tend to occur on days with low wind speeds, clear or partly cloudy skies, and cold temperatures. Weather conditions during periods when the 8-hour average CO concentrations at the Turnagain site were at or above the 98th percentile are summarized in Table III.B.3-3.‡‡ .The average temperature during these periods was 4°F, with a range from -16°F to +18°F. The average wind speed was 2 miles per hour.

It should be noted that 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. 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 than temperatures in west Anchorage. 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.

‡‡ CO data from Turnagain for the period October 1998 – December 2008 were analyzed to determine the 98th percentile 8-hour average concentration. This was computed to be 5.8 ppm. Table III.B.3-3 provides a summary of weather conditions during 8-hour periods when CO concentrations were equal to or higher than 5.8 ppm.

Table III.B.3-3
Meteorological Conditions during Periods of High CO Concentrations at Turnagain Monitoring Station (8-hour Average >= 98th Percentile)
October 1998 – December 2008

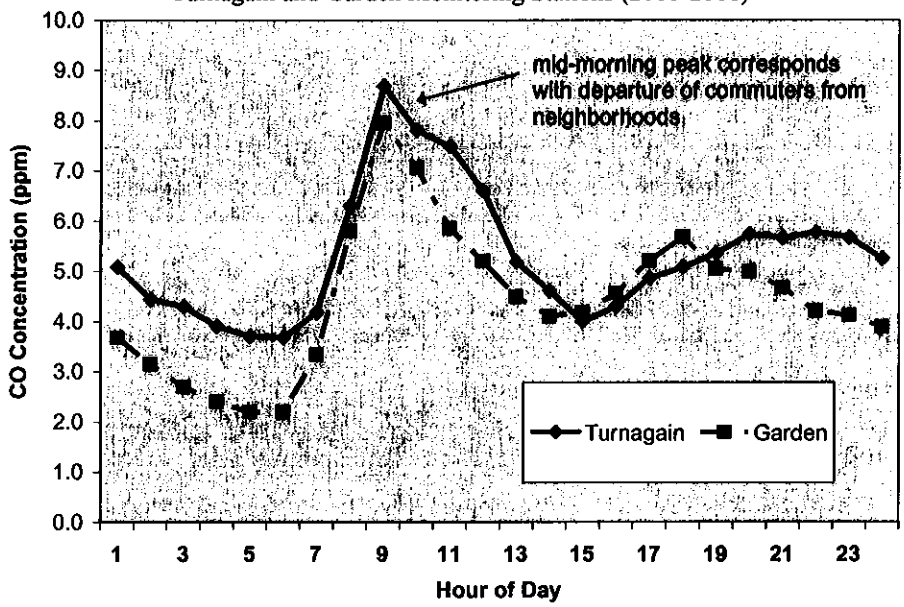
Date	8-hour Average (ppm)	Day of Week	Time of Day	Temp (°F)	Wind Speed (mph)	Sky Cover*
12/16/1998	7.69	Wed	4 PM - 12 AM	2	2	CLR
12/24/1998	8.06	Thu	4 PM - 12 AM	6	0	FEW
1/4/1999	5.90	Mon	4 PM - 12 AM	-1	4	CLR
1/6/1999	10.14	Wed	11 AM - 7 PM	2	2	FEW
2/7/1999	5.80	Sun	10 PM - 6 AM	-9	2	FEW
2/8/1999	7.31	Mon	3 AM - 11 AM	-9	7	SCT
2/11/1999	6.09	Thu	1 AM -9 AM	-16	4	CLR
2/22/1999	6.50	Mon	7 PM - 3 AM	9	3	BKN
2/23/1999	7.61	Tues	4 AM - 12 PM	11	0	OVC
11/10/1999	5.93	Wed	4 AM - 12 PM	10	4	CLR
11/27/1999	7.16	Sat	5 PM - 1 AM	10	1	CLR
12/6/1999	7.24	Mon	6 AM - 2 PM	9	5	CLR
1/15/2000	7.21	Sat	7 PM - 3 AM	2	3	CLR
2/17/2001	6.13	Sat	10 PM - 6 AM	15	2	CLR
11/13/2001	6.13	Tues	7 PM - 3 AM	14	0	SCT
11/14/2001	7.74	Wed	4 AM - 12 PM	12	0	SCT
11/30/2001	5.90	Fri	9 PM - 5 AM	1	2	FEW
12/3/2001	6.30	Mon	8 AM - 4 PM	-3	1	CLR
12/4/2001	5.95	Tues	8 AM - 4 PM	2	3	FEW
12/5/2001	7.23	Wed	7 AM - 3 PM	3	3	BKN
12/7/2001	6.28	Fri	5 PM - 1 AM	-7	3	BKN
12/16/2001	9.78	Sun	12 PM -8 PM	-8	5	SCT
12/18/2001	7.40	Tues	9 AM - 5 PM	-6	3	SCT
1/25/2002	5.86	Fri	4 AM - 12 PM	2	5	CLR
2/6/2002	6.49	Wed	4 AM - 12 PM	18	0	SCT
12/5/2003	8.27	Fri	5 PM - 1 AM	8	2	CLR
1/1/2004	7.48	Thu	2 PM - 10 PM	4	0	SCT
1/3/2004	7.61	Sat	1 PM - 9 PM	11	2	CLR
1/4/2004	7.88	Sun	12 PM -8 PM	6	3	BKN
1/5/2004	8.11	Mon	10 AM - 6 PM	5	0	FOG
1/12/2004	5.87	Mon	5 PM - 1 AM	6	1	FEW
1/17/2006	6.09	Tues	6 AM - 2 PM	8	2	BKN
1/24/2006	6.11	Tues	4 AM - 12 PM	-5	1	SCT
11/29/2006	6.53	Wed	8 AM - 4 PM	14	0	SCT
12/29/08	6.35	Mon	7 AM – 3 PM	-2	0	FEW

* Sky Cover is the fraction amount of sky obscured. CLR = 0, FEW = 1/8 - 2/8, SCT = 3/8 – 4/8, BKN = 5/8 – 7/8, OVC = 8/8

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 concentrations in the mid-morning following the morning commute and accompanying vehicle warm-up idle. Figure III.B.3-4(a) shows the 99th percentile hourly concentration measured at the Turnagain and Garden sites during the winter CO seasons (October-March) in the period 2000-2008. The diurnal patterns observed at these two sites are very similar and implicate cold start and warm-up idling as a significant source of emissions at both sites. CO concentrations rise quickly in the early morning hours as commuters start their cars and leave for work from these two residential neighborhoods. They peak between 9 and 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.

Figure III.B.3-4(a)
Diurnal Variation in 99th Percentile Hourly CO Concentrations at Turnagain and Garden Monitoring Stations (2000-2008)

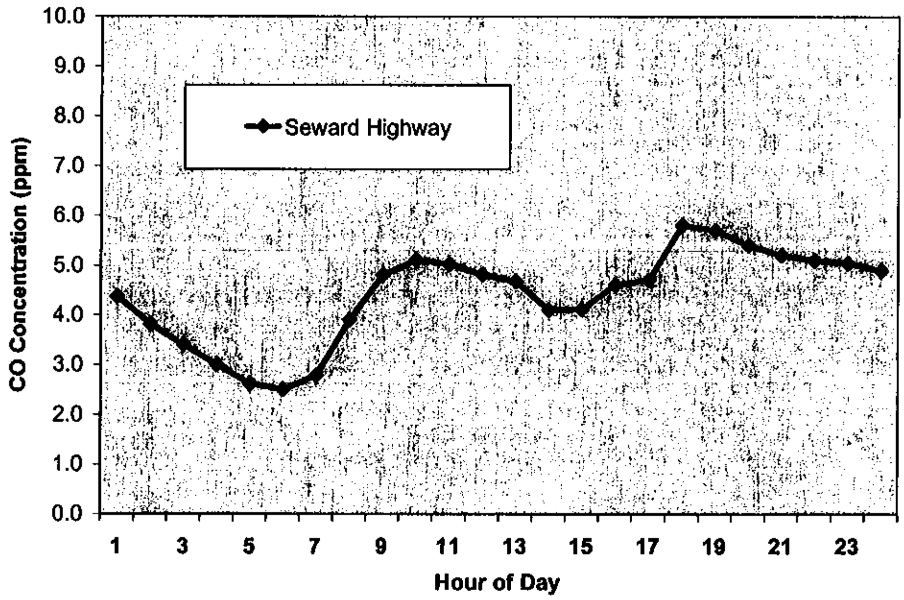


The diurnal pattern in CO concentrations near major traffic arterials is different than residential areas. Figure III.B.3-4(b) shows the diurnal pattern at the Seward Highway station, located at the busy intersection of the Seward Highway and Benson Boulevard§§ Although a morning peak is present, the highest concentrations in the day correspond with the evening commute. Concentrations peak between 5 and 6 p.m. and decline slowly

§§ The Seward Highway Station was decommissioned on December 30, 2004. This discussion and Figure III.B.3-4(b) therefore are limited to data collected from 2000-2004.

thereafter. 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(b)
Diurnal Variation in 99th Percentile Hourly CO Concentrations at Seward Highway Monitoring Stations (2000-2004)



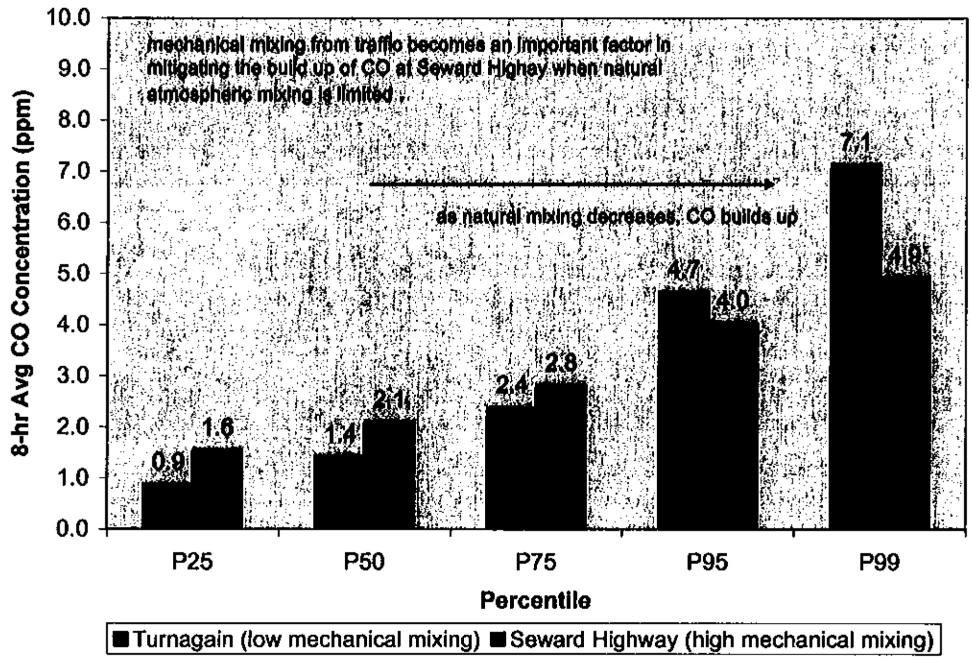
Role of Mechanical Turbulence from Vehicle Traffic in Reducing Ambient CO Concentrations during Stagnation Conditions

As noted to earlier, the highest CO concentrations in Anchorage tend to occur in residential neighborhoods rather than near 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 be higher than residential areas. Ambient monitoring data indicate that this is not the case.

In testimony given before a National Research Council committee assembled in 2001 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.[6] Monitoring data support this hypothesis.

Figure III.B.3-5 compares CO concentrations by percentile at the Seward Highway and Turnagain stations. Traffic volumes are an order of magnitude greater near the Seward Highway station than the Turnagain station. On days when natural atmospheric mixing from wind and thermal convection is good, the additional mixing provided by mechanical turbulence of vehicle traffic at Seward Highway is relatively unimportant. Under these conditions one would expect CO concentrations at Seward Highway to be higher than those at Turnagain because traffic and CO emissions are so much greater. Indeed, the lower quartile (P25) and median (P50) concentration are considerably higher at Seward than Turnagain. However, when a strong ground-based temperature inversion and lack of wind create very poor natural atmospheric mixing, mechanical mixing from vehicle traffic appears to be a very important factor in mitigating the build up of high CO concentrations. Under these extreme meteorological conditions concentrations at Turnagain are much higher than those at Seward Highway. The 99th percentile (P99) CO concentration at the Turnagain station is more than 40% higher than the Seward Highway station.

Figure III.B.3-5
Effect of Mechanical Mixing on CO Concentrations at
Seward Highway and Turnagain Stations



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, or between 2002 and 2008.

The highest and second highest 8-hour averages for five Anchorage monitoring stations are tabulated by year, 1980 – 2008, in Table III.B.3-5. The number of days exceeding the NAAQS at each station is also tabulated. Dramatic declines in CO have occurred in Anchorage over the past three decades.

Data from the 7th & C Street, Jewel Lake and Bowman, and 8th and L 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 was discontinued in March 2004 because concentrations measured there were lower than the other monitors operating in the network. The Bowman station in South Anchorage was operated from January 2006 through March 2007. It was discontinued because it too had low CO concentrations. The 8th and L station has only been in operations since October 2007.

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

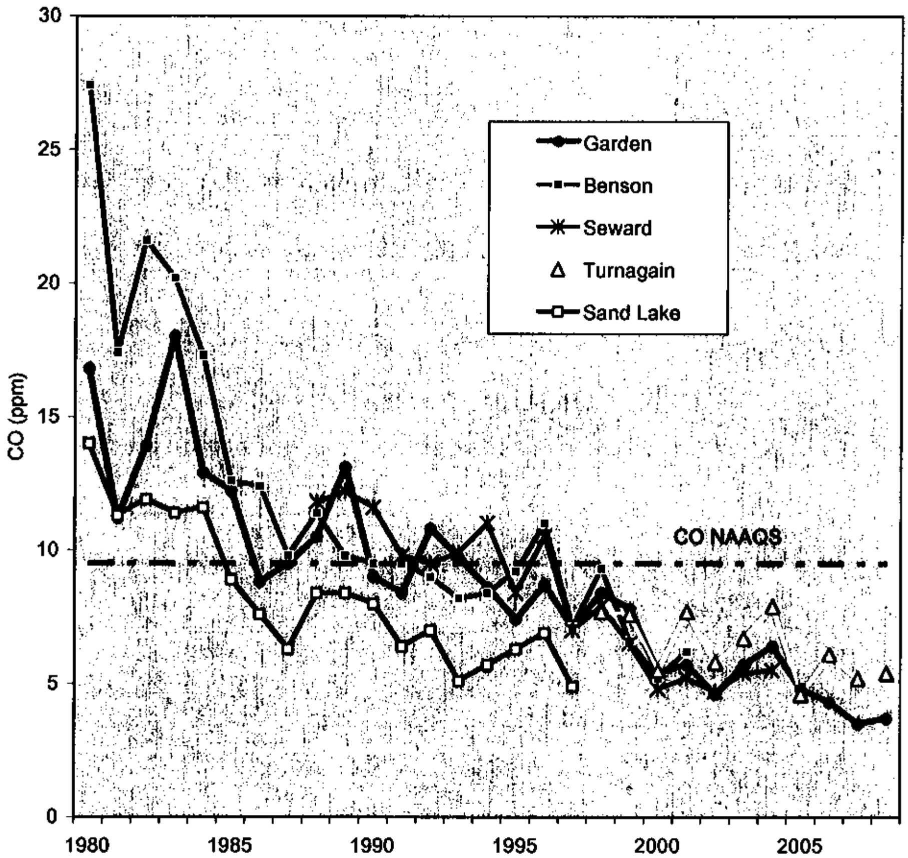
Summary of CO Data from Anchorage Monitoring Stations (1980 –2008)

	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
2003	--	--	--	6.1	5.7	0	--	--	--	6.2	5.4	0	8.3	6.7	0
2004	--	--	--	6.8	6.4	0	--	--	--	5.8	5.5	0	8.1	7.9	0
2005	--	--	--	4.8	4.8	0	--	--	--	--	--	--	5.7	4.6	0
2006	--	--	--	5.1	4.3	0	--	--	--	--	--	--	6.5	6.1	0
2007	--	--	--	4.0	3.5	0	--	--	--	--	--	--	5.5	5.3	0
2008	--	--	--	4.0	3.7	0	--	--	--	--	--	--	6.3	5.4	0

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

Annual second maximum concentrations recorded from these five sites are plotted in Figures III.B.3-6. Available data from 1980-2008 are plotted. The Garden station, located in an east Anchorage residential area provides the longest data record in the network. CO concentrations at Garden declined by 76% during this 29 year period. Benson, Sand Lake and Seward Highway experienced similar declines.

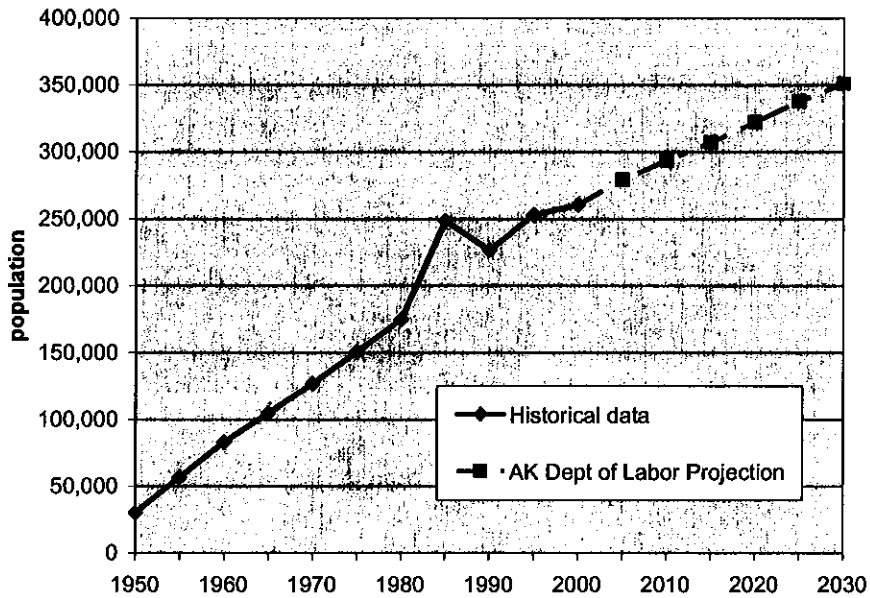
Figure III.B.3-6
Trend in 2nd Maximum 8-hour CO Concentration at Anchorage CO Monitoring Stations 1980 - 2008



Population Growth

Located in a state that has been historically subject to short-term cycles of economic booms and recessions, the Anchorage area has experienced a slowing, but stable pattern of long-term population growth in recent years. Between 1950 and 1990 the average rate of growth was nearly 5,000 persons per year. Growth between 1990 and 2008 slowed to about 3,500 per year. Growth over the next twenty years is expected to further slow to about 2,900 per year, slightly under 1% per annum. Figure III.B.3-7 depicts historic and projected population growth in the Municipality of Anchorage.***

Figure III.B.3-7
Population Growth and Projected Growth and in Anchorage, Alaska



Sources: U.S. Census (1950 -2000), Alaska Department of Labor (projections 2010 – 2030)

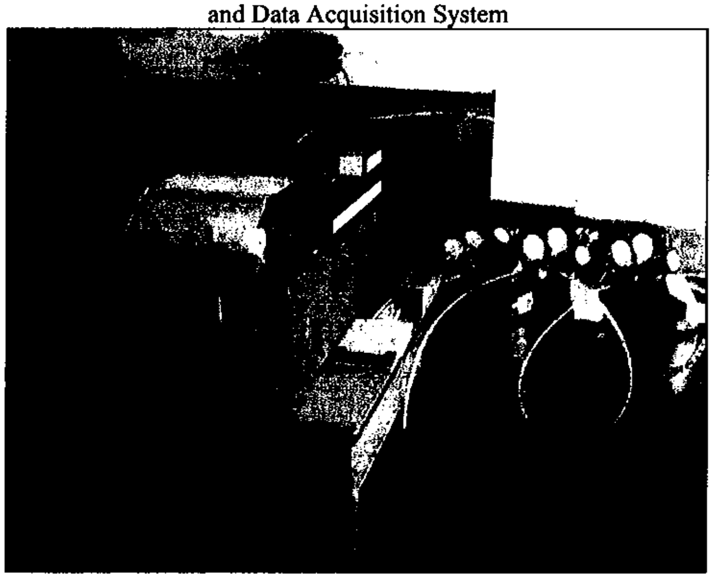
*** Figure III.B.3-7 includes population outside the Anchorage bowl but within the Municipality of Anchorage. Thus, the Eagle River-Chugiak and Girdwood areas are included.

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 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



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 for inclusion in the nationwide air quality database known as AQS. CO monitoring is conducted in conformance with guidelines established in federal regulations, 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. 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.

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Table III.B.4-1

Description of Anchorage CO Monitoring Sites

Location	Site Description
Turnagain (active)	Monitoring began at this neighborhood-scale site in October 1998 CO concentrations measured here were the highest of the twenty sites monitored during a saturation monitoring study conducted in the winter of 1997-98. It now exhibits the highest concentrations of the current network. It exceeded the NAAQS once in 1999 and 2001.
Garden (active)	Monitoring began at this residential neighborhood location at 16th and Garden Street in 1979. In the early 2000's, Garden typically recorded higher peak concentrations than the micro-scale sites at Seward Highway and at Benson.
Parkgate (active)	Monitoring began at this middle-scale site in Eagle River (approx 10 miles north of Anchorage) in December 2005. Thus far, concentrations appear to be low relative to other active sites (i.e., Turnagain, Garden) in the network.
8th and L Street (active)	Monitoring began at this middle-scale site in downtown Anchorage in October 2007. Thus far, concentrations appear to be low relative to other active sites in the network.
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. This site frequently recorded exceedances of the NAAQS in the late 1970's, 1980's and early 1990's. The last exceedance was measured here in 1996. Benson was decommissioned in December 2001 when it became evident that the Seward Highway site exhibited higher concentrations.
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 (discontinued)	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. In the late 80's and early 90's this site frequently measured exceedances of the NAAQS. However, no exceedances were measured after calendar year 1996. This station was decommissioned in December 2004 when it became clear that future exceedances at this site were unlikely and the highest CO concentrations were occurring in residential areas.
Jewel Lake (discontinued)	Monitoring began here at this neighborhood-scale site in west Anchorage in October 2002 and was discontinued in March 2004 because CO concentrations were lower than the other three sites in the network.
Bowman (discontinued)	Monitoring at this neighborhood-scale site in south Anchorage was conducted between January 2006 and March 2007. Monitoring was terminated when it became apparent that CO concentrations were very low at this site.

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

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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. Three saturation monitoring studies have been conducted by the MOA to assess the adequacy of the monitoring network. The 1997-98 saturation study resulted in the establishment of the 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.

III.B.5 Transportation Control Strategies

Control Measures Implemented as a Consequence of the 2004 Maintenance Plan

This section discusses the control measures implemented in fulfillment of commitments of the maintenance plan approved by the EPA in 2004 and previous attainment and maintenance plans. The Anchorage 2004 maintenance plan included I/M, the Share-A-Ride and Vanpool programs, 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. Note that this section includes a description of the I/M Program as it existed in 2007 when "new" vehicles were exempted for the first four years after initial purchase. In January 2010 this exemption was extended to six years. MOA's commitment to continued operation of I/M will cease upon approval of this document as a revision to the SIP.

The CO reductions from all the programs listed below were estimated for calendar year 2007 using a MOVES-based modeling approach.

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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. It has been included in all subsequent attainment and maintenance plans approved by the EPA including the maintenance plan approved in 2004. 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 for model year vehicles 1968-1995 and OBDII††† testing for 1996 and newer vehicles. The current program requires biennial testing but exempts new vehicles for the first four years after purchase.‡‡‡ According to an independent evaluation by Sierra Research in 2001, the Anchorage I/M program was rated among the best decentralized programs in the country.[7]

Cut points - CO emission cut points, the maximum tailpipe CO emission concentration allowed in a passing I/M test in Anchorage, are generally more stringent than the federal warranty limit of 1.2%. Cut points by vehicle category, as defined in Table 1 of AAC 52.037(b), are:

Light Duty Gasoline Vehicles (LDGV)

	Idle	2500 RPM
1968-1971	5.0%	4.0%
1972-1974	4.0%	3.0%
1975-1980	2.0%	2.0%
1981-1993	1.0%	1.0%
1994 and newer	0.5%	0.5%

††† OBDII refers to the second generation of On-board Diagnostic Systems on vehicles. OBDII was required on all MY 1996 and newer vehicles and allows I/M technicians to determine whether a vehicle's emission testing system is working properly by interrogating the OBDII computer on the vehicle.

‡‡‡ The I/M Program was modified slightly in January 2006 to expand the new car I/M testing exemption from two years to four years. The Municipality and the State submitted SIP revisions supporting the four-year test exemption to the EPA in 2006.

Light Duty Gasoline Trucks (LDGT1 and LDGT2)

	Idle	2500 RPM
1968-1972	5.0%	4.0%
1973-1978	4.0%	3.0%
1979-1983	2.0%	2.0%
1984-1993	1.0%	1.0%
1994 and newer	0.5%	0.5%

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, mandatory OBDII testing was implemented on July 1, 2001, ahead of the EPA mandated implementation date.

Enforcement - Working with ADEC, the MOA has implemented a number of changes to improve the effectiveness of enforcement against program evaders. ADEC has conducted parking lot surveys in Anchorage[8] that suggest that up to 10% of the vehicles operating in Anchorage could be evading I/M requirements. 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.

Estimated CO Reduction – The EPA MOVES model was used to estimate CO reductions from I/M in 2007. In 2007, the I/M program reduced area-wide CO emissions in Anchorage by an estimated 6.1 tons per day, about 5% of total vehicle emissions. Attributes of the MOA program are summarized in Table III.B.5-1.

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Table III.B.5-1

Attributes of Anchorage I/M Program in 2007

Program Element	**Year 2007 Anchorage Program**
Network type	Decentralized
Start date	July 1, 1985
Inspection frequency	Biennial, exemption for newest 4 model years
Model year coverage	1968 and newer
Vehicle type coverage*	Passenger cars and trucks, light commercial trucks
Test type	Two-speed idle (1995 MY and older) OBDII (1996 MY and newer)
Emission cut points	More stringent than federal limits
Under hood inspection**	Comprehensive visual and functional checks
Compliance rate	90% for 1995 MY and older, 93% for 1996 MY and newer
% Reduction in vehicle emissions in 2007	4.6%
Estimated CO Reduction in Year 2007	6.1 tons per day

** Visual and functional tests were not required for 1968-74 model year vehicles. For 1996 and newer vehicles, visual and functional tests were limited to catalyst and oxygen sensor inspection. 1975-1995 vehicles received a comprehensive visual and functional test.

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Share-A-Ride Program

Program Description – The Anchorage Share-A-Ride Program provides carpool and vanpool services to individuals travelling within or commuting to Anchorage. Carpooling was first identified as a CO control strategy in the 1982 MOA air quality plan. The vanpool program began in 1995. The Share-A-Ride Program was included in the 2004 CO Maintenance Plan as primary control measure. Carpooling and vanpooling programs are supported with Congestion Mitigation / Air Quality funding from the Federal Highway Administration.

In 2007, there were 365 individuals and 181 carpools actively participating in the program. The vanpool program has experienced substantial growth since its inception and there is an on-going demand for more vanpools especially among long distance commuters living outside of Anchorage in the Matanuska Susitna Valley, Eagle River-Chugiak and Girdwood. Table III.B.5-2 shows the growth that has occurred in the vanpool program over the last decade. In 2007 there were 42 vanpools and 589 vanpool riders; by 2008 this number had increased by another 20%.[9]

Table III.B.5-2 Vanpool Program Participation (1996-2008)		
Year	Number of Vanpools	Number of Vanpoolers
1996	9	126
1997	10	137
1998	11	151
1999	14	184
2000	18	231
2001	18	260
2002	21	270
2003	23	323
2004	24	363
2005	24	375
2006	41	569
2007	42	589
2008	52	810

Estimated CO Reduction – In 2007, based on program statistics, the carpooling and vanpooling components of the Share-A-Ride program eliminated approximately 800 cold starts and 10,000 miles of travel per day from the Anchorage roadway network. This resulted in an estimated CO reduction in the Anchorage maintenance area of approximately 0.3 tons per day, about 0.2% of motor vehicle emissions.

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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.[10] Survey data show that over three-quarters of the vehicles in the MOA are equipped with block heaters.[11] 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 the winter of 2004, the MOA initiated the Plug@20 public awareness campaign, encouraging vehicle owners to plug-in block heaters whenever temperatures dropped below 20 °F. Television, radio, and print media along with targeted advertising have been employed.

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The MOA and ADEC have provided additional incentives to encourage residents to plug-in. Since the winter of 1999-2000, nearly 10,000 programmable electrical timers, designed to turn block heaters on two-to-three hours prior to the morning commute, have been

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distributed free-of-charge to Anchorage residents. In addition, beginning in the winter of 2002-2003, and continuing on for the four following winters, residents who owned vehicles without block heaters could have them installed for a nominal charge of $25. When the program ended in December 2006, over 8,000 block heaters had been installed in Anchorage vehicles.

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Annual telephone surveys have been conducted at the conclusion of each winter since 2000 to assess the effectiveness of the block heater promotion and incentive programs. These 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. Survey data suggest that, even for those who have not received incentives, plug-in rates have increased as a result of TV, radio and print media advertising.

Estimated CO Reduction – Annual telephone survey data indicate that over 70% of respondents saw or heard the television or radio ads. Survey results suggest that plug-in rates have doubled from about 10% from October 1999 to about 20% in 2007. Survey data indicate that plug-in rates among those who have received either a free timer or subsidized block heater installations approach 50% when temperatures fall to 10°F or colder.

In 2007, on an area-wide basis, the increase in plug-in rates resulting from incentives and promotions provided an estimated CO reduction of about 0.9 tons per day. This amounts to a 0.7% reduction in area-wide vehicle emissions. The impact of block heater promotion and incentives in residential areas is likely greater because cold start emissions are a more significant part of total emissions. In neighborhoods with large numbers of vehicles parked outside, increases in block heater plug-in rates may play a significant role in reducing CO emissions from the morning commute. Some of the highest CO concentrations in Anchorage are experienced in these neighborhoods on cold winter mornings.

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Combined Impact of Control Programs on Base Year 2007 CO Emissions

In the year 2007, the combined reduction of the three CO control programs described above was 12.3 tons per day. These programs reduced daily motor vehicle CO emissions from an estimated 79.4 tons per day to 67.1 tons per day. Reductions are summarized in Table III.B.5-3.

Table III.B.5-3
Combined Reduction from Locally Implemented CO Control Programs in Anchorage (2007)
(tons per day)

I/M Program	6.1
Share-A-Ride Program (carpool and vanpool)	0.3
Engine Block Heater Promotion	0.9
Cumulative Benefit of Control Measures	7.3
% Reduction in Motor Vehicle Emissions	5.8%

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Stationary Source Program

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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 fifteen 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.

Primary Control Measure Commitments for the 2008 – 2023 Maintenance Plan Period

Section III B.6 contains an analysis of Anchorage maintenance prospects during the 2008-2023 maintenance plan period. The most significant revision in this plan from previous maintenance plans submitted to EPA is the deletion of the commitment to I/M as a primary CO control measure. Even if I/M continues to operate as a "local option," because the commitment to IM in the SIP has been removed, the CO reduction provided by I/M is assumed to be zero after 2012. The impact of eliminating the I/M Program on overall CO emissions in Anchorage and on the probability of continued maintenance of the CO NAAQS will be discussed in Section III.B.6.

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Under this Maintenance Plan, the probability of complying with the NAAQS is estimated to be 99% or higher each year during the period 2008-2023. In other words, even with deletion of I/M as a primary control measure, there is no more than a 1-in-100 chance of violating the standard in any year.

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Primary CO Control Measures

Three primary control measures will be implemented during the 2008-2023 maintenance plan period. These include air quality public awareness, transit marketing, and the ridesharing and vanpooling program. Because all of these programs rely on voluntary participation by the public in order to realize emission reductions, the CO reduction benefits of these programs were ignored in the analysis of maintenance prospects discussed later in Section III.B.6.§§§

The status of these four programs in the 2008-2023 maintenance planning period is discussed in more detail below.

Air Quality Public Awareness

Air quality public awareness was a key air quality improvement strategy and primary measure of the 2004 maintenance plan and this effort will continue. Survey data suggest that public awareness campaign efforts over the past eight years have resulted in measureable changes in engine block heater plug-in rates among Anchorage motorists. Air quality public awareness is supported by congestion mitigation / air quality funds from the Federal Highway Administration. Future funding is programmed in the 2010-2013 Anchorage Transportation Improvement Program (TIP). The public awareness effort is expected to broaden into other areas where changes in public behavior can result in improvements in CO air quality. Some of these areas include:

- Promotion of alternatives to the single occupancy vehicle such as bicycling, walking, public transit, car and vanpooling, telecommuting, and electronic meetings and conferencing.****

§§§ Generally speaking, the benefits of voluntary strategies are less certain. EPA guidance recommends excluding anticipated pollutant reductions from voluntary measures when analyzing prospects for compliance with the NAAQS. The EPA guidance regarding voluntary measures can be found in *Incorporating Emerging and Voluntary Measures in a SIP,* U.S. EPA, September 2004.

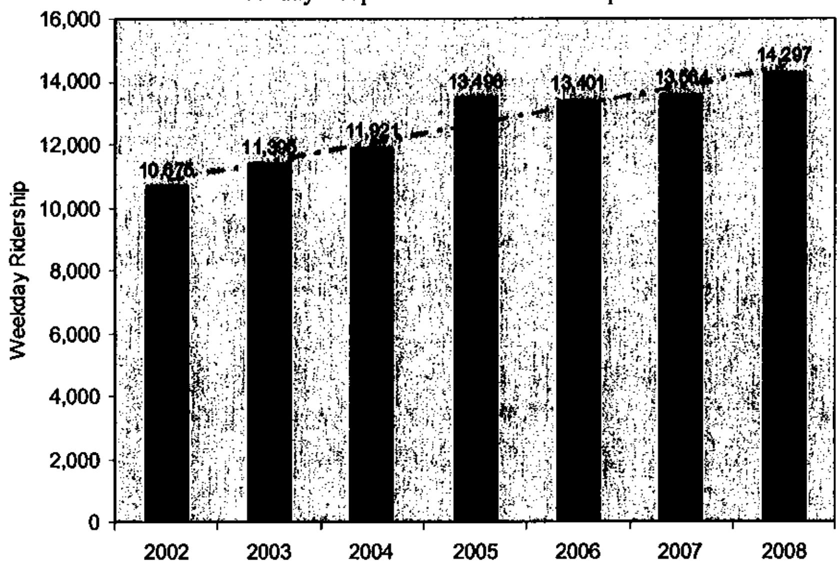
**** One important factor in the successful promotion of bicycling, walking and transit is providing safe and accessible routes for pedestrians and cyclists. This means making routes available that minimize conflicts with motor vehicle traffic and clearing snow promptly in the winter. Safe routes to school are particularly important

- Encouraging motorists to combine trips to reduce travel and the number of cold starts (i.e., promote trip chaining).
- Increasing public awareness with regard to the importance of regular vehicle maintenance in reducing air pollution and improving fuel economy. Simple maintenance checks such as air filter replacement, oil changes, and proper tire inflation can make a big difference.

Transit Marketing

Anchorage's public transit system, People Mover, receives congestion mitigation / air quality (CMAQ) funding from the Federal Highway Administration to advertise and promote its service in Anchorage. The Anchorage TIP includes funding through 2013 for transit promotion. Figure III.B.5-2 shows transit ridership has increased significantly over the past several years. [12] Although many factors have probably contributed to increased ridership, on-going marketing is an essential part of the continued growth of People Mover ridership. A transit marketing effort will continue, now as a committed primary measure in this Maintenance Plan.

Figure III.B.5-2
Weekday People Mover Bus Ridership



In 1998, as a direct result of its transit promotion efforts, People Mover reached an agreement with the University of Alaska that provides free bus service (called U-Pass) for their students and staff. Since that time Alaska Pacific University, Charter College have joined in with a faculty and staff pass program and most recently Conoco Phillips has joined the U-Pass program for all their Anchorage-based employees. Efforts to reach similar agreements with other employers and institutions are on-going.[13]

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for "school age" pedestrians and bicyclists. A significant number of vehicle trips could be eliminated if more students walked, biked or took the bus to school instead of being dropped off by parents.

Carpooling and Vanpooling

The 2004 maintenance plan committed to implementing a carpooling and vanpooling program in Anchorage. Support for Anchorage's Share-A-Ride Program will continue through the 2008-2023 maintenance plan period. As noted earlier in this section, the vanpooling program has experienced considerable growth in the past decade and demand for new service is on-going. CMAQ funds for support of the Share-A-Ride Program are programmed through 2013 in the Anchorage TIP.

Estimated CO Reduction Benefit from Implementation of Primary Measures 2008-2023

As noted earlier, because of the voluntary nature of the air quality public awareness, transit marketing and the Share-A-Ride programs, the CO reductions anticipated from these three measures are ignored in the assessment of future probability of compliance with the NAAQS. Nevertheless, survey data suggest that these measures are currently providing tangible CO reductions in Anchorage and they have the potential to provide additional reductions in the future. The combined current CO reduction from these three measures is estimated to be about 1.5 tons per day, about 1% of total emissions.

Deleted: The I/M Program is projected to reduce motor vehicle CO emissions by roughly 15% during the 2008-2023. However, because the motor vehicle fleet is expected to grow progressively cleaner over time, the absolute magnitude of emission reduction provided by I/M drops from about 10.2 tons per day in 2011 to 8.8 tons per day in 2023.

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Ancillary Benefits of Primary Measures

Although reducing CO emissions has been a prime focus in Anchorage for three decades, there is growing realization of the need to reduce other air pollutants. Monitoring data in Anchorage suggest that ambient concentrations of benzene, a known human carcinogen associated with leukemia, are among the highest in the U.S. Alaska gasoline contains more benzene than most of the U.S. and motor vehicles are a significant source of this toxic air pollutant in Anchorage. Studies conducted in Fairbanks by Sierra Research suggest that strategies aimed at reducing CO also reduce benzene. Like CO, emissions of hydrocarbons such as benzene tend to be highest during cold start and warm-up idle when engines are cold. Thus, using an engine block heater prior to a cold start not only reduces CO emissions but also benzene and other air toxics.[14]

Greenhouse gas emissions are of growing concern globally and locally. Besides being a source of CO, motor vehicles are a significant source of carbon dioxide (CO_2) and other greenhouse gas emissions. This plan supports the use of transit, carpooling and vanpooling, telecommuting, walking, bicycling and other alternatives to the single occupancy vehicle. Besides reducing CO emissions, these strategies provide CO_2 emission reduction benefits. As these strategies become more successful, CO_2 reductions increase.

This plan recognizes the importance of addressing other air pollutants even if they are unrelated to CO emissions. The Municipality of Anchorage is committed to examining new technlogies that lead to reduction of air pollutant emissions including CO_2 and diesel particulate. The Muncipality is examining the purchase of of high fuel economy vehicles, including hybrid electrics, for its own fleet.

Consistency with Other Municipal Plans and Programs

The air quality improvement strategies outlined in the CO Maintenance Plan rely in large part on reducing the dependence on the single occupancy vehicle by enhancing alternative transportation modes such as transit, carpooling, vanpooling, bicycling and walking. This strategy is consistent with many other plans and programs adopted by the Municipality.

One of the goals of the *Anchorage Long Range Transportation Plan* (LRTP) is to "provide a transportation system that provides viable transporation choices among various modes." Objectives include the "development of a safe network of trails and sidewalks that provide year-round, reasonable access to work, schools, parks, services, and the natural environment." Meeting these objectives will make walking, cycling and transit more attractive, reduce single occupancy vehicle use and help decrease air pollution, including CO. The LRTP also recognizes the need for transit service improvements and endorses recommendations included in *The People Mover Blueprint: A Plan to Restructure the Anchorage Transit System.* Additional buses and stable funding will be necessary to attain the goals and objectives identified in the route restructuring plan.

The Municipality is in the process of developing a plan that will address specific needs as related to pedestrian and bicycle travel. This Non-Motorized Plan was identified in the LRTP as a task to be completed. The first chapter of the Non-Motorized Plan, the Pedestrian Plan was adopted by the Municipality in October 2007. The Pedestrian Plan establishes a 20 year framework for improvements to enhance the pedestrian environment and increase opportunities to choose walking as a mode of transportation. The Pedestrian Plan features a list of over 300 capital projects in the Municipality that will create safer and more pleasant places to walk. The Municipality recently adopted the next chapter of the Non-Motorized Plan, the Bicycle Plan. This Bicycle Plan identifies a network of facilities to be used by commuter cyclists to navigate Anchorage more safely. Both of these plans identify ways for Anchorage to develop the infrastructure necessary to make walking and bicycling more attractive as a means to get to work, school and shopping.

III.B.6 Modeling and Projections

EPA, based on its regulatory guidance, prefers that dispersion modeling techniques be used to demonstrate attainment and maintenance of air quality standards in State Implementation Plans. In May of 2002, representatives from the MOA, FNSB and the ADEC 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[15], 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 micro-scale meteorological parameters needed for adequate model performance for regulatory purposes. Therefore, after evaluating several options, the participants settled on the use of a probabilistic roll-forward approach in the maintenance demonstration.

As general guidance, EPA staff has stated that this maintenance demonstration should show a 90% or greater probability of complying with the NAAQS each year during the maintenance planning period. The modeling analysis discussed in this section assumes that the CO reductions provided by the I/M Program will be zero in 2013 and beyond.††††

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Probabilistic Roll-Forward Modeling / Maintenance Demonstration

Because the Turnagain site exhibits the highest CO concentrations in the monitoring network, a regression analysis of observed second 8-hour maximum CO concentrations at this site was performed.§ Using commonly accepted statistical techniques, the CO regression line and upper-bound 90th percentile prediction interval were computed. In theory, 90% of observed second maximum concentrations should fall below this interval. The upper-bound 90th percentile prediction interval values for 2007 serves as the design value (DV).

A nine square kilometer area surrounding the Turnagain site was identified and the emissions within this area were inventoried for base year 2007 and projected through 2023. (See Figure III.B.3-1 (a)) Conventional statistical methods were used to estimate the probability of complying with the NAAQS in the year 2007, the base year for the analysis. The "roll forward" technique, used in the previous maintenance demonstration, was used to estimate probability of complying with the standard in future years. This technique relies on CO emissions projections for years 2008 through 2023 to help estimate the probability of complying with the NAAQS during this time period. A more detailed description of the methodology used in this analysis can be found in the Appendix to Section III.B.6.

†††† The actual termination date for I/M is unknown. The commitment to I/M will continue until EPA approves this SIP revision; this could take up to 18 months from submission. For the purpose of this maintenance demonstration, a 2013 termination date for I/M was assumed.

§ Although not shown here, a similar analysis was also performed on data from the Garden station. Because Garden has lower CO concentrations than Turnagain, the computed probability of complying with the NAAQS is substantially higher at Garden than Turnagain. Thus, Turnagain provides a more rigorous analysis with regards to the likelihood of a future violation.

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The probabilistic roll-forward procedure consists of 5 basic steps:

1. Compute the base year 2007 DV using the 90th percentile prediction interval from Turnagain station CO data.
2. Compile the 2007 base year CO inventory and determine the quantity of emissions generated in the nine square kilometer area surrounding the Turnagain monitoring station during a 24-hour "design day." A design day is defined as a winter weekday when a CO violation is most likely to occur. Emission modeling assumptions (i.e. ambient temperature, traffic activity, etc.) reflect conditions on the design day.
3. Using the roll-forward technique, the computed 2007 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 at Turnagain.
4. Using the roll-forward equation, compute the quantity of emissions that can be generated within the Turnagain site area 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 the nine kilometer square area surrounding the Turnagain site, project the quantity of CO emissions generated on a design day in 2009, 2011, 2013, 2015, 2017, 2019, 2021, and 2023 to assess whether compliance of the NAAQS will be maintained throughout the 2008-2023 maintenance plan period with a 90% probability or greater.

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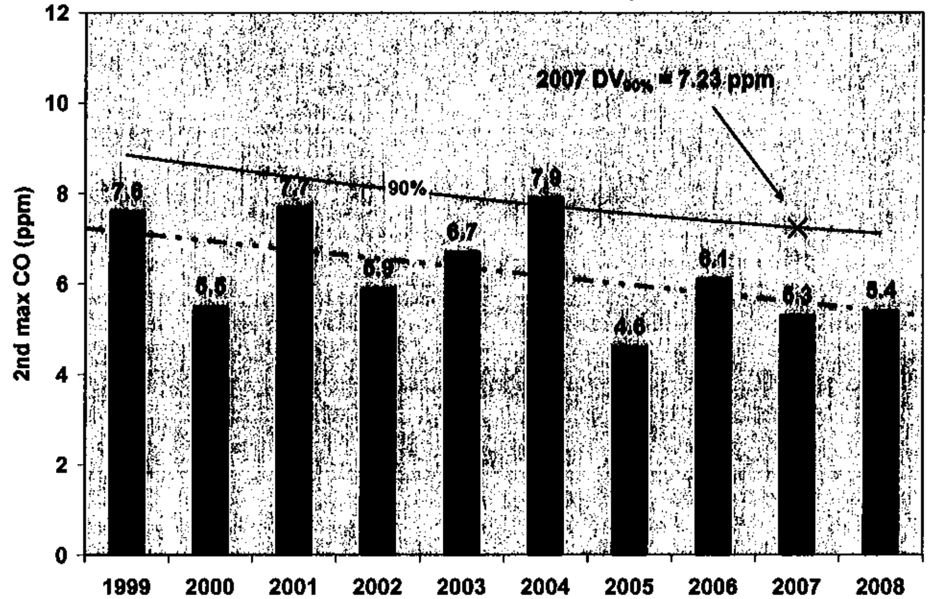
A description of how this procedure was applied in the nine square kilometer area surrounding the Turnagain monitoring station follows.

Step 1: Computation of 2007 DV for Turnagain Monitoring Station

The probabilistic approach referred to above was used to compute the DV for the Turnagain Highway monitor. Results of the statistical procedure employed to compute the DV are illustrated in Figure III B.6-1. The computed 2007 DV is 7.23 ppm.

Figure III.B.6-1
Computation of Probabilistic DV for 2007 from
90th Percentile Prediction Interval at Turnagain Station



Step 2: Computation of Micro-area Emission Inventory for Turnagain Station

A gridded emission inventory comprised of the 200 one-kilometer square grids that make-up the Anchorage bowl was prepared for base year 2007. 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 the EPA MOVES model to estimate mobile source CO emissions. The modeling analysis is 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.

A micro-area inventory for the nine square kilometer area surrounding the Turnagain monitor was compiled by summing the CO emission estimates from each of the nine grid cells that comprise the area. CO emissions are summarized in Table III.B.6-2.

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Table III.B.6-2 Estimated Year 2007 CO Emissions in Nine Square Kilometer Area Surrounding the Turnagain Monitoring Station (emissions in tons per day)				
Motor Vehicles	Fireplaces or Woodstoves	Space Heating	Other	TOTAL CO EMISSIONS*
8.61	0.62	0.28	0.70	10.20

* Numbers do not sum due to rounding

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Step 3: Use Roll-Forward Equation to Calculate Allowable Emission Increase at Turngain Station

The roll-forward equation can be used to compute the amount that CO emissions can be increased and still maintain compliance with the NAAQS. The equation is written as follows:‡‡‡‡

$$\%\ allowable\ emission\ increase = \frac{NAAQS - DV}{DV - bkg} x100 = \frac{9.0 - DV}{DV - bkg} x100$$

In the equation above the DV was computed in Step 1 to be 7.23 ppm but the background concentration *(bkg)* has not yet been defined. Note, that the background value yielding the least allowable percentage increase in emissions is zero. Thus the most conservative assumption for computing allowable emissions is a background value of zero. This was utilized in this maintenance demonstration. The allowable increase in emission in the Turnagain area from base year 2007 is calculated as follows:

$$\%\ allowable\ emission\ increase = \frac{9.0 - 7.23}{7.23 - 0.0} x100 = 24.5\%$$

Thus, in the Turnagain area, emissions can increase from 2007 levels by 24.5% and still maintain a 90% probability of compliance with the NAAQS.

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

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If the allowable emission increase at each monitoring station is known from Step 3, the quantity of CO that can be emitted in the nine square kilometer area surrounding the Turnagain station and still meet compliance with 90% probability can be determined from the 2007 micro-inventory. The result of this computation is shown in Table III.B.6-3.

‡‡‡‡ Note that the value assumed for the NAAQS in this equation is 9.0 ppm when in fact 8-hour CO concentrations below 9.5 ppm meet the NAAQS. This lends an added margin of safety to the computation.

Table III.B.6-3

Allowable Emissions in the Nine Square Kilometer Area Surrounding the Turnagain Monitoring Station (Maintain >= 90% Probability of Compliance)

2007 Emissions (tons per day)	2007 Emissions (tons per day)	Allowable Emissions (tons per day)
10.20	24.5%	12.70

Step 5: Prepare CO Emission Projections for 2008-2023 and Assess Prospects for Continued Compliance with the NAAQS

Prospects for continued compliance with the NAAQS during the 2008-2023 maintenance plan period were assessed by preparing emission projections for a design day in 2009, 2011, 2013, 2015, 2017, 2019, 2021 and 2023. The Anchorage Transportation Model was run for analysis years 2007, 2017, and 2027. Although mobile and area source activity levels in intervening years were interpolated, mobile source emission factors were estimated by running MOVES 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.

MOVES was run with the assumption that the I/M Program will change from a four year new car exemption to a six year exemption in January 2010 and would be discontinued prior to 2013.

As noted earlier, any CO reductions that might result from enhancements to the other primary control measures discussed in Section III.B-5 (i.e., air quality public awareness, rideshare/vanpooling, transit marketing) have been ignored in these emission and compliance projections. Although the MOA and ADEC intend to continue and enhance current efforts to increase plug-in rates among motorists, plug-in rates were conservatively assumed to remain at year 2007 levels throughout the maintenance plan period. Anticipated growth in vanpooling and transit ridership has also been disregarded. This provides an added measure of conservatism to the computations.

Figure III.B.6-3 shows projected emissions and prospects for continued compliance with the NAAQS at the Turnagain station. (Projected CO emissions increase in 2013 because CO reductions provided by I/M are assumed to cease in that year.) In theory, the probability of

§§§§ It should be noted that when MOVES vehicle start emission rates for Anchorage were examined, they were found to *increase* between 2007 and 2015. (Running emission rates declined as expected.). The increase in the start emissions rate appears to be an anomaly because emission rates are normally expected to decline over time due to improvements in the vehicle fleet. This is almost certainly true in this case because new cold temperature emission standards have been mandated by EPA for vehicles beginning with model year 2010. The MOVES model "anomaly" seems to be most obvious at cold ambient temperatures assumed in the Anchorage modeling. We understand that EPA is investigating and that if a problem is found it will be remedied in a future release of MOVES. The impact on the overall emission trend analysis presented here and in the CO Maintenance Plan is relatively insignificant, however.

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Deleted: Cold start / warm-up idle emissions were estimated using data collected by Sierra Research in testing programs conducted in 1998-1999 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.[11] 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. ¶
¶
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 a block heater also declines). For example, the plug-in benefit falls from 86 grams in 2000 to 52 grams per cold start in 2013. ¶ [... [5]]
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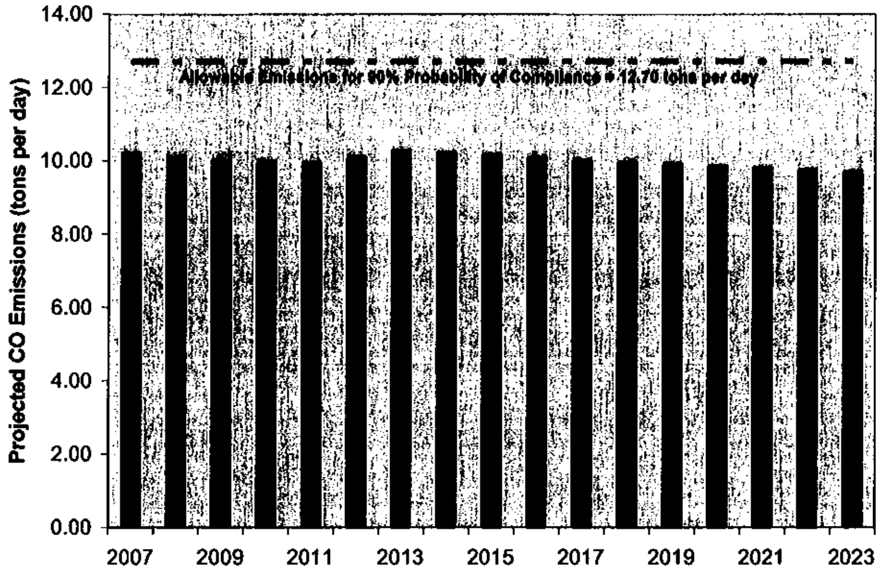
maintaining compliance with the NAAQS in any given year is 90% or greater if emissions remain below the allowable emission levels identified in the figure.§§§§

Figure III.B.6-3

Compliance Prospects at the Turnagain Station through 2023



Conclusions Regarding Long-Term Prospects for Compliance with the CO NAAQS in Anchorage

The preceding analysis suggests there is a very high probability of continued compliance with the CO NAAQS. Anchorage has not violated the NAAQS since 1996 and no exceedances have been measured since 2001. During the period 2008-2023, the estimated probability of complying with the NAAQS is 99% or greater each year.

An additional analysis was performed (see Appendix to Section III.B.6) to see how sensitive the compliance projections were to assumptions about the growth in emissions over time and the effect of eliminating the I/M Program. This sensitivity analysis examined a "worst case" scenario in which:

(1) the growth in vehicle travel in the Turnagain area was assumed to be three times greater than projected (vehicle activity would increase by 12% between 2007 and 2023 instead of the 4% assumed);

(2) a 2% per annum growth in wood heating was assumed among households in the Turnagain area resulting from high natural gas prices.

Using these substitute assumptions, CO emissions were re-estimated for the 2008-2023 period and the resultant probabilities of complying with the NAAQS were re-computed.

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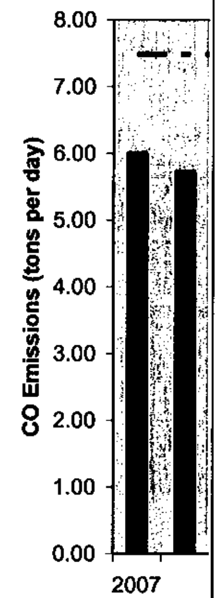

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Even with the assumed higher rates of growth in vehicle travel and wood burning, the probability of compliance is estimated to be greater than 98% each year through 2023.

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The sensitivity analysis provides additional confidence that there is a high likelihood that Anchorage will remain in compliance with the NAAQS even if future growth in vehicle travel and wood burning is more rapid than anticipated in the projections presented earlier.

Impact of Deleting I/M as a Primary Control Measure in the SIP on Other Criteria Pollutants

Section 110(l) of the Clean Air Act states:

> *Each revision to an implementation plan submitted by a State under this Act shall be adopted by such State after reasonable notice and public hearing. The Administrator shall not approve a revision to a plan if the revision would interfere with any applicable requirement concerning attainment and reasonable further progress (as defined in section 171), or any other applicable requirement of this Act.*

A review of EPA's Green Book***** shows that, with the exception of CO, Anchorage has not been classified as nonattainment for any of the criteria pollutants, including: ozone, PM-2.5, PM-10, sulfur dioxide, nitrogen dioxide and lead. It should be noted, that unlike Fairbanks, PM-2.5 concentrations in Anchorage are well below the current 24-hour and annual NAAQS.

***** *http://www.epa.gov/oar/oaqps/greenbk/index.html*

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III.B.7 Contingency Plan

Section 172(c)(9) of the CAAA requires individual nonattainment plans to "provide for the implementation of specific measures to be undertaken if the area fails to make reasonable further progress, or to attain the national primary ambient air quality standard by the (applicable) attainment date . . . ." It further states that such contingency measures shall be structured to take effect, if triggered, without any further action by the State or EPA.

Because I/M and the ethanol-blended gasoline program were control measures in the previous Anchorage attainment plan, they must be included as contingency measures to be implemented if needed to address future violations of the CO NAAQS.

In addition, a number of other control measures are included in the contingency plan for possible implementation. The menu of control measures available for implementation and the projected amount of time needed for implementation after being triggered by a violation of the NAAQS is listed in Table III.B.7-1.

In the event monitoring data indicate that a violation of the ambient CO standard has occurred, Anchorage would examine the data to assess the spatial extent (i.e., hot spot versus region), severity and time period of the episode as well as trends over time.††††† Based on this information, Anchorage, in consultation with ADEC, would determine which measure or measures in Table III.B.7-1 to implement.

Table III.B.7-1

Menu of Anchorage Contingency Measures

Contingency Measure	Projected Time Necessary for Implementation
Increase public awareness and education, transit, carpool and vanpool promotion efforts	6 to 12 months
Curtail or limit use of fireplaces, wood stoves and other wood burning appliances when high CO is predicted	6 to 12 months
Promote increase in transit ridership among commuters by offering reduced fares, or free transit fares for employees of companies that contribute to subsidy.	12 to 24 months
Reinstate block heater installation subsidy	12 to 24 months
Reinstate ethanol-blended gasoline	12 to 24 months
Reinstate I/M	12 to 24 months

The schedule for completing the above process would allow one month for data analysis and control measure selection once the data are validated. The time required for control measure implementation would depend on the measure(s) selected, but in no case would extend

††††† For example, if the CO violation(s) occurred in a residential area during evening hours and was associated with elevated PM-2.5, it might implicate residential wood heating as important factor in the violation. Thus, it might be appropriate to implement a curtailment or restriction of fireplace and wood stove use when high CO episodes are predicted.

beyond 24 months of the violation. If inventory revisions in future years indicate the probability of attainment will drop below a 90% confidence interval, Anchorage would conduct a similar analysis and consultation process with ADEC to select and implement the appropriate control measure or measures. Once implemented, Anchorage will track monitoring data and determine in consultation with ADEC whether additional controls are needed.

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. The plan was developed and published by the MOA in October 1993 and adopted by reference under AMC 15.30.06. Copies of the plan are available from the MOA, Department of Health and Human Services. A copy of AMC 15.30 is included in the Appendix to Section III.B.8.

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 the State or the local government designated by the State for such purposes (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 the State has relied on a local government for the implementation of any plan provision, the State retains responsibility for ensuring adequate implementation of such plan provisions.

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 to Section II, and copies of AMC 15.30 and 15.35 are included in Volume III, Appendix to Section III.B.8.

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. As noted in Section III.B.5, the commitment to continued operation of I/M will cease upon approval of this document as a revision to the SIP. However, if the Assembly so chooses, I/M may continue as a local option as stipulated in local ordinance. AMC 15.80 is included in the Appendix to Section III.B.9.

The State of Alaska retains the regulatory authority to reestablish the I/M and oxygenated fuels programs under 18 AAC 52.007, 18 AAC 52.005(i) and 18 AAC 52.030 in the event that the I/M area violates the NAAQS for carbon monoxide in the future.

Adequate Local Personnel and Funding

Air quality monitoring and planning in Anchorage is performed by the Municipal Department of Health and Human Services (DHHS). These functions are currently supported by revenues from I/M Program Certificate of Inspection fees and an annual Section 105 grant from EPA.[‡‡‡‡‡] The overall budget and staffing level of the air quality program is reviewed annually by the MOA Administration and by the Anchorage Assembly. This process provides a means to address needs on a timely basis, consistent with requirements outlined in the Municipal charter and ordinance.

‡‡‡‡‡ In 2007, air quality program activities in DHHS were supported with $323,000 in I/M Program revenues and with a $135,195 EPA Section 105 grant.

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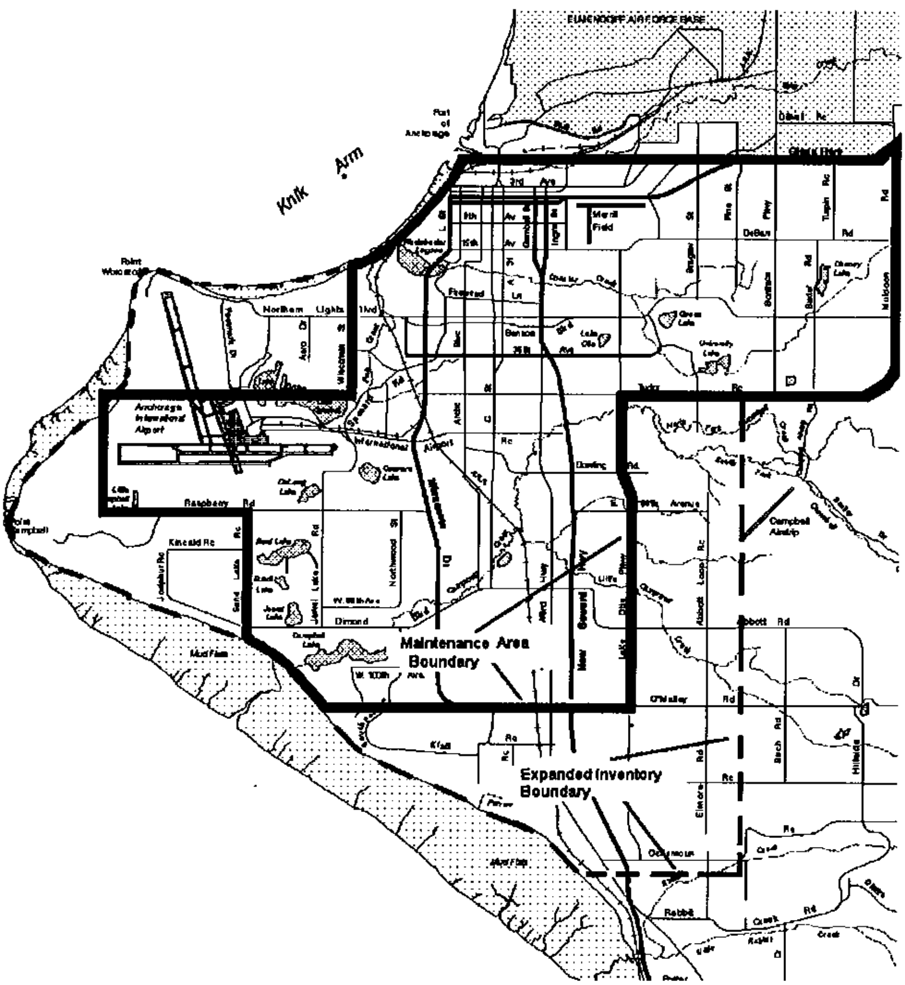
III.B.10 Motor Vehicle Emissions Budget

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 2008 and beyond, unless changed in an EPA-approved SIP.

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

In a manner similar to that used in the compliance demonstration discussed in III.B.6, the roll-forward approach was used to compute the regional motor vehicle emissions budget for the expanded emission inventory area described in Figure III.B.10-1. The emission budget is based on estimated emissions within the boundary of this area during the 2007 base year. As was the case in the maintenance demonstration presented in Section III.B.6, it can be shown that total emissions within the inventory area can increase from 2007 levels because there was a greater than 90% probability of meeting the NAAQS at 2007 levels. In other words, CO emissions can increase somewhat from 2007 levels and the probability of compliance would still be greater than 90%. The roll-forward computation is used to determine how much the CO emission sources can increase within the inventory area and still maintain compliance with the NAAQS. This amount is the "total CO emission budget." Because some of these emission are from sources other than motor vehicles (aircraft, wood heating, etc.), the budget "available" for motor vehicle emissions will be less than the total budget.

The process for determining the motor vehicle emission budget is described below.

1. Use roll-forward method to compute *total* CO emission budget from 2007 area-wide emission inventory and computed 2007 design value (DV).

   Area-wide CO emissions (2007) = 159.3 tons per day
   2007 DV = 7.23 ppm
   Allowable increase in area-wide emissions = $\frac{9.0-7.23}{7.23-0.0} x100$= 24.5%

   Total CO emissions budget = (1+0.245) x 159.3 = 198.3 tons per day

2. Subtract maximum projected "non-motor vehicle emissions" in 2007 - 2023 planning period from the total CO emission budget to determine what is allotted for motor vehicles. (This occurs in 2023 at the end of the planning period.)

   2007 Motor Vehicle Emissions Budget = Total allowable emissions less non motor vehicle emissions = 198.3 – 41.8 = **156.5 tons per day**

The emission budget for years beyond 2023, the end of the maintenance plan, shall also be assumed to be 156.5 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 Long Range Transportation Plan. The analysis suggests that, barring unanticipated major changes in population or employment growth, motor vehicle emissions from Anchorage transportation network will remain below the motor vehicle emission budget during the period 2008–2023. Projected motor vehicle emissions are compared to the budget in Figure III.B.10.2.

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The motor vehicle emission budget for the years covered by the maintenance plan, 2008-2023, will shrink over time because emissions from other non motor vehicle sources are expected to grow during this period. Because emissions from all sources in the inventory area cannot exceed the 125.8 ton per day limit, the amount of the budget available for motor vehicle emissions will decrease. This is shown in Table III.B.10.1. ¶
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Table III.B.10.1¶
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Motor Vehicle Emission Budget [... [8]]
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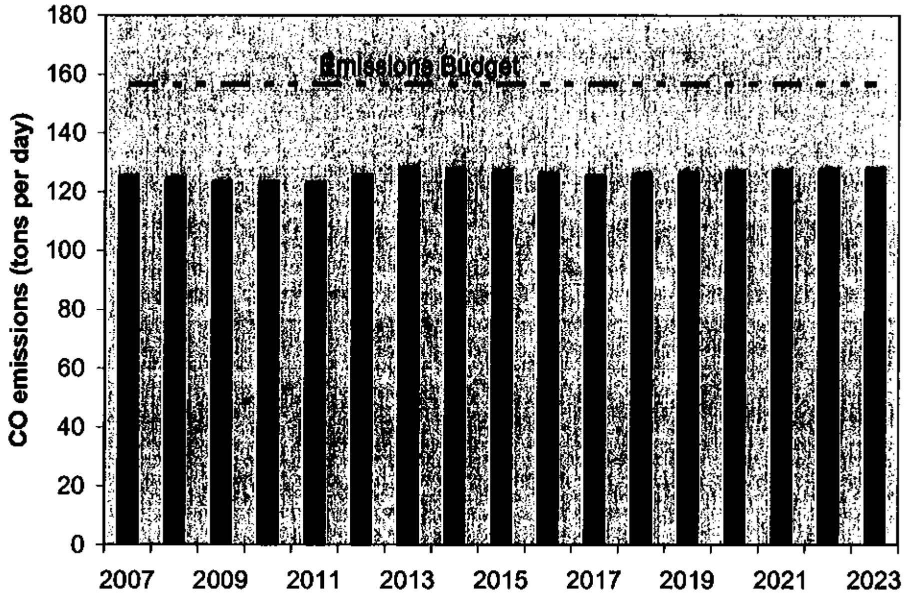
Figure III.B.10-2. Projected Motor Vehicle Emissions vs. Budget 2007 - 2023



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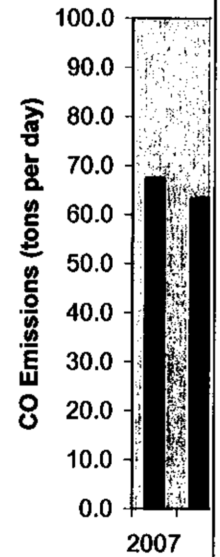

As noted earlier, there is an apparent anomaly in the MOVES model that results in an increase in the vehicle start emission rate estimates between 2007 and 2015 at the cold ambient temperatures assumed for modeling Anchorage. MOVES projects an increase in the start emission rate even though EPA has mandated new cold temperature emissions standards for vehicles beginning with model year 2010 which would be expected to result in a decline in the CO emissions rate. We understand that EPA is investigating this anomaly. Presumably, if a fix is made to MOVES, future emission projections will decline in relation to the 2007-based budget. This means that projected future emissions could be less than suggested in the figure above and further below the budget.

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);
  - Prior to submittal to EPA, this plan will be filed by the Lieutenant Governor as per state regulation.
- be subject to a public hearing;
  - Prior to submittal to EPA, these plan revisions were the subject of a public hearing held in Anchorage on August 2, 2010. The affidavit of oral hearing is included in the Appendix to Section III.B.10.

- be developed through consultation among federal, State and local agencies;
  - Federal, state, and local agencies were consulted on the motor vehicle emissions budget. (Note ADEC will update based on comments received).
- be supported by documentation that has been provided to EPA ;
  - This plan contains documentation supporting the motor vehicle emission budget. See Section III.B.3. The CO emission inventory is included in the Appendix to Section III.B.3.
- address any EPA concerns received during the comment period;

The methodology presented in this section is consistent with the methodology employed in the previous Maintenance Plan, which was designed to address guidance received from EPA Region 10 staff, including:

- clearly identify and precisely quantify the revised budget;
  - 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 continued maintenance of the ambient CO standard;
  - 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 continued maintenance of the CO standard.
- demonstrate that the budget is consistent with and clearly related to the emissions inventory and the control measures in the plan revision;
  - The motor vehicle emissions budget is established based on the Anchorage CO emission inventory and control measures included in the plan.
- explain and document revisions to the previous budget and control measures, and include any impacts on point or area sources; and
  - The budget presented in this plan is an update of the budget established in the previous version of this plan. A discussion of revisions to the control measures and impacts on point and area sources is included in section III.B.5
- address all public comment on the plan's revisions and include a compilation of these comments.
  - The response to comments received will be included in the Appendix to Section III.B.10. In addition, the Anchorage Assembly passed a resolution ((2010-174) approving the plan revisions on June 8, 2010. A copy of this resolution is also

included in the same appendix. (Note ADEC will update based on comments received)

Once a motor vehicle emissions budget is found to be adequate by EPA, emissions modeled from the transporation network reflected in the Anchorage Long Range Transportation Plan (LRTP) and Transportation Improvement Program (TIP) must be less than or equal to the motor vehicle emissions budget. For projects not from a conforming TIP, the additional emissions from the project together with the TIP emission must be less than or equal to the budget.

Regional Conformity Determination Methodology

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Because a hybrid method, that relies on the use of MOBILE6 for modeling on road travel emissions and local emissions data to estimate idle emissions, it is necessary to clearly set out a means for agencies to compute emissions for use in TIP and project conformity determinations.

On-road mobile source emission inventories typically are computed using emission factors generated by EPA's latest vehicle factor model, MOBILE6 (version 6.2). Unfortunately, MOBILE6 is limited in its ability to represent wintertime CO emission factors in cold-weather communities. That model fails to adequately treat two very common wintertime practices in Anchorage that significantly affect vehicle CO emissions:

Extended initial idling of vehicles to warm them up prior to travel; and

Use of block heaters to keep the engine warm while parked for long periods to aid in cold start driveability.

To address these limitations, on-road mobile source emissions were computed using a hybrid methodology that combines actual measurements of warm-up idling and plug-in benefits with emission factors from MOBILE6. This methodology is described in detail in Appendix to Section III.B.3.

To address the subsequent use of this hybrid approach within the conformity process, the following steps are being incorporated into the conformity procedures for Anchorage transportation plans and projects. The additional steps set out in this section are to be used in conjunction with the applicable requirements for conformity found in 18 AAC 50.700-18 AAC 50.735 and Volume II - Sections III.I and III.J of this SIP.

Analysis Years Required for Demonstration of Consistency with Emission Budget

Transportation plans and programs must be shown consistent with the motor vehicle emission budget shown above. Criteria and procedures for determining the consistency with the emissions budget are established in 40 CFR Part 93.118. These regulations state that consistency with the motor vehicle emission budget must be demonstrated for

- each year that the applicable emission plan specifically establishes a motor vehicle emission budget;
- for the last year of the transportation plan's forecast period; and
- for any intermediate years as necessary so that the years for which consistency is demonstrated are no more than ten years apart.

The conformity regulations state that "the regional emissions analysis may be performed for any years in the timeframe of the transportation plan provided they are not more than ten years apart and provided the analysis is performed for the attainment year (if it is in the timeframe of the transportation plan) and the last year of the plan's forecast period."[§§§§§] The regulations also state that consistency with the motor vehicle budget for other years "may be determined by interpolating between the years for which the regional analysis is performed." Because Anchorage is a maintenance area that has already attained the CO standard, it will not be necessary to include the attainment year as an analysis year in future transportation plans. Thus, for future transportation plans and programs in Anchorage, explicit conformity analysis, involving a separate run of the transportation model and computation of the CO emissions for that particular year, must be performed for the last year of the transportation plan, and any additional years necessary to ensure that explicit conformity demonstrations are performed no more than ten years apart. Intervening years may be computed by interpolation to establish conformity with each year of the emission budget shown in Table III.B.10-2.

Assumptions used in modeling analysis for conformity determinations must be consistent with those in the CO Maintenance Plan. Because this SIP revision assumes that the CO reductions provided by the I/M program cease after 2010, any modeling performed for conformity analyses must also assume this, even if the I/M program is still in operation as a "local option." The other primary measures included in the Plan (air quality public awareness, transit marketing, and the ridesharing and vanpooling program) are voluntary programs; their CO reduction benefits were disregarded in the analysis of Anchorage's

§§§§§ See 40 CFR 93.118 d(2)

prospects for continued compliance with the NAAQS. Therefore the CO reductions from those programs must also be disregarded in regional conformity analyses.

Methodology Employed to Compute Emissions in Analysis Years

The motor vehicle emission budget shown in Table III.B.10-1 was prepared using the EPA MOVES model with specific assumptions regarding vehicle fleet characteristics, fuel specifications, ambient temperatures and other parameters required by MOVES. The State is updating the current transportation conformity process to address MOVES requirements. The amended process will be implemented after gaining Interagency Consultation approval. After approval ADEC will maintain copies of these MOVES inputs files and recommended assumptions to be used in all conformity analyses. These input files and assumptions should be used unless ADEC, through the interagency conformity consultation process determines that the use of alternate inputs is appropriate. Conformity requirements are laid out in Volume II, Sections III.I and III.J of this plan and 18 AAC 50.700 – 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., the LRTP or TIP) computations of mobile source emissions will use the same 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 vehicle start estimates provided by the Anchorage Transportation Model and post processing software. Currently, these post-processor outputs are utilized in a separate Excel spreadsheet model that contains MOVES-generated emission factors for computing mobile source emissions under Anchorage-specific conditions.

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 all non-attainment and maintenance areas. Thus, in Anchorage, hot-spot CO modeling must be performed in project-level conformity determinations.

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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-level conformity determinations.¶
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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.

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Assumptions for AM Peak Period (7 AM – 9 AM) [... [9]]

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The EPA has released guidance on how the MOVES model should be used to prepare project level conformity analyses.[16] 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 do **not** significantly impact 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 MOVES. 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 do significantly impact 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. The EPA guidance on how MOVES should be used in project level conformity analyses recommends that idle emissions be modeled by assuming a vehicle speed of 0 mph. It describes how inputs regarding average soak time should be derived. The soak time assumed has a significant impact on the emission rate. The interagency consultation team should review and approve these assumptions.

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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 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 and these assumptions should be consistent with those employed in the maintenance demonstration in this Plan.‡‡‡‡‡‡ 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.

~~Unless otherwise approved through interagency consultation, the CO background value to be employed in hot spot modeling is 5.1 ppm for a one hour average or 3.6 ppm for an 8 hour average. These values should be used to model CO emissions in 2008. Background concentrations are expected to decline over time in relation to anticipated future reductions in CO emissions. To estimate background concentrations for future years, the 2008 background concentration should be adjusted downward in accordance with CAL3QHC modeling guidance. A detailed discussion on how the 2008 background concentration was derived can be found in the Appendix to Section III.B.10.~~

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‡‡‡‡‡‡ As noted earlier, this means disregarding the CO reduction benefits of air quality public awareness, transit marketing, and the ridesharing and vanpooling programs..

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. An example of a project of this type is an airport expansion.

III.B.11 Redesignation Request

On February 18, 2004 the State of Alaska submitted a request to the EPA that Anchorage be redesignated from a serious nonattainment area to an attainment area. 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 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;
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.

The information necessary for EPA to make these five findings was as 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 did not experience any violations of the NAAQS during the three-year period, 2000-2002, prior to submission of the redesignation request. (§§§§§§)

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. 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.

§§§§§§ The period without a violation now extends through 2008. An expanded discussion of Anchorage CO air quality data is included in Section III.B.3.

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 submitted the Maintenance Plan concurrently with the redesignation request. The department requested 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. This request was approved by EPA effective July 23, 2004 (64FR 34935).

[1] "Anchorage 2007 Carbon Monoxide Emission Inventory and 2007 – 2023 Emission Projections," Air Quality Program, Municipality of Anchorage, April 2009.

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

[4] "Analysis of the Probability of Complying with the National Ambient Air Quality Standard for CO in Anchorage between 2007 and 2023," Anchorage Air Quality Program, April 2009.

[5] "Municipality of Anchorage I/M Program Evaluation Study," prepared for the Municipality of Anchorage by Sierra Research, Inc., Report No. SR2007-01-01, January 19, 2007.

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

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

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

[9] "Public Transportation Department Ridership Report," Anchorage People Mover, prepared January 2009.

[10] "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.

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

[12] Public Transportation Department Ridership Report, Anchorage People Mover, prepared January 2009.

[13] E-mail communication from Alton Staff, Anchorage People Mover, March 2009.

[14] "Fairbanks Cold Temperature Vehicle Testing: Warm-up Idle, Between Trip Idle, and Plug-in," Sierra Research, July 2001.

[15] "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.

[16] "Using MOVES in Project-Level Carbon Monoxide Analyses," EPA-420-B-10-041, December 2010

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Appendices

Appendix to Section III.B.3

Anchorage 2007 Carbon Monoxide Emission Inventory and 2007-2023 Emission Projections

Municipality of Anchorage
Department of Health and Human Services
Air Quality Program

April 2011

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1 Introduction

This document provides technical support and justification for the methods used to prepare the maintenance demonstration for Anchorage, submitted as a revision to the Alaska State Implementation Plan (SIP). This is the latest of a succession of revisions to a document originally prepared in support of the Anchorage CO Maintenance Plan submitted in 2004 and last revised in March 2010. The March 2010 revision relied on a MOBILE6-based methodology to estimate and project CO emissions from mobile sources in Anchorage.* Since that document was prepared the EPA has mandated that all conformity analyses and SIP demonstrations utilize a new model called MOVES instead of MOBILE6 beginning in 2012. As a consequence, this document has been revised to utilize a new MOVES-based methodology to prepare new estimates of motor vehicle CO emissions during the 2007-2023 maintenance planning period. No changes have been made to the emissions estimates that do not rely on the MOVES or MOBILE6 models (e.g. point, non-road and area sources) and no substantive changes have been made to the narrative discussing these sources.

This document includes a comprehensive inventory of the sources of CO emissions for base year 2007. Historically, violations of the CO NAAQS have occurred most often on cold winter weekdays, therefore a 24-hour inventory was prepared that reflects ambient temperatures, traffic volumes and other emission source activity levels experienced on a typical winter "design day" in 2007.

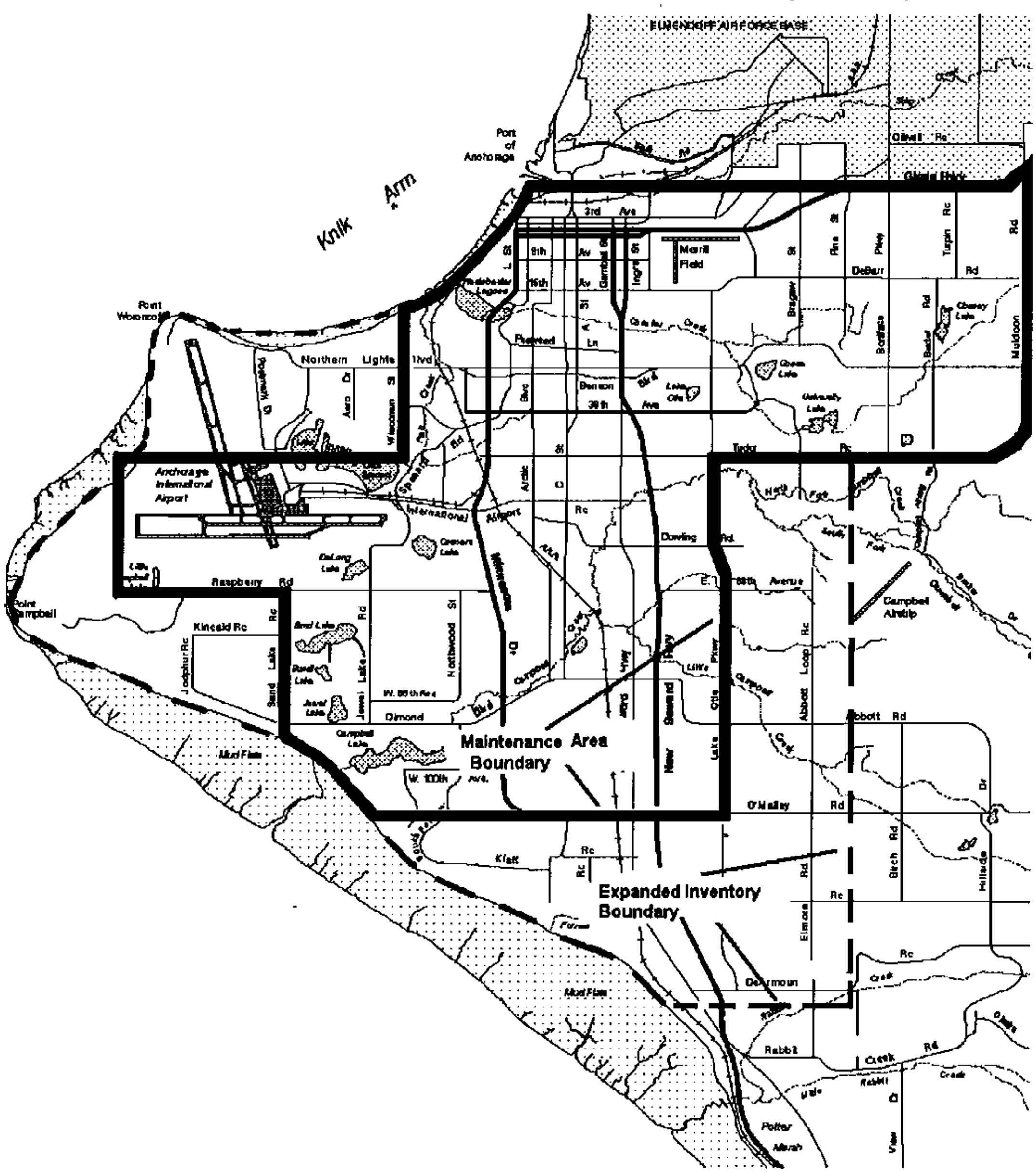
In April 2007 an air quality conformity analysis was prepared when the Anchorage Long Range Transportation Plan was amended to include the Knik Arm Crossing. The most recent population, employment, and land use assumptions and forecasts were used in the development of this analysis. Specific forecasts were developed for analysis years 2007, 2017 and 2027. This demographic data was used to generate the 2007 base year CO inventory for the maintenance plan revisions. In addition this data was used directly or interpolated to generate forecasts for 2009, 2011, 2013, 2015, 2017, 2019, 2021 and 2023.

* Actually a modified version of MOBILE6 called AK MOBILE6 was used. AK MOBILE6 differs from the conventional MOBILE6 model because it includes methods to estimate CO emissions from extended idling of light duty motor vehicles and the increased emission rates that occur from vehicles running before they are fully warm. This is explained later in more detail in Section 5.1.

2 Inventory Boundary

The Anchorage nonattainment area boundary was established in 1978. Upon EPA's approval of the maintenance plan in 2004, the area encompassed by this boundary became the maintenance area. The inventory boundary contains this maintenance area plus some additional area to the south and west where significant residential and commercial growth has occurred over the past two decades. For this reason, the inventory area was expanded slightly to encompass areas not included in the nonattainment area. The boundary of the maintenance area is shown along with the expanded inventory area in Figure 2-1. The inventory area encompasses approximately 200 square kilometers of the Anchorage Bowl.

Figure 2-1
Anchorage Maintenance Area with Expanded Inventory Boundary



3 Anchorage Transportation Model and Inventory Grid System

The CO inventory was based in large part on traffic activity outputs from the Anchorage Transportation Model. The Anchorage Transportation Model is used by the metropolitan planning organization in the Municipality of Anchorage known as AMATS[†] to evaluate transportation plans and programs. It was validated against measured traffic volumes in base year 2002 and utilizes the latest planning assumptions to forecast future travel activity. The model was developed using TransCAD travel demand modeling software. Because TransCAD is a GIS-based model, post-processing software can be used to overlay a grid system on the inventory area. The post-processor is used to disaggregate the inventory area into grid cells, each one square kilometer in size.

Transportation activity estimates (e.g., vehicle miles of travel, number of trip starts, and vehicle speeds) were produced for each of the cells. The grid location of every roadway link in the transportation network is known. Thus, the attributes of a particular roadway link (e.g., traffic volume and speed) can be assigned to a particular grid. If a roadway link crosses the boundary between two or more grids, its attributes are assigned to the appropriate grid in relation to the proportion of the length of link contained in each grid. In other words, if 80% of a roadway link lies within a particular grid, 80% of the vehicle travel is assigned to that grid and 20% to the other grid. The transportation model generates separate travel activity estimates for the AM peak (7 am – 9 am), PM peak (3 pm – 6 pm) and off-peak hours (9 am – 3 pm, 6 pm – 6 am) and travel activity estimates are further disaggregated by road facility type and trip purpose. [‡, §]

Demographic information (population, number of dwelling units, income, and employment information) is collected by census tract. Because most census tracts in Anchorage are larger in size than the one- kilometer grids the demographic characteristics of a particular grid must be estimated from lower resolution census tract data. If, for example, a particular census tract was comprised of three one kilometer grids, the population and employment in that census tract was divided equally among the three grids contained in the census tract. This demographic information was helpful in developing gridded estimates of non-vehicular source activities, like wood burning and space heating where the amount of activity (i.e. wood burning or residential space heating) was assumed to be related to the number of dwellings in a grid.

Emissions from other area sources such as Ted Stevens Anchorage International Airport, Merrill Field, marine vessel operations at the Port of Anchorage and railroad activity in the rail yard and haul routes were assigned to the grids where the activity takes place. Similarly, emissions from point sources such as electrical power plants were assigned to the grid where the source is located.

The Anchorage emission inventory grid system is shown in Figure 3-1.

† AMATS stands for Anchorage Metropolitan Area Transportation Solutions.

‡ There are five road facility types defined in the Anchorage Transportation Model: (1) freeway/expressway; (2) major arterial; (3) minor arterial; (4) collector; and (5) local road.

§ The Anchorage Transportation model categorizes travel into seven purposes: (1) home-based work, (2) home-based school, (3) home-based shopping, (4) home-based other, (5) non home-based work, (6) non home-based, non-work; and (7) freight-related truck trips. Thus, for each time period, the model produces estimates of the number of trip starts and VMT in each grid by trip purpose.

Figure 3-1
Anchorage Area Inventory Grid System

4 Time-of-Day Estimates of Emissions Activity

Separate estimates of mobile source CO emissions were prepared for the morning commute (7 a.m. – 9 a.m.), the evening commute (3 p.m. – 6 p.m.) and combined off-peak periods (6 p.m. – 7 a.m. and 9 a.m. – 3 p.m.). These estimates relied on time-of-day activity estimates (e.g., number of trip starts and VMT) generated by the Anchorage Transportation Model. A 24-hour inventory was compiled by summing the separate emission contributions from each time period.

Activity estimates for non-vehicular sources were available on a 24-hour basis only, however. Time-of-day estimates had to be developed from these 24-hour values. For some sources (e.g. airport, natural gas combustion), activity was assumed to be continuous throughout the day and emissions were apportioned accordingly. Fireplace and wood stove usage is more likely to occur in the evening after 6 p.m. For this reason, 90% of all wood burning activity was assumed to take place during the off peak time period.

Table 4-1 shows the specific time periods inventoried and gives examples of the types and levels of activity characteristic of those time periods. (Note that the 2-hour AM peak comprises 8.3% of a 24-hour day, the 3-hour PM peak comprises 12.5% of the day, and the 19-hour off peak period comprise 79.2% of the day.)

Table 4-1
Apportionment of CO Source Activity by Time Period

Source Category	AM Peak. 7 a.m. – 9 a.m.	PM Peak. 3 p.m. – 6 p.m.	Off-Peak 9 a.m. – 3 p.m 6 p.m. – 7 a.m.	Comments
motor vehicle start and running emissions	From model (~20%)	From model (~25%)	From model (~55%)	Travel activity higher in AM and PM peak periods
Residential wood burning	3.0%	7.0%	90.0%	Most burning in evening
space heating	8.3%	12.5%	79.2%	Evenly distributed through day
Ted Stevens Int'l Airport	8.3%	12.5%	79.2%	Evenly distributed through day
Merrill Field	8.3%	12.5%	79.2%	Evenly distributed through day
Miscellaneous / Other *	8.3%	12.5%	79.2%	Evenly distributed through day
Point Sources	8.3%	12.5%	79.2%	Evenly distributed through day

5 Motor Vehicle Emissions

The EPA has mandated the use of MOVES for all SIP planning and conformity determinations beginning March 2012. In a preliminary analysis, Sierra Research showed that MOVES-based mobile source CO emissions estimates for the Anchorage CO inventory area were 50% or more greater than those produced by the current AK MOBILE6 model. This means that any conformity analysis performed after March 2012 will generate substantially higher estimates of emissions. If the current AK MOBILE6-based Anchorage CO emissions budget in the Alaska SIP is not amended before then Anchorage could exceed the allowable mobile source emission budget. For this reason, Anchorage has decided to re-estimate mobile source emissions during the 2007-2023 maintenance planning horizon and amend the existing budget using the new MOVES-based emission estimation methodology. This section describes how MOVES was utilized along with the Anchorage Transportation Model to develop an amended CO emission inventory and projections. This same methodology will be used to develop a new MOVES-based mobile source emission budget and for future conformity determinations.

5.1 Overview of Previously Used AK MOBILE6-based Emission Estimation Methodology

Mobile source CO emissions estimates previously relied on emission factors produced from a modified MOBILE6-based emissions factor model known as AK MOBILE6. These emission factors were applied to pertinent traffic activity outputs from the Anchorage Transportation Model to estimate emissions. Emission factors produced by AK MOBILE6 were applied to the activity estimates generated by the transportation model's post-processor to generate CO emissions estimates for each grid. AK MOBILE6 differed from the standard version of MOBILE6 because it included an off-model computation of start emissions that was based on local cold start emissions data collected in Alaska by Sierra Research. For Anchorage, these off-model computations were made with a spreadsheet model that allowed factors such as soak time, average idle duration and the proportion of vehicles that are plugged-in (i.e., using a block heater prior to start-up) to be accounted for in the estimation of start emissions. These factors varied by time of day and trip purpose. For example, during the AM peak, the assumed average idle duration for a home-based work trip (7 minutes) was longer than a non-home based, non-work trip (1 minute). The spreadsheet model was used to compute start emissions in a particular grid from the transportation model's estimate of the number of vehicle starts by each trip purpose in that grid and the assumed idle duration, soak time and block heater plug-in rates for those trips. Look-up tables containing start emission factors as a function of idle duration and soak time were used to estimate emissions for the starts in the grid.[**]

For running emissions, the "conventional" MOBILE6 model was used to generate spreadsheet lookup tables with gram per mile emission factors by speed and thermal state. MOBILE6 allowed the user to supply assumptions regarding the soak time distribution of the vehicles started by time-of-day and running emission factor estimates were very sensitive to these assumptions.[††] Modeled emissions were higher for those time periods when a large proportion of vehicles of a particular trip purpose were assumed to have had long soak times and lower when most soak times are short. For example, home-based work trips during the AM peak had higher CO emission rates because they included a large proportion of vehicles with long soak times.

[**] These look-up tables were developed by Sierra Research from emissions data collected in Alaska during the winter of 2000-2001. The spreadsheet also utilizes Sierra Research data to compute the CO reductions from block heater usage.

[††] Soak time is the amount of time that a vehicle has been parked with the engine off prior to startup. Sierra used six different soak time distributions to characterize the thermal state (i.e., how warmed up they were) of the vehicles operating on a road at a particular time.

Sierra Research defined six soak time distributions to characterize the thermal state of the fleet of vehicles operating in a particular grid during each of the three time periods. Travel model outputs were used to determine which of these six soak distributions was most appropriate for modeling the running emissions on a particular road facility type (e.g., freeway vs. collector) and trip purpose for each grid. The emission factors generated by MOBILE6 were then incorporated into a lookup table in the spreadsheet model. The spreadsheet could then identify an appropriate running emission factor based on the travel model's estimate of the average speed and thermal state of vehicles operating on the different road facility types within each grid. These emissions factor were multiplied by the VMT in the grid to compute running emissions from the VMT in that grid for each trip purpose and road facility type.

The spreadsheet computed CO emissions by summing the start and running emissions from all 200 grids in the inventory area. For conformity determinations these emissions were compared to the emission budget in the SIP. The CO maintenance demonstration examined emissions from a nine-grid sub-area surrounding the Turnagain CO monitor in west Anchorage, an area believed to be representative of the highest CO concentrations in the Anchorage area...

5.2 New MOVES-based Methodology

The new MOVES-based methodology used to develop the inventory and projections in this revised document mirrors the AK MOBILE6-based methodology in many ways. It still relies on the same basic grid-based travel activity outputs (e.g., vehicle starts, VMT, average speed) that the AK MOBILE6 method used. The MOVES methodology uses a modified version of the spreadsheet model previously employed, substituting MOVES-generated running and start emission factors for the AK MOBILE6 factors used previously.

Perhaps the biggest difference in the new MOVES vs. AK MOBILE6-based method is that the new spreadsheet model no longer relies on local emission test data produced by Sierra Research to calculate start emissions; it uses a single fleet-wide start emission factor that varies by hour of the day, generated by MOVES. This simplifies spreadsheet computations; the AK MOBILE6 spreadsheet generated seven separate start emission factors corresponding to each trip purpose because each trip purpose had different assumptions about the soak time and idle duration that could affect both start and running emissions. Although MOVES considers the soak distribution (by hour) in the computation of start emissions, the running emission rate is independent of both ambient temperature and soak time.

To model emissions, MOVES requires extensive user-supplied model inputs that reflect local conditions such as vehicle fleet characteristics, fuel composition, ambient temperature, I/M program characteristics, road type distribution. These inputs, and how they are be derived are discussed in the last section of this report (see MOVES Run Specifications and County Data Manager Inputs.

5.2.1 MOVES-based Start Emissions Computation

As noted earlier, the Anchorage Transportation Model provides estimates of the number of vehicle starts occurring in each of the 200 one-km^2 grids in the inventory area for three separate time periods: AM peak, PM peak and off-peak periods. In order to use this detailed information, our objective was to get MOVES to produce an emission factor that would provide estimate of average CO emissions per vehicle start (grams CO per start).

We have found that the simplest way to do this is to run MOVES and direct the model to output emissions and activity levels only for those processes relating to start and/or extended idle emissions.[‡‡] Specifically these processes are: (1) start exhaust; (2) crankcase start exhaust; (3) crankcase extended idle exhaust; and (4) extended idle exhaust. Although MOVES provides an *emission rates* computation option (in *Scale* on the Navigation Panel), we have found that running MOVES using the *inventory* option is an easier method of computing emission rates.

When MOVES is run using the inventory computation option, it generates a number of MYSQL output files. Two of these are of particular interest. The first details the level of process activity (e.g., number of vehicles starts, hours of extended idling by combination long haul trucks for each hour of the day and the second details the quantity of CO emitted each hour from each process activity.[§§] The emission factors required for the spreadsheet model (e.g., CO emitted per vehicle start) can then be easily computed on an hour-by-hour basis from the two MYSQL output files. A lookup file for these emission factors can be created from the MYSQL files for use in the spreadsheet model. An example of such a lookup file is shown in Table 5-1 below.

Table 5-1
Lookup File for Start and Extended Idle CO Emission Factors

MOVES Start & Idle EF 2007 Base Year with I/M				
Ending Hour	% of daily starts in hour	tailpipe + crankcase CO (g/start)	% of daily extended idling from long haul trucks in hour	extended idle CO g/ truck start
1	0.75%	67.36	6.28%	142.11
2	0.34%	115.21	6.11%	170.18
3	0.11%	144.20	5.77%	109.97
4	0.20%	139.88	5.26%	105.84
5	0.37%	172.69	4.58%	75.42
6	0.76%	190.40	4.07%	61.45
7	3.80%	190.41	3.57%	30.73
8	5.98%	166.07	3.06%	26.98
9	6.33%	149.02	2.89%	38.69
10	5.51%	101.19	2.55%	21.95
11	5.02%	103.63	2.38%	23.25
12	6.98%	101.78	2.21%	33.29
13	7.27%	89.94	2.21%	33.29
14	6.35%	104.91	2.21%	29.59
15	5.97%	103.30	2.38%	28.68
16	7.87%	115.08	2.55%	27.11
17	7.74%	108.91	3.23%	83.40
18	7.71%	123.00	3.74%	150.22
19	6.85%	118.64	4.58%	207.41
20	4.79%	111.59	5.26%	136.08
21	4.02%	131.62	5.94%	195.53
22	2.39%	111.08	6.28%	227.38
23	1.95%	135.95	6.45%	291.90
24	0.95%	133.77	6.45%	259.47

‡‡ In MOVES extended idle emissions refer only to idle emissions from combination long haul trucks. Other extended idle emissions such as those that occur among passenger cars and trucks during long warm up periods prior to the morning commute are not included. Extended idle emissions from combination long haul trucks make up a very small portion of total CO emissions in Anchorage.

§§ The Anchorage Transportation Model does not provide an estimate of the hours of extended idling among long haul trucks. It does, however, provide an estimate of the number of freight truck starts. Thus, the extended idle emission factor was related back to the MOVES estimate of long haul truck starts (MOVES source id = 62) rather than hours of extended idling. The resulting emission factor was therefore grams CO emitted per long haul truck start.

The spreadsheet model applies a weighted average emission factor from the lookup table above to the amount of start or extended idle activity estimated by the transportation model for the time period in question.[***] For example, during the AM peak period (7 am – 9 am), the weighted average tailpipe + crankcase start emission factor is 157.3 g/start. If the transportation model estimated that there were 800 starts in a particular grid cell, computed start emissions in that grid would be 125,840 grams or 277 lbs. A different start emission factor would be used for PM and off-peak starts. For example, the start emission factor for the PM peak (3 pm – 6 pm) is lower (115.7 g/start) than the AM peak because vehicles started during that period, on average, have shorter soak times and warmer engines than those started in the morning.

The spreadsheet model assigns start and extended idle emissions to the grid cell where the transportation model determined the vehicle start to have occurred.[†††]

Even though the spreadsheet model has the capability of estimating the benefits of engine block heater usage, the previous CO maintenance plan did not take credit for these benefits. For consistency, this "MOVES-amended" 2007 base year inventory and maintenance projections does not either.

5.2.2 MOVES-based Running Emissions Computation

As is the case with start emissions, MOVES requires extensive user-supplied inputs to estimate running emissions. These inputs and the run specification used to generate running emissions are discussed in detail in Attachment to this appendix. As noted earlier, the Anchorage Transportation Model provides grid-based estimates of VMT and vehicle speed by road facility type three separate time periods. This subsection will discuss how MOVES is used to generate the running emission factors (grams per mile) necessary to estimate running emissions in each of the model grids from the transportation model estimates of travel activity.

We have found that the simplest way to generate running CO emission factors is to run MOVES in the *emission rates* rather than the *inventory* mode used to generate start and extended idle emission factors. MOVES includes two processes that relate to running emission factors: (1) running exhaust; and (2) crankcase running exhaust. Using the *emission rates* mode, we select these two pollutant processes and MOVES will generate emission factors by speed bin and road type for both processes. The emissions from both of these processes are independent of ambient temperature and time-of-day, so the MOVES model output is fairly simple. Because we are using the *emission rates* mode, MOVES generates a MYSQL output file, called *rateperdistance that* provides emission factors in grams per mile. A spreadsheet model lookup table can be derived from the MYSQL output file generated by the MOVES run. Because the MOVES output produces emission factors by speed bin, we use an interpolation process to produce emission factors in one mile per hour increments for use in the lookup table.

The Anchorage Travel Model produces estimates of the VMT in each grid disaggregated into five facility types. MOVES emission factors for restricted access road (road type = 4) is applied to transportation model estimates of the VMT accrued on freeways and expressways and MOVES

[***] The weighted average emission factor for each time period is determined by weighting the emission rate for each hour in the time by the MOVES proportion of starts that occur in those hours. Example:

AM peak start EF = (166.07 x 5.98% +149.02 x 6.33%)/(5.98% + 6.33%) = 157.3 g/start

[†††] MOVES defines start emissions as "the addition to running emissions caused by the engine start." Unless a vehicle spends a substantial time warming up, a large portion of these "start emissions" occur as the vehicle moves during the first part of its trip. Thus, it is likely that a portion of some start emissions occur in grid cells other than the one assigned by the model.

emission factors for unrestricted access roads (road type = 5) are applied to VMT accrued on local, collector, minor arterial and major arterial roadways. ‡‡‡ The transportation model provides speed estimates for each of the five facility types within each grid. These speed estimates are used to select the appropriate running emission factor in the spreadsheet look-up table.§§§ The estimated VMT on the five road facility types in each grid is multiplied by the appropriate emission factor to estimate running emissions. Table 3 shows an example of a spreadsheet emission factor lookup table (portions of the look-up table have been cut so that it can fit on one page).

Table 5-2
Example Spreadsheet Lookup File for Running CO Emission Factors

Base Year 2007 MOVES Interpolated Running Emission Factors (with I/M) by Road Type			
Speed	speed bin	road type=4 urban restricted	road type=5 urban restricted
2.5	1	45.206	44.658
3.0	1	41.326	40.991
4.0	1	33.566	33.657
5.0	2	25.806	26.323
6.0	2	23.899	24.569
⋮	⋮	⋮	⋮
27.0	6	10.362	10.919
28.0	6	10.346	10.773
29.0	6	10.330	10.626
⋮	⋮	⋮	⋮
55.0	12	10.965	8.151
56.0	12	10.902	8.181
57.0	12	10.839	8.210
58.0	12	10.776	8.239
59.0	12	10.712	8.269
⋮	⋮	⋮	⋮
72.0	15	12.909	10.928
73.0	15	13.366	11.442
74.0	15	13.824	11.956
75.0	16	14.281	12.470

‡‡‡ MOVES actually has four road types (rural restricted access, rural unrestricted access, urban restricted access, and urban unrestricted access) but Anchorage only has the two urban-type roads in its CO inventory area.

§§§ Vehicle speed estimates generated by the Anchorage Transportation Model were significantly different than those measured in a travel time study conducted by the Municipality and the Alaska Department of Transportation in 1998. Empirical speed correction factors, derived from that travel time study are applied to transportation model speed estimates. To match travel time study estimates, transportation model estimates of speed for freeway/expressways are increased by 17% and speeds on collectors and minor and major arterial roadways are reduced by 17%. A "default" speed of 15 mph is assumed for VMT on local roads.

The lookup table is used in conjunction with Anchorage Transportation Model estimates of VMT and speed on each facility type within a grid to estimate running emissions within the grid. Table 4 shows a sample computation of running emissions for Grid Cell ID =1104 (an area near the intersection of Northern Lights Boulevard and Seward Highway) during the AM peak period in 2007.

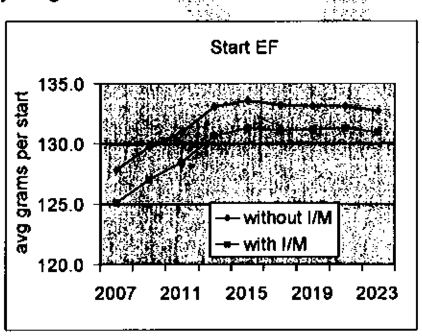
Table 5-3
Sample Computation of Running Emissions for Grid Cell 1104

Facility Type	MOVES Road Type	VMT (miles)	Speed (mph)	Emission Factor (g/mi)	CO Emissions (lbs)
Freeway/Expressway	4	1,751	57.4	10.8	42
Major Arterial	5	5,119	31.0	10.3	116
Minor Arterial	5	3,001	29.8	10.6	70
Collector	5	44	23.6	11.9	1
Local Streets	5	474	15.0	14.8	15
TOTAL	--	10,390			244

5.3 Summary of Motor Vehicle Emissions

Table 5-4 summarizes key motor vehicle activity (vehicle starts, truck starts and VMT) along with the emissions resulting from this activity. The vehicle inspection and maintenance program (I/M) was assumed to be operating in 2007 and 2009 with a 4-year grace period for new vehicles and with a 6-year grace period in 2011. The program was assumed to be discontinued in 2013 and beyond. Start emissions make up the greatest part of all motor vehicle emissions. They make up about 68% of motor vehicle emissions in base year 2007. Their contribution grows to about 78% by 2023.****

**** When start and running emission rates during the period 2007-2023 were examined, running emission rates were found to decrease steadily (as expected) but start emission rates generated by MOVES actually *increased* between 2007 and 2015. Given the fact that the vehicle fleet is normally presumed to become newer and cleaner over time, especially with the phase-in of new EPA-mandated vehicle cold temperature emission standards in 2010, it suggested an anomaly in the model. We understand that EPA is investigating and that if a problem is found it will be remedied in a future release of MOVES. The impact on the overall emission trend analysis presented here and in the CO Maintenance Plan is relatively insignificant.



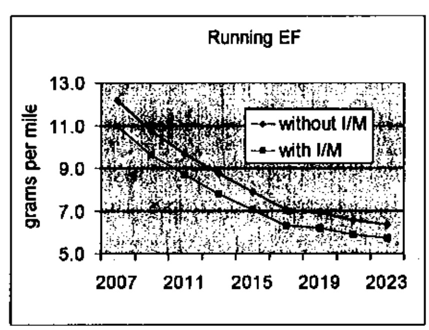


Table 5-4
Summary of Estimated Area-wide-Motor Vehicle CO Emissions in Anchorage

		Start Emissions		Extended Idle (Truck only)		Running Emissions		
Year	I/M status	Total Starts (per day)	Start Emissions (tons/day)	Truck Starts (per day)	Extended Idle Emission (lbs)	VMT (mi/day)	Running Emissions (tons/day)	Total CO Emissions (tons/day)
2007	yes	639,007	84.83	2,496	0.34	3,344,312	40.46	**125.62**
2009	yes	647,609	87.23	2,533	0.29	3,417,283	36.17	**123.70**
2011	yes	656,211	89.39	2,571	0.35	3,490,253	33.40	**123.14**
2013	no	664,813	93.80	2,608	0.36	3,563,224	34.28	**128.44**
2015	no	673,415	95.37	2,645	0.36	3,636,195	31.59	**127.32**
2017	no	682,017	96.33	2,682	0.37	3,709,166	28.84	**125.55**
2019	no	692,026	97.72	2,711	0.38	3,779,015	28.62	**126.71**
2021	no	702,035	99.14	2,739	0.39	3,848,865	27.78	**127.31**
2023	no	712,044	100.26	2,767	0.39	3,918,715	27.46	**128.11**

6 Aircraft Operation Emissions

In June of 2005 Sierra Research, Inc. prepared the "Alaska Aviation Inventory."†††† They compiled air pollutant emission estimates for airports across Alaska including Ted Stevens Anchorage International Airport (ANC) and Merrill Field Airport in Anchorage. Both summer and winter CO emissions associated with aircraft operation for various pollutants were estimated for the year 2002. Sierra collaborated with CH2MHill to collect the specific information on aircraft operations at ANC and Merrill Field necessary for input into the Federal Aviation Administration's EDMS Model (Version 4.2). EDMS was used to generate estimates of CO emissions from aircraft and aircraft support equipment. In EDMS, aircraft support equipment includes both ground support equipment (GSE) and on-board auxiliary power units (APUs) that are used to provide power to aircraft when on the ground. Winter season CO emissions estimates for ANC and Merrill are shown in Table 6-1.

Table 6-1
24-hour CO Emissions from ANC and Merrill Field in 2002

	Aircraft Support Equipment APU and GSE (tons per day)	Aircraft (tons per day)	TOTAL (tons per day)
ANC	8.21	3.32	11.53
Merrill	0.00	0.63	0.63

The ANC Master Plan contains an analysis of historical trends in aircraft operations and projections through 2027. The draft Plan projects an average annual growth rate of 2.4% between 2005 and 2027. Historical data on total operations in 2002 when Sierra prepared their emissions estimates were used along with the growth projections in the draft Master Plan to project future emissions from ANC. Emissions were presumed to grow in direct proportion to total operations. Results are shown in Table 6-2.

Table 6-2
Projected Aircraft Operations and CO Emissions at ANC

Calendar Year	Estimated or Projected Annual Aircraft Operations	CO Emissions (tons per day)
2002 (base year of Sierra inventory)	309,236	11.53
2007	331,708	12.37
2009	347,845	12.97
2011	363,982	13.57
2013	379,810	14.16
2015	395,327	14.74
2017	410,845	15.32
2019	435,440	16.24
2021	460,036	17.16
2023	484,631	18.07

†††† Alaska Aviation Emission Inventory, prepared for the Alaska Department of Environmental Conservation, June 2005.

Winter CO emissions from Merrill Field were computed in a similar manner. Sierra's 2002 CO emissions estimate (0.633 tons/day) was scaled upward in proportion to the projected increase in aircraft operations at Merrill. The Merrill Field Master Plan (2000) contains growth projections for the period 1997 through 2020. Annual operations are projected to increase from 187,190 in 1997 to 270,800 in 2020. Assuming linear growth, CO emissions can be projected for the period 2007-2023. These projections are shown in Table 6-3.

Table 6-3

Projected Aircraft Operations and CO Emissions at Merrill Field Airport

Calendar Year	Estimated or Projected Aircraft Operations	CO Emissions (tons per day)
1997	187,190	
2002	**205,366**	**0.633**
2007	223,542	0.689
2009	230,813	0.711
2011	238,083	0.734
2013	245,353	0.756
2015	252,624	0.779
2017	259,894	0.801
2019	267,165	0.823
2021	274,435	0.846
2023	281,706	0.868

7 Residential Wood Burning Emissions

The basic assumptions used in the preparation of emission estimates from residential wood burning were not changed from those used in the Year 2000 Anchorage Attainment Plan. Assumptions regarding wood burning activity levels (i.e. the number of households engaging in wood burning on a winter season design day) were corroborated by a telephone survey conducted by Ivan Moore Research (IMR) in 2003. IMR asked approximately 600 Anchorage residents whether they had used their fireplace or woodstove during the preceding day. The survey was conducted when the preceding day had a minimum temperature between 5 and 15 degrees F. Survey results were roughly consistent with the assumptions used in the attainment plan inventory. The basic assumptions used to estimate wood burning were based on data from a telephone survey[‡‡‡‡] performed by ASK Marketing and Research in 1990.

The ASK survey asked Anchorage residents how many hours per week they burned wood in their fireplace or wood stove. Because the AP-42 emission factors for fireplaces and wood stoves are based on consumption in terms of the amount of wood (dry weight) burned, hourly usage rates from the survey had to be converted into consumption rates. Based on discussions between MOA and several reliable sources (OMNI Environmental Services, Virginia Polytechnic Institute, Colorado Department of Health), average burning rates (in wet weight) of 11 pounds per hour for fireplaces and 3.5 pounds per hour for wood stoves were assumed for the Anchorage area. Residential wood burning assumptions are detailed in Table 7-1.

Table 7-1
Residential Wood Burning CO Emission Factors for Anchorage

Appliance	Average use per weekday (hours per household per day)	Average dry weight of wood consumed (lbs per hour)*	Average amount of wood burned per household (dry lbs / day)	Estimated wood burning CO emissions per household (lbs/day)
Fireplaces	0.156	7.15 lbs/hr	1.11	0.141
Wood Stoves	0.032	2.275 lbs/hr	0.073	0.006
TOTAL Fireplaces + woodstoves	0.188	------	1.18	0.147

Survey results suggest wood burning rates are relatively low in the Anchorage area. The vast majority of wood burning is "pleasure burning;" very few residents need to burn wood for primary or supplemental heat. If the average fire in the fireplace and/or woodstove is assumed to last three hours, Table 9 suggests that about 1 in every 16 households in Anchorage bums wood on a typical winter weekday.

The Anchorage Transportation Model post-processor provided information on the number of households in each grid. The calculated CO emission rate of 0.147 lbs of CO per day was assigned to each household in a grid. Thus wood burning emissions were highest in grids with high housing density.

Projecting future trends in wood heating in Anchorage is difficult. On one hand, anecdotal evidence suggests that fewer wood burning appliances are being installed in new homes in

‡‡‡‡ "Air Quality Survey of Anchorage Residents," prepared by ASK Marketing & Research for the Municipality of Anchorage, April 1990.

Anchorage. This is consistent with trends being observed nationally. On the other hand, increases in natural gas prices could result in increases in wood heating. For the purpose of this inventory, residential wood burning was assumed to increase in direct proportion with the number of households in the Anchorage inventory area. Area-wide wood burning emissions for the period 2007 - 2023 are shown in Table 7-2.

Table 7-2
Anchorage-wide 24-hour CO Emissions from Residential Wood Burning

Calendar Year	Number of Households in Inventory Area	24-Hour Emissions (tons)
2007	84,936	6.24
2009	86,582	6.36
2011	88,229	6.48
2013	89,875	6.60
2015	91,522	6.72
2017	93,168	6.84
2019	94,045	6.91
2021	94,923	6.97
2023	95,800	7.04

8 Space Heating Emissions

A telephone survey conducted by ASK Marketing and Research in 1990 indicated that natural gas is the fuel used for virtually all space heating in Anchorage. ASK survey results are shown in Table 8-1.The methodology used to compute natural gas space heating emissions for this maintenance demonstration is identical to that used in the Year 2000 Anchorage CO Attainment Demonstration and the 2004 Anchorage CO Maintenance Plan.

Table 8-1
Methods of Home Heating in Anchorage
(ASK Marketing & Research, 1990)

Natural gas	88.2%
Electricity	9.2%
Fuel oil	0.2%
Wood / other	1.3%
Don't know	1.1%
Total	100.0%

Enstar distributes natural gas to Kenai, Anchorage and other parts of Southcentral Alaska. According to Enstar, in 1996 approximately 80% of their gas sales were to Anchorage.[§§§§] Table 11 indicates that about 88% of all homes in Anchorage are heated with natural gas. A small fraction of homes are heated by wood or fuel oil. Wood heating has already been quantified separately in the inventory. The consumption of fuel oil for space heating was small in 1990 and likely even smaller in 2007. Calculated area-wide CO emissions from space heating with fuel oil are negligible (less than 25 pounds per day) and are not included in the inventory. Finally, the emissions associated with electrical heating occur at the generation plant. These emissions are accounted for separately in the point source inventory.

A detailed report of natural gas sales to residential, commercial and industrial customers was available for calendar year 1990[*****] for Southcentral Alaska.[†††††] Peak winter usage rates were estimated for residential customers and for commercial/industrial customers from this report. Demographic data (i.e. number of households, number of employees) were used to estimate per household consumption rates for residential customers and per employee consumption for commercial/industrial customers. The most recent AP-42 CO emission factors (July 1998) for uncontrolled residential furnaces (40 lbs CO/ 10^6 ft^{3}) and small boilers (84 lbs CO/ 10^6 ft^{3}) were used to characterize residential and commercial space heating emission. Calculated peak natural gas consumption and emission rates are shown in Table 8-2.

[§§§§] Personal communication with Dan Dieckgraff, Enstar Natural Gas, March 22, 2001.

[*****] Although data from more recent years were available, the reporting format had changed and less detailed data were available. Unlike the 1990 report, natural gas consumption was not reported separately for residential, commercial/industrial, and power generation customers.

[†††††] FERC Form No. 2 (ED 12-88), submitted by ENSTAR Natural Gas Company, 1991.

Table 8-2
Peak Natural Gas Consumption and CO Emission Rates in Anchorage (1990)

	Consumption Rate per Day	AP-42 Emission Factor (lbs. per 10^6 ft^3)	CO Emission Rate (lbs per day)
Residential	658 ft^3 per household	40	0.0263 per household
Commercial/ Industrial	434 ft^3 per employee	84	0.0364 per employee

On an area-wide basis, CO emissions from natural gas combustion were calculated by multiplying the CO emission rates in Table 13 by the number of households and employees in the inventory area. Table 8-3 presents the results of this calculation for the period 2007 – 2023. Emissions resulting from the combustion of natural gas for power generation are excluded. These emissions are accounted for separately in the point source inventory.

Table 8-3
CO Emissions from Natural Gas Combustion

Calendar Year	Number of Households in Inventory Area	Number of Employees in Inventory Area	Calculated Total Natural Gas Consumption (mcf)	CO Emissions from Natural Gas Combustion* (tons/day)
2007	84,936	145,516	119,127	3.77
2009	86,582	146,755	120,749	3.82
2011	88,229	147,994	122,372	3.86
2013	89,875	149,234	123,994	3.91
2015	91,522	150,473	125,617	3.95
2017	93,168	151,712	127,238	3.99
2019	94,045	153,731	128,693	4.04
2021	94,923	155,750	130,148	4.09
2023	95,800	157,769	131,602	4.14

* excludes natural gas used by utilities for electrical power generation

CO emissions from natural gas combustion were also calculated on a grid-by-grid basis by multiplying the emission rate per household or per employee by the number of households or employees in each grid. Thus, grid cells with a large number of households and/or employees were assigned the greatest emissions.

9 Non-road Sources

Non-road sources include miscellaneous fuel burning sources such snowmobiles, chain saws, portable generators, snow blowers and other equipment used for snow removal. As a starting point for this analysis, the EPA NONROAD model (version 2005) was run for base year 2007. The model provides estimates of non-road equipment types and activity levels for Anchorage. These model outputs were reviewed carefully to assess whether or not non-road equipment populations and usage (i.e., hours per year) were reasonable. The NONROAD model uses a top-down approach in which state-level equipment populations are allocated to counties on the basis of activity indicators that are specific to certain equipment types. Anchorage is the major wholesale and retail distribution center for the state. Because the NONROAD model activity indicator is based on the number of businesses within a particular SIC code, the model has a tendency to over-allocate the equipment to Anchorage and ignore usage that occurs outside the Anchorage area. For example, the NONROAD estimate for generator sets is likely heavily skewed by sales to non-Anchorage customers who come to Anchorage to purchase a generator for use in areas outside of the power grid.

The default model outputs are given in terms of average monthly, year-round use. These outputs were adjusted to reflect the fact that activity levels for non-road sources would be expected to be reduced on a typical midwinter exceedance day when ambient temperatures are near 0 °F. The activity levels of all-terrain vehicles, motorcycles, pressure washers, air compressors and pumps are likely substantially reduced in midwinter. Pressure washer activity, for example, was assumed to be 10% of that estimated by NONROAD. Other sources were also adjusted significantly from the NONROAD model's default outputs. These local adjustment factors are shown in Table 14. It is important to note, that without adjustment, the NONROAD model's estimate of CO emissions from the sources listed in the table is 120.8 tons per day in 2007 nearly equal in magnitude to the MOVES estimate for motor vehicle emissions (125.7 tons per day). Given what is known about the CO problem in Anchorage, clearly something is amiss. After the activity adjustment factors are applied to the NONROAD model estimates, the total contribution from the sources listed in the table is 9.1 tons per day.

Default output emissions from commercial and residential snow blowers were also reduced. Anchorage climatological records indicate that CO exceedances are typically preceded by cold, clear weather without snow. Thus, snow blower activity is likely to be lower on elevated CO days. For this reason the NONROAD estimate of residential and commercial snow blower activity was cut by 50%.

The NONROAD model default estimate for the snowmobile population in Anchorage is 34,985. Although there are a considerable number of snowmobiles in Anchorage, virtually all use occurs outside of the nonattainment area. Snowmobile use in Anchorage is banned on public land throughout the Anchorage nonattainment area because of safety and noise issues. Although there is some use in surrounding parklands, (i.e., Chugach State Park) these areas are located at least three miles from the emission inventory area boundary. However, there is likely to be some small amount of engine operation for maintenance purposes, etc. This was assumed to average about 0.1 hours per unit per month inside the inventory area. This usage rate is about 50 times lower than the NONROAD default value.

Finally, some of the NONROAD model outputs were clearly unreasonable. For example, there is no commercial logging activity in the Anchorage bowl. Because there is no commercial logging in the CO maintenance area, the NONROAD estimate of CO emissions from logging equipment chain saws was disregarded and it was cut by 80% to reflect that little garden or home wood cutting activity is likely to take place in mid-winter.

Table 9-1

Estimation of NONROAD CO emissions in 2007

	Number of Units	EPA NONROAD Model Estimate of CO emissions (unadjusted)	Activity Adjustment Factor	Revised CO Inventory Estimate (tons/day)
air compressors	251	0.83	0.50	0.42
ATVs	14,481	0.90	0.02	0.02
Chainsaws	6,159	0.56	0.20	0.14
concrete saws	144	0.60	0.25	0.15
Forklifts	94	0.41	1.00	0.41
generator sets	4,758	7.13	0.25	1.78
pressure washers	1,898	3.08	0.10	0.31
Pumps	1,227	1.73	0.25	0.43
snowblowers commercial	864	2.26	0.50	1.13
snowblowers residential	9,517	1.02	0.50	0.51
Snowmobiles	34,985	96.73	0.02	1.93
Welders	419	2.10	0.50	1.05
Other	91,767	3.47	varies	0.84
TOTAL NONROAD		120.83		9.12

To estimate future year emissions, the sources listed in Table 9-1 were increased in proportion to growth in households or employment. If the non-road source was primarily related to household activities, the growth in emissions was assumed to mirror the projected growth in households. Household-related sources include snowmobiles and residential snow blowers. For sources primarily related to commercial activity such as welders, pumps and air compressors, growth in emissions was tied to growth in employment. Non-road emission projections are shown in Table 9-2.

Table 9-2
CO emissions from Non-road sources 2007-2023 (tons per day)

Calendar Year	CO Emissions from Non-road Sources
2007	9.12
2009	9.24
2011	9.35
2013	9.47
2015	9.59
2017	9.70
2019	9.82
2021	9.93
2023	10.04

10 Railroad Emissions

Because railroad emissions are a relatively insignificant source of CO, no changes have been made to the estimates or methodology originally employed in the 2004 CO Maintenance Plan. The Alaska Railroad (ARR) supplied data on line haul and switchyard fuel consumption to the Alaska Department of Environmental Conservation for calendar year 1999. Total fuel consumption in the Anchorage switchyard was estimated to be 370,000 gallons during calendar year 1999. ARR also provided data on line haul fuel consumption between milepost 64 and 146. Annual fuel consumption along this 82-mile section of track was estimated to be 771,000 gallons. Only 14 miles of track (roughly MP 104 through MP 118) are inside the emission inventory area. The proportionate share of consumption within the inventory area was estimated to be 131,600 gallons. Twenty-four hour consumption rates were calculated by dividing annual totals by 365.

EPA guidance[‡‡‡‡‡] provides separate emission factors for yard and line haul emissions. These factors, expressed on a gram per gallon basis, were applied to ARR fuel consumption estimates to compute emissions.

Railroad fuel consumption and emissions are summarized in Table 10-1. Switchyard emissions were distributed to the three grid cells that encompass the rail yard in the Ship Creek area of Anchorage. The rail route in Anchorage crosses 15 grids cells in the Anchorage inventory area. Line haul emissions were distributed equally among these 15 grid cells.

Table 10-1
Alaska Railroad Emission Estimates 2007-2023

	Consumption (gal/year)	Consumption (gal/day)	Locomotive Emission Factor (grams/gal)	CO emissions (tons/day)
Yard	370,000	1,014	38.1	0.04
Line Haul	131,634	361	26.6	0.01
Total	501,634	1,375		0.05

Although railroad activity is expected to increase in future years, above the activity levels reported in 1999, the emissions increases that might be expected from this growth are likely to be offset by improvements in locomotive control technology. The Alaska Railroad recently replaced 28 of their 62 locomotives with new models that produce less pollution and are more fuel efficient. In addition, between 2002 and 2007, the railroad equipped two-thirds of their locomotives with devices that reduce the amount of time locomotives idle in the Anchorage switchyard and reduce fuel consumption. For the purpose of this analysis, CO emissions from the ARR were assumed to remain the same through 2023. Although this is a crude assumption, the significance of ARR emissions is very small. Hence, refining these future year projections would have a negligible effect on the overall inventory.

[‡‡‡‡‡] EPA Technical Highlights Document, EPA 420-F-97-051, December 1997.

11 Marine Vessel Emissions

The Port of Anchorage serves primarily as a receiving port for goods such as containerized freight, iron, steel and wood products, and bulk concrete and petroleum. Commercial shipping lines, including Totem Ocean Trailer Express and Horizon Lines bring in four to five ships weekly into the Port. The Port is currently undergoing a significant expansion that is intended to modernize the facility and double its size. In 2005, over 5 million tons of commodities moved across the Port's docks.

Despite the magnitude of this activity at the Port, CO emissions are relatively small. In June 2005, Pechan and Associates prepared an emission inventory for the ADEC that estimated winter and summer season CO emissions from the Port for the year 2002.§§§§§ This report provided an estimate of total emissions that occur from all four modes of commercial marine activity for the winter (defined as October through March). These four modes include cruise, reduced speed zone (RSV), maneuvering, and hotelling. However, as defined for modeling purposes, the cruise and RSV modes occur far from Port. Cruise mode activity occurs more than 25 miles form Port and the RSV mode occurs 2 miles or more from Port. Because cruise and RSV mode CO emissions occur so far from Port and therefore have little or no influence on CO concentrations in the Anchorage CO maintenance area, these emissions were excluded from this inventory.****** In addition to the 2002 inventory, the Pechan inventory also includes a forecast of winter CO emissions for 2005 and 2018. Interpolation and extrapolation was used to estimate CO emissions from Port of Anchorage marine activity from 2007 – 2023. These estimates are shown in Table 11-1.

Table 11-1
Estimated CO Emissions from the Port of Anchorage

Year	Estimated CO emissions (tons per day)
2007	0.09
2009	0.10
2011	0.11
2013	0.12
2015	0.12
2017	0.13
2019	0.13
2021	0.13
2023	0.13

§§§§§ Commercial Marine Inventories for Select Alaska Ports, prepared for the Alaska Department of Environmental Conservation by E.H. Pechan and Associates, June 2005.

****** Cruise and RSV emissions account for about 56% of total winter CO emissions. Therefore only 44% of the emissions in the Pechan inventory were included in this inventory.

12 Point Source Emissions

Point source emissions estimates for the year 2005 served as the basis for the 2007 base year point source emission inventory prepared for this maintenance plan and projections through 2023. Point source emissions were expected to grow in relation to the number of households. Thus the emission estimates for 2005 were adjusted upward in proportion to the growth in the number of households in the inventory boundary area.

ADEC is responsible for issuing operating permits to all stationary sources that have fuel-burning equipment with a combined rating capacity of greater than 100 million Btu per hour. The MOA also issues operating permits to all point sources in Anchorage with a combined rating capacity of greater than 35 million Btu per hour. The ADEC and MOA permit systems were used to inventory all stationary sources that are required to obtain such permits in the Anchorage non-attainment area. In addition, point sources that produce more than 10 tons per year (TPY) of CO (minor sources) were individually quantified to achieve a more precise estimate of the minor source contribution to the overall emission inventory from stationary sources.

The identification of minor sources was accomplished by contacting fuel distributors in Anchorage. We determined whether any facilities consumed sufficient quantities of fuel to exceed the annual 10 TPY of CO threshold. Using EPA's emission factors, AP-42 (fifth edition), fuel quantities equivalent to 10 TPY of CO were compared to sales of fuel to large users. This identified potential 10+ TPY of CO point sources. This approach determined that only permitted sources in Anchorage emitted more than 10 TPY of CO.

The ADEC point source computations were based on annual information provided by the source. The emission factors were from the most current version of AP-42. The ADEC calculated daily point source emissions for a typical wintertime day during the peak CO season by dividing the annual activity levels by the number of days per year. Actual facility operating information was available for 2005. Source emission estimates were based on actual fuel consumption and operations rather than permit allowable emissions.

Based on ADEC-issued air quality permits, there are six point sources in the Anchorage non-attainment area. Estimated annual emissions from each source for 2005 and projected daily emissions for the 2007-2023 period are listed in the table at the end of this section. Three of the six point sources identified in the Anchorage inventory were gas-fired (primarily natural gas) electrical generating facilities. Other sources include a sewage sludge incinerator, and two bulk fuel storage facilities.

There are three point sources that are located outside the non-attainment area. Two are located on military bases at Elmendorf Air Force Base and Fort Richardson. These facilities were excluded from the base year inventory because the CO emissions on these two military facilities are not considered significant contributors to the Anchorage attainment problem. The third facility is Anchorage Municipal Light and Power Sullivan Power Plant. It is located approximately two kilometers east of the northwest corner boundary of the nonattainment area. Even though this source is located outside the boundaries of both the attainment area and emission inventory area, it is included in the inventory. Emissions from the Sullivan Plant were assigned to the furthest northwest grid in the inventory area. This grid is located approximately 2 kilometers west of the power plant.

The ADEC used facility-reported information and AP-42 emission factors to estimate emissions for each of the six point sources. The methodology and emission factors used to estimate actual emissions at each facility is available upon request.

The ADEC Operating Permit system results in the collection of the emission information through requirements for annual and triennial emission reports, on-site inspections, the reporting of source test data and quarterly production levels and fuel usage, and interactions with each source. In addition, there was no CO emission control equipment identified on any of the sources included in the inventory. Therefore, 100% of the emission estimates resulting from the application of the AP-42 factors identified above was assumed for the inventories. Thus the application of a Rule Effectiveness factor did not appear to be appropriate and was not included for any of the point sources included in this inventory.

The estimates of actual emissions for a typical winter day (in tons per day) at each point source for the year 2005 and the projections for 2007 through 2023 are provided in Table 12-1.

Table 12-1
Point Source CO Emissions Summary (tons per day)

	Projected Daily CO Emissions based on growth in number of households									
Owner	2005	2007	2009	2011	2013	2015	2017	2019	2021	2023
Tesoro Alaska Petroleum Company, Anchorage Terminals I & II	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Anchorage Water & Wastewater Utility, Point Woronzof, John Asplund Wastewater Treatment Facility	0.26	0.27	0.27	0.28	0.28	0.29	0.30	0.30	0.30	0.30
Chugach Electric Association, International Station Power Plant	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Anchorage Municipal Light & Power, George Sullivan Plant Two	0.93	0.95	0.97	0.99	1.00	1.02	1.04	1.05	1.06	1.07
Anchorage Municipal Light & Power, Hank Nikkels Plant One	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08
Flint Hills Resources Alaska, LLC	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
TOTAL POINT SOURCE EMISSIONS	1.28	1.31	1.33	1.36	1.38	1.41	1.43	1.45	1.46	1.47

13 Compilation of Area-wide Emissions Summary

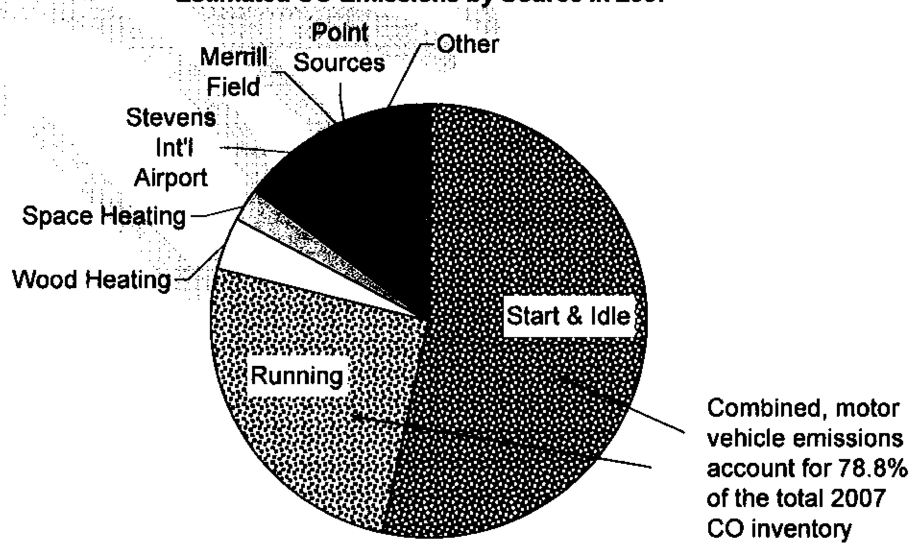
Based on the methodology outlined in the previous section, total CO emissions from all sources in the inventory area were calculated for a typical winter weekday in 2007, when conditions are conducive to elevated CO concentrations. Table 13-1 shows that total area-wide CO emissions are estimated to be 159.5 tons per day. Motor vehicles account for an estimated 78.8%. Figure 13-1 shows that most of these motor vehicle emissions are from start emissions.

Table 13-1.
Sources of Anchorage CO emissions in 2007 base year in Anchorage inventory area

Source Category	CO Emitted (tons per day)	% of total
Motor vehicles	125.6	78.8%
Aircraft Operations Ted Stevens Anchorage International and Merrill Field Airport	13.1	8.2%
Wood burning – fireplaces and wood stoves	6.2	3.9%
Space heating – natural gas	3.8	2.4%
Miscellaneous (snowmobiles, snow removal, welding, rail, marine, etc.)	9.3	5.8%
Point sources (power generation, sewage sludge incineration)	1.3	0.8%
TOTAL*	159.3	100.0%

*Total does not add to 100.0% because of rounding.

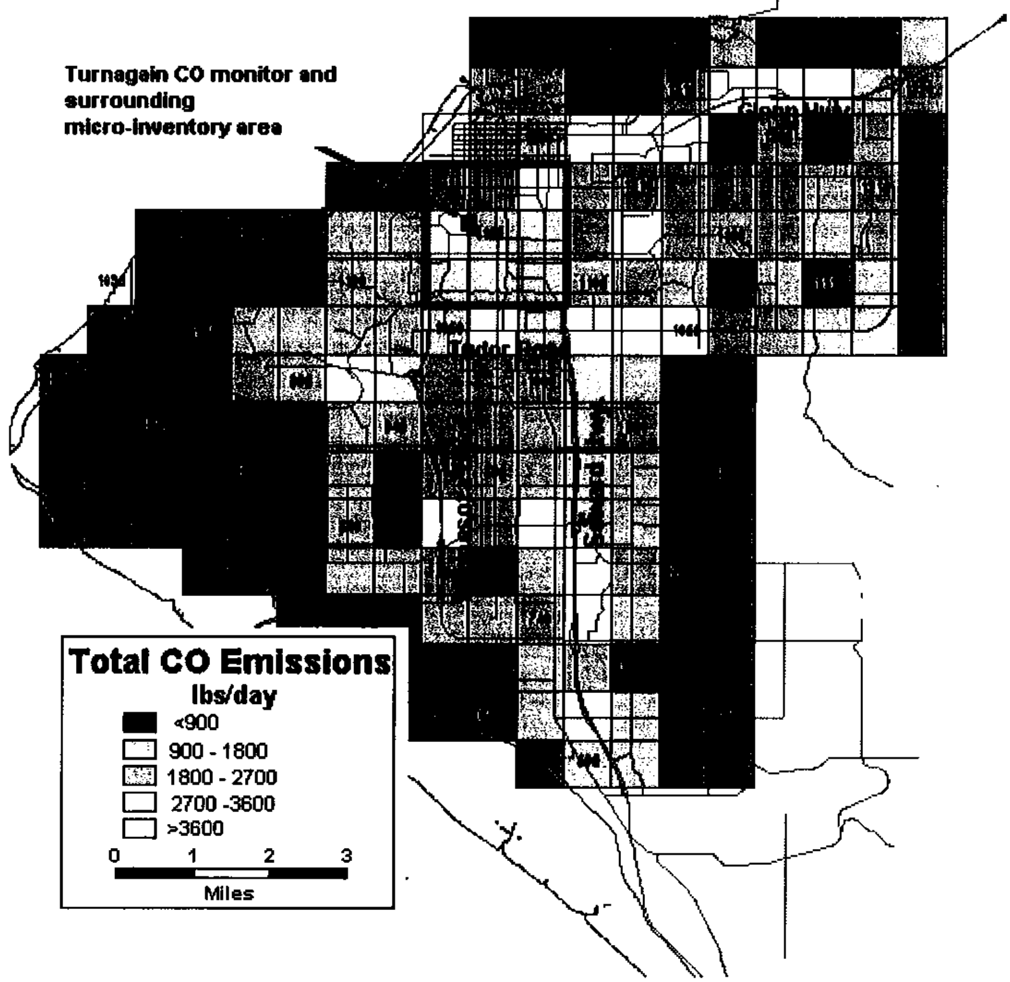
Figure 13-1
Estimated CO Emissions by Source in 2007



14 Compilation of Turnagain Area Micro-inventory

The area-wide CO inventory discussed in the previous section will be necessary to prepare the motor vehicle emission budget for use in future region-wide air quality conformity determinations. However, this "area-wide view" of emissions is not very useful in analyzing the factors leading to high CO concentrations at particular locations in Anchorage. Monitoring data, including a saturation monitoring study conducted in 1997-98 have demonstrated that CO concentrations vary widely throughout Anchorage and that some areas are more prone to high concentrations and have a greater potential to violate the national ambient air quality standard. The Turnagain monitoring station, located in a Spenard-area neighborhood (see Figure 14-1), has exhibited the highest CO concentrations of all the monitoring stations in Anchorage.

Figure 14-1
CO emissions distribution in Anchorage
(Turnagain micro-inventory area boundary noted with red border)



During the 1997-98 CO Saturation Study 8-hour CO concentrations at Turnagain were the highest among the 20 sites included in the study.[††††††] Even though the probability of violating the CO NAAQS at Turnagain is estimated to be just 1-in-100, analysis suggests that the probability of violating the standard at other monitoring stations is much lower. [‡‡‡‡‡‡] For this reason, the Turnagain site is being used for the maintenance demonstration. In order to perform this demonstration, CO emissions in the area immediately surrounding the Turnagain site must be known for base year 2007 and projected through 2023.

Because the Anchorage inventory data is disaggregated into one-kilometer^2 grids, CO emissions can be analyzed in the area immediately surrounding the Turnagain station. A nine-square kilometer area including and surrounding the Turnagain site was selected for analysis. The area selected is shown in Figure 14-1. As can be seen in the figure, the emissions in the nine grids comprising this analysis area are among the highest in the inventory area. In 2007, this nine square kilometer area contained an estimated population of 19,776. Total estimated employment was 9,005. This area is one of the most densely populated areas in the Anchorage bowl.

Results of the 2007 base year micro-inventory for the nine-kilometer^2 area surrounding the Turnagain station are shown in Table 14-1 for a "design day" when conditions are conducive to the highest ambient CO concentrations. Emissions were modeled for a cold January weekday, when hourly temperatures vary from 2.6 to 6.2 deg F. Under these conditions total CO emissions in the micro-inventory area were estimated to be 10.23 tons per day. Motor vehicles account for an estimated 84.4% of the emissions in the area. Note, unlike the area-wide inventory, there is no contribution from aircraft operations or point sources in the area. Motor vehicles account for 84.4% of all CO emissions in the micro-inventory area.

Table14-1
Sources of CO Emissions in Turnagain Micro-inventory Area 2007 Base Year Design Day

Source Category	CO Emitted (tons per day)	% of total
Motor vehicles	8.61	84.4%
Wood burning – fireplaces and wood stoves	0.62	6.1%
Space heating – natural gas	0.28	2.7%
Miscellaneous (e.g.; snowmobiles, snow removal)	0.70	6.8%
TOTAL*	10.20	100.0%

*Total does not add to 10.20 tons per day because of rounding.

Projected emissions in the Turnagain micro-inventory area are tabulated for the period 2007-2023 in Table 14-2. CO emissions increase slightly in 2013 due to the assumed termination of the I/M Program in 2012 but decline steadily thereafter. In contrast to the slight 6.6% increase in CO emissions projected area-wide between 2007 and 2023, emissions in the Turnagain area are expected to decline by about 5% during this same period. This is because slower rates of growth in population and vehicle travel are projected in the Turnagain area than the Anchorage bowl as a whole.

[††††††] Winter 1997-98 Anchorage Carbon Monoxide Saturation Study, Municipality of Anchorage Department of Health and Human Services, September 1998.

[‡‡‡‡‡‡] Analysis of the Probability of Exceeding the CO Standard between 2007 and 2023, Municipality of Anchorage Department of Health and Human Services, February 2011.

Table 14-2
Estimated Total 24-hour CO Emissions CO on Design Day in Turnagain Micro-Inventory Area (tons per day)

		Projected CO Emissions by Source					
		motor vehicles					
	projected population	start & extended idle	running	wood burning	space heating	other	**TOTAL**
2007	19,776	6.01	2.60	0.62	0.28	0.70	**10.20**
2009	20,090	6.14	2.28	0.63	0.28	0.71	**10.03**
2011	20,404	6.26	2.08	0.64	0.28	0.71	**9.97**
2010	20,247	6.20	2.18	0.63	0.28	0.71	**10.00**
2013	20,718	6.52	2.11	0.66	0.28	0.72	**10.29**
2015	21,032	6.59	1.92	0.66	0.29	0.73	**10.18**
2017	21,346	6.62	1.72	0.67	0.29	0.73	**10.03**
2019	21,536	6.58	1.64	0.68	0.29	0.74	**9.93**
2021	21,725	6.55	1.55	0.68	0.29	0.75	**9.82**
2023	21,915	6.49	1.48	0.69	0.30	0.76	**9.71**

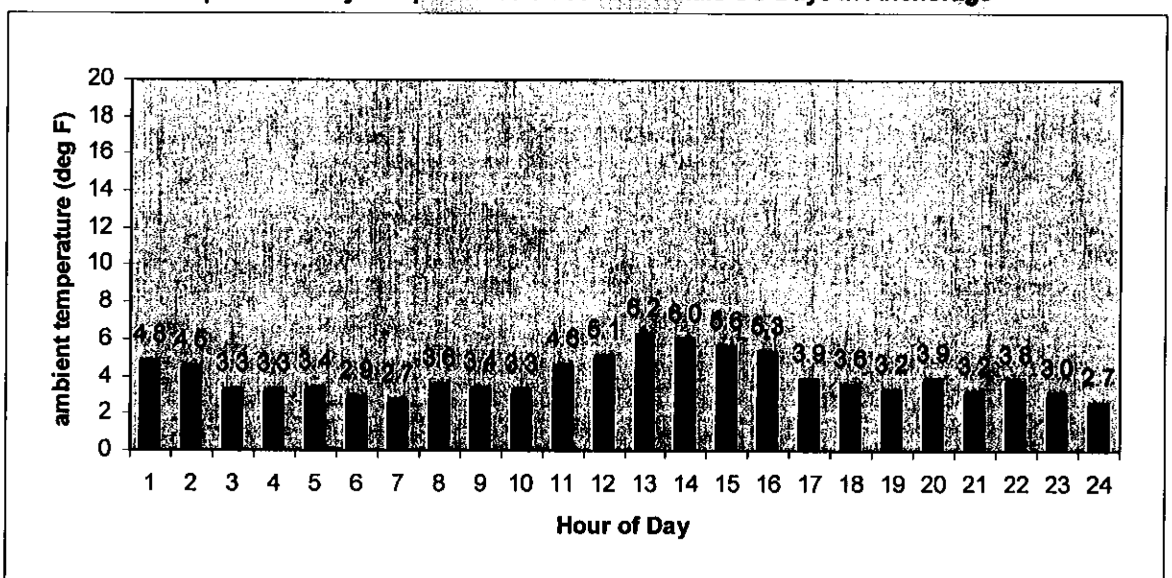
15 MOVES Run Specifications and County Data Manager Inputs

The EPA provides guidance on how MOVES should be run for SIP-related emission inventories and for conformity determinations in a guidance document.[24] It stipulates that MOVES should be run using the *County* domain scale. When MOVES is run under this domain scale it requires a series of user-supplied local data files, designated in the MOVES County Data Manager, that reflect the specific characteristics of the area being modeled. There are nine data files required. Each of these data files, and the origin of the data within them, is discussed. In addition, this section also discusses alternative vehicle fuels and technology (AVFT) inputs used to characterize the Anchorage gasoline vs. diesel fueled fleet in MOVES.

15.1 Meteorology Data

Anchorage experiences its highest CO in mid-winter. We examined hourly ambient temperature data on those days with the very highest 8-hour average CO (criteria ≥ 99th percentile) at the Turnagain monitor between 1999 and 2009.[25] The 21 days with the highest 8-hour average CO concentration were selected from this 11 year period and a composite diurnal temperature profile was developed from data collected by the NWS at Ted Stevens Anchorage International Airport. Note that there is very little variation over the course of the day.

Figure 15-1
Composite Hourly Temperatures on 99th Percentile CO Days in Anchorage



The hourly data above has been used as temperature inputs when MOVES is used to estimate starting emissions. (Ambient temperature assumptions have no effect on CO running emissions.) Although CO emissions estimates are unaffected by relative humidity (RH) assumptions, MOVES requires field for RH to be filled in; 80% was used.

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[24] *Technical Guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity,* EPA 420-B-09-046, December 2009

[25] The 99.5 percentile criterion was normalized to account for the downward trend in CO that has occurred over the past decade. In 1999 the 99.5 percentile concentration was 7.2 ppm; in 2009 it was 5.3 ppm.

15.2 Source Type Population

ADEC hired Sierra Research, Inc. to characterize the *source type population* or types of vehicles (e.g.; passenger car, passenger truck, combination long haul truck) in the Anchorage fleet by using a VIN (vehicle identification number) decoder to examine the Alaska DMV database narrowed to zip codes in the Anchorage CO inventory area. This effort has provided an excellent estimation of the number of vehicles in each of the 13 vehicle types defined by MOVES.

The result of this effort (excerpted from Sierra's report to ADEC) is shown in Table 15-1. Although the VIN decoder estimate revealed a motorcycle population of 8,446 in the inventory area, the effective population was assumed to be zero in January when CO emissions were modeled with MOVES.

Table 15-1
Anchorage Vehicle Populations by MOVES Source Type

Source Type ID	Source Type Description	**Vehicle Population**	**Assumed % Growth between 2007 and 2023**
11	Motorcycle	~~8,446~~ 0[a]	0.0%
21	Passenger Car	62,404	27.5%
31	Passenger Truck	122,558	27.5%
32	Light Commercial Truck	12,371	20.3%
41	Intercity Bus	195	13.3%
42	Transit Bus	242	27.5%
43	School Bus	328	13.3%
51	Refuse Truck	85	13.3%
52	Single Unit Short-haul Truck	1,370	13.3%
53	Single Unit Long-haul Truck	118	13.3%
54	Motor Home	5,499	0.0%
61	Combination Short-haul Truck	941	13.3%
62	Combination Long-haul Truck	601	13.3%
Total Vehicle Fleet		215,158	

[a] Motorcycle activity in Anchorage during the winter months was assumed to be zero.

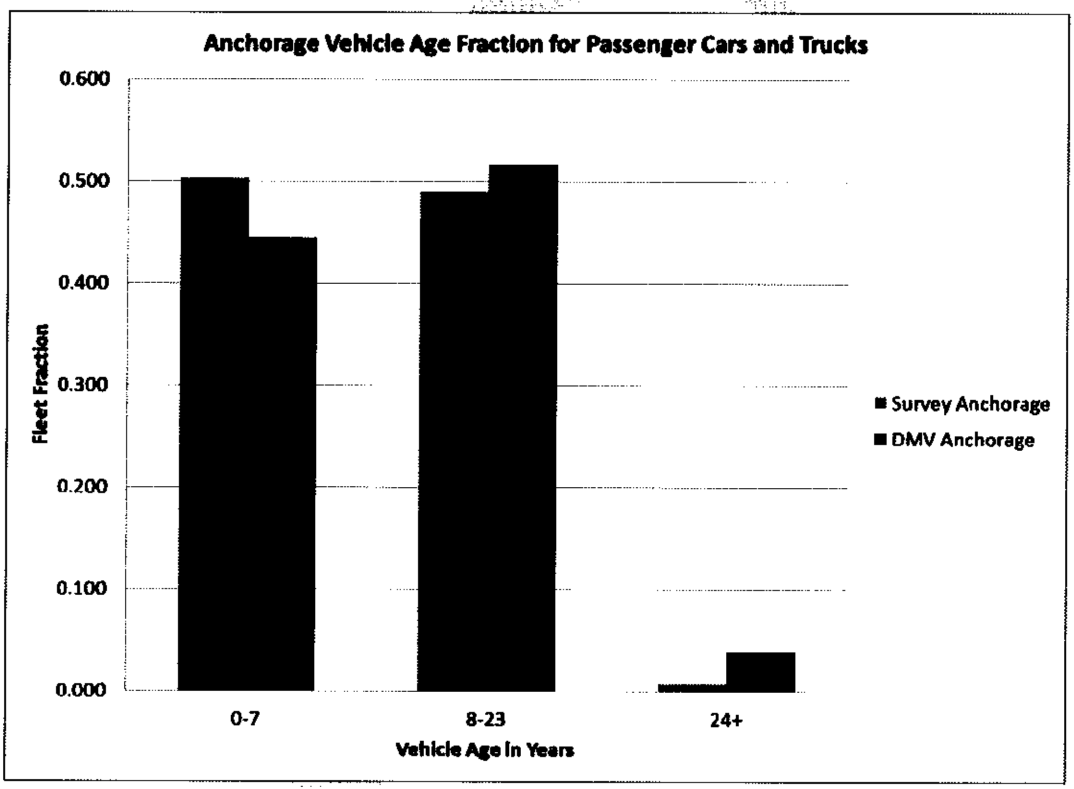
Vehicle populations (and the distribution among vehicle types) had to be projected through 2023. Historical I/M data were examined and that data suggested that the I/M eligible vehicle population (largely passenger cars and trucks) has been growing at an average rate of approximately 2.5% per year, about twice the rate of population growth in Anchorage. Absent any data on the expected growth of these vehicles by vehicle type, varying assumptions were made about growth in specific categories. For example, because of increases in the cost of fuel, the motor home population was expected remain constant throughout the planning period. The population in the Anchorage inventory area is projected to grow by 13.3% between 2007 and 2023. Table 15-3 shows the assumed growth in the vehicle populations during the same time period. It should be noted that MOVES emission estimates for composite fleet emissions are not particularly sensitive to these growth assumptions.

15.3 Age Distribution

Vehicles age distribution for each of the thirteen MOVES source types were estimated by Sierra Research using DMV, parking lot survey and MOVES default data. After the population for each source type was determined, the age distribution of vehicles in that source type was computed. Source types 41 through 62 (buses, heavy trucks and motor homes) relied on DMV data for their age distribution calculations.

Sierra observed that the apparent age distributions for passenger cars and trucks (source types 21, 31 and 32) estimated from parking lot survey data differed from the DMV data. Roughly half of the parking lot-surveyed vehicles fall into a category of model year 2004 and newer (Figure 15-2). The DMV data shows 10% fewer vehicles in the same age group. The parking lot survey data was relied upon to determine the age distribution for passenger cars, passenger trucks, light commercial trucks and motorcycles because it was believed to more accurately represent the active vehicle fleet in the winter CO season. DMV data were relied upon for age distributions of buses, short-haul, long-haul and refuse trucks, and motor homes.

Figure 15-2
Comparison of DMV and Survey-Based Vehicle Age Distributions of Passenger Cars and Passenger Trucks In Anchorage
(from Sierra Research memo to ADEC, 1/12/2011)



15.4 Vehicle Type VMT

15.4.1 HPMS Vehicle Type VMT Year

The ADOT&PF (Central Region 2007-2009) Traffic Volume Report.[26] includes traffic count data that can be easily mapped into the six basic (10, 20, 30, 40, 50, 60) MOVES vehicle VMT categories. Winter traffic count data from eleven count stations in the Anchorage inventory area were used to estimate the percentage of VMT accrued by each MOVES vehicle type.[27] The Anchorage Traffic Model estimates that daily weekday VMT in the inventory area is 3,344,312. An estimate of annual VMT can be made by scaling-up the daily weekday estimate as follows (DOT data suggests that Saturday traffic is about 90% of weekday and Sunday is about 75 %.)

Average daily VMT = ((3,344,312 x 5) + (3,344,312 x 0.9) + (3,344,312 x 0.75))/7 = 3,177,096
Average annual VMT = 1,159,640,186

Estimates of annual VMT used in MOVES modeling are shown below.

Table 15-2
DOT count-based estimates of Annual VMT by MOVES vehicle type (in 10^3 miles)

	MOVES Vehicle Type						
	10	20	30	40	50	60	All
% of VMT	0	405,020	677,962	5,676	33,832	98,184	1,220,674
Annual VMT	0.0%	33.2%	55.5%	0.5%	2.8%	8.0%	100%

15.4.2 Month VMT Fraction

The ADOT&PF Traffic Volume Report also includes data on traffic volumes by month... The table below shows January traffic count data from Anchorage roads relative to an "average" month in the year, where an average month is 100%. January traffic is 88.6% of average. On an average month, the fraction of annual of VMT accrued = 1/12 = 0.0833. The amount accrued in January is lower (0.866 x 0.0833 = 0.0752). This value was used in MOVES to model the January VMT fraction.

[26] Data from:
http://www.dot.alaska.gov/stwdplng/transdata/traffic/cen_reports/07_08_09ATVR_Final_9_2_2010.pdf

[27]. According to DOT these data may be somewhat unreliable in distinguishing between cars and pickup trucks because of counter limitations. For this reason, the relative proportions of cars vs. truck may be re-adjusted pending the results of the ADEC VIN decoder effort discussed above.

Table 15-3
January VMT Counts as a Percentage of an "Average" Month on Anchorage Roads

SANDLAKE ROAD	85.1%
OLD SEWARD HIGHWAY - NORTH OF SUNDOWN COURT	92.1%
A Street at Chester Creek	90.7%
C Street at Chester Creek	90.0%
Arctic Boulevard –South of 76th Avenue	87.0%
DeBarr Road –East of Wintergreen Street	88.4%
Dimond Boulevard –West of Arctic Boulevard	86.2%
Ingra and Gambell at Chester Creek	86.8%
International Airport Road – West of Fairbanks St	89.2%
Minnesota Drive at Chester Creek	88.1%
Minnesota Drive – NORTH OF DIMOND BOULEVARD (WIM)	92.1%
Minnesota Drive –South of Int'l Airport Road	89.9%
Northern Lights Blvd – East of LaTouche Street	89.0%
Northern Lights Blvd – West of Forest Park Drive	88.5%
O'Malley Road – East of Seward Highway	84.8%
TUDOR ROAD - WEST OF TUDOR CENTER DRIVE	89.6%
TUDOR ROAD - WEST OF PATTERSON STREET	87.9%
Average	**88.6%**
fraction of annual VMT occurring in January =	**0.0752**

15.4.3 Day VMT Fraction

Default data from MOVES was used to apportion weekend and weekday travel. These assumptions do not significantly affect estimates for running emissions because we are using emission factors along with Anchorage Transportation Model estimates of VMT to compute emissions. We will be estimating CO emissions for weekdays only.

15.4.4 Hour VMT Fraction

The ADOT&PF Traffic Volume Report also includes information that can be used to estimate the VMT fraction by hour of the day. The results of this analysis are shown below. These values were used as inputs in the MOVES modeling.

Table 15-4
Distribution of VMT by Hour on Anchorage Roads

Hour	Proportion of Daily VMT
1	0.01241
2	0.00794
3	0.00618
4	0.00447
5	0.00506
6	0.01141
7	0.02724
8	0.05124
9	0.04929
10	0.04447
11	0.04776
12	0.05824

Hour	Proportion of Daily VMT
13	0.06582
14	0.06594
15	0.06782
16	0.07529
17	0.08206
18	0.08153
19	0.06500
20	0.04953
21	0.04112
22	0.03571
23	0.02641
24	0.01835

15.5 Average Speed Distribution

Sierra Research examined speed estimates from the Anchorage Transportation Model and constructed a spreadsheet that converted these speed estimates into the speed distributions (16 speed bins) required by MOVES for each source types and road type by hour of the day. Although an effort was made to accurately reflect these speed distributions in the MOVES speed distribution input file, this information is less critical because will be using MOVES in the *emission rates* mode rather than the *inventory* mode when developing the inventory, emission budget and for performing conformity analyses. The spreadsheet model was used to estimate the average speed of vehicles traveling on the two road types within each grid and select an appropriate MOVES-based emission rate based on that speed.

15.6 Road Type Distribution

The Anchorage Transportation Model provides information of the amount of VMT accrued on five different road types and these five types can be mapped into the four road types required by MOVES. (The Anchorage inventory area has only two of these road types, urban unrestricted access and urban restricted access.) Transportation model estimates of VMT accrued on local, collector, minor arterial and major arterial roadways are combined to make up an estimate of the *urban unrestricted access* road type defined by MOVES. Freeway and expressway VMT estimates are simply re-defined as *urban restricted access* VMT. For 2007, the transportation model estimates that about 73% of travel occurs on unrestricted access roads and the remainder on restricted access.

15.7 Ramp Fraction

Absent better information, the MOVES default ramp fraction (8%) was used as the fraction for Anchorage.

15.8 Fuel Supply and Fuel Formulation

The MOVES defaults for fuel supply and formulation assume that market share of gasoline blended with 10% ethanol in Anchorage will increases to 100% by 2012. Tesoro Alaska, the main refiner and gasoline supplier in Anchorage has informed us that there is an exemption to the Renewable Fuel Standard (RFS) in Alaska and that they have no plans to blend ethanol in the gasoline in the forseeable future.[28] For this reason, for modeling purposes, we "zeroed" out the market share of ethanol-blended gasoline. Tesoro also informed us that they met the ultra-low sulfur specification before 2007 and that they did not envision further changes in sulfur content in the coming years. Table 15-5 shows gasoline fuel formulation assumptions for the period 2007-2011 and for 2013-2023. The main difference in specification is the lowered benzene content after 2012. This change is unlikely to have an impact on modeled CO emissions. MOVES supplied defaults were used for the diesel fuel spec. Although there is some minimal use of other motor fuels such as natural gas, this was assumed to be zero for modeling purposes.

[28] E-mail communication from Kip Knudson, Tesoro Alaska 1/11/2011.

Table 15-5
Gasoline Fuel Formulation Assumptions Used In Anchorage MOVES Modeling

	Time Period	
	2007-2011	2013-2023
Fuel Formulation ID	8077	8859
Fuel Subtype ID	10	10
RVP	15.2457	15.2457
Sulfur Level	30	30
ETOH Volume %	0	0
MTBE Volume %	0	0
ETBE Volume %	0	0
TAME Volume %	0	0
Aromatic Content %	31.7475	29.8113
Olefin Content %	0.92	0.92
Benzene Content %	3.7	0.6445
e200	54.7901	57.0202
e300	91.781	93.8415

15.9 I/M

Table 15-6 shows the Vehicle Inspection and Maintenance (I/M) Program assumptions used in the MOVES modeling. In 2007, the Anchorage I/M program included a 4-year testing exemption or grace period for new cars. In 2011 this grace period was extended to 6 years. For modeling purposes the I/M program was assumed to be discontinued in 2012.

Table 15-6
I/M Assumptions Used in Anchorage MOVES Modeling

	Time Period			
	2007 - 2009	2011	2013-2023	Explanation of MOVES Codes
I/M in operation?	Yes	Yes	No	
Grace Period	4 yrs	6 yrs	—	
Source Types	21, 31, 32	21, 31, 32	-----	Passenger cars = 21, passenger trucks = 31, light commercial trucks =32
I/M test standards MY <1996	12	12	-----	Two-mode, 2500 RPM/Idle Test =12
I/M test standards MY ≥ 1996	51	51	-----	Exhaust OBD Check = 51
Inspection frequency	2	2	-----	Biennial =2
Compliance Factor MY <1996	90%	90%	-----	
Compliance Factor MY ≥ 1996	93%	93%	-----	

15.10 Alternative Vehicle Fuels and Technology (AVFT) Inputs

Sierra Research observed differences in gasoline/diesel splits from MOVES default values varied from 1% to 30% for most source types and model years. Because these differences were relatively substantial in some instances, the MOVES *AVFT* option was used to input Anchorage-specific information on gasoline diesel splits when it was available. (Default values were used pre MY 1981 vehicles). Sierra found that Anchorage tended to have a higher diesel fraction than the default for most source types. As an example, the diesel fraction of the MOVES default or compared to Anchorage for passenger cars (source type 21) in Table 15-7.

Table 15-7
Comparison of Anchorage Fleet to MOVES Defaults
% of Diesel-Fueled Passenger Cars

Model Year	MOVES Default	Anchorage AVFT
1981	7.64%	22.43%
1982	6.09%	19.18%
1983	3.10%	8.29%
1984	1.88%	6.60%
1985	1.17%	4.92%
2001	0.38%	0.48%
2002	0.38%	0.86%
2003	0.38%	0.98%
2004	0.38%	0.74%
2005	0.38%	1.13%
2006	0.38%	1.79%
2007	0.38%	0.00%
2008	0.38%	0.06%
2009	0.38%	0.73%
2010	0.38%	0.73%

Appendix to Section III.B.6, Anchorage CO Maintenance Plan

Air Quality Program
Municipality of Anchorage
Department of Health and Human Services
April 2011

Analysis of the Probability of Complying with the National Ambient Air Quality Standard for CO in Anchorage between 2007 and 2023

Background

In July 2008, the Anchorage Assembly directed the Municipal Department of Health and Human Services to work with the State of Alaska to remove the I/M Program as a requirement in the State Implementation Plan for air quality with a stipulation that it be retained as a local option and not be subject to a further SIP revision if further local action results in changes to or a discontinuation of the program. As a result a new probabilistic maintenance demonstration has been prepared that analyzes the impact of terminating I/M on prospects for future compliance with the national ambient air quality standard (NAAQS).*

Prior to the preparation of the previ[illegible] Anchorage CO Maintenance Plan in 2004, the Municipality of Anchorage (MOA), the Alaska De[illegible]ent of Environmental Conservation (ADEC) and EPA Region 10 staff agreed that a probabi[illegible]roach should be used in the Anchorage maintenance demonstration. The MO[illegible] and EPA agreed that this demonstration must show a 90% or greater probability of me[illegible] th[illegible]tional ambient air quality standard in each year during the 20[illegible]lifetime of the [illegible]te[illegible] Plan.

The MOA is usin[illegible] same m[illegible]dology us[illegible]e 20[illegible] Plan in this revised maintenance demonstration. Th[illegible]ethodology [illegible]ies on c[illegible]tional st[illegible]cal methods to estimate the probability of complyin[illegible]th the N[illegible]S in the [illegible]r 2007, the base year for the analysis. The "roll forward" technique, u[illegible]d in the [illegible]vious mai[illegible]ance demonstration, is used to estimate pro[illegible]ying with [illegible] st[illegible]rd in future [illegible]rs. This technique relies on CO emissions proje[illegible]8 thro[illegible]stimate the probability of complying with the NAAQS [illegible]ing this time [illegible]d.

This is a "te[illegible]ical revision" [illegible] ea[illegible] document prepared in March 2010. This revised document sub[illegible]tes CO emiss[illegible] esti[illegible]es generated by the new EPA emissions model MOVES for previ[illegible] estimates g[illegible]rated by AK MOBILE6. Although the computed probabilities of continued mainte[illegible]ce change[illegible]htly as a consequence, there is very little change in conclusions from the p[illegible]bility a[illegible]sis regarding prospects for continued maintenance of the CO NAAQS. The analysi[illegible]hat there is a very high probability of continued compliance with the NAAQS through 20[illegible]

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Method

Estimating the Probability of Complying with the NAAQS in Base Year 2007

The NAAQS for CO is set at 9 ppm for an 8-hour average not to be exceeded more than once per year. Because the NAAQS effectively disregards the highest 8-hour average in determining compliance, *the measure of whether a community meets the standard is*

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* Even though I/M could continue as a local option program, CO reduction benefits were ignored because it is no longer a committed primary control measure in the SIP.

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determined by the magnitude of the second highest 8-hour average, or second maximum. For this reason, this analysis focuses on the probability of the second maximum being above or below the 9 ppm NAAQS.

Standard regression analysis techniques can be used to estimate the probability of complying with the CO NAAQS in 2007. By definition, a violation occurs when the second maximum concentration is higher than 9 ppm. The probability that this will or will not occur can be computed using the prediction interval. The prediction interval is defined mathematically as follows:

Equation 1

$$y_p = y_h + t_{(\alpha;\, n-2)} \cdot s\{pred\}$$

where

$$s\{pred\} = \sqrt{MSE[1 + \frac{1}{n} + \frac{(X_h - \bar{X})^2}{\sum(X_i - \bar{X})^2}]}$$

In this circumstance, we are interested only in the upper limit of the prediction interval†. In this case we want to compute the value corresponding to the upper 90th percentile interval in base year 2007. If 2007 could be "repeated" numerous times, with the "normal" variety of meteorological conditions and other variables that effect CO concentrations, the second maximum concentration would fall at or below this value 90% of the time. This value is the base year 2007 design value (2007 $DV_{90\%}$).

Over the past 30 years, CO monitoring has been conducted at ten permanent CO stations‡ and at numerous additional temporary stations throughout Anchorage and Eagle River. Data suggest that the Turnagain monitor, located in a residential area in west Anchorage, has the highest CO concentrations of the four monitors in the current network. (See analysis in the Attachment at the end of this report.) Although it is difficult to compare recent data from Turnagain with data collected from other sites a decade or more earlier, studies suggest that the CO concentrations at Turnagain are likely representative of the highest ambient CO concentrations encountered in Anchorage. For this reason, Turnagain was selected as the site for the maintenance demonstration.

First and second maximum 8-hour CO concentrations measured at Turnagain are shown in Table 1.§

† This is known as a one-sided prediction interval. In this case we use the one-sided t-statistic when using Equation 1.

‡ For the purposes of this discussion, we define a permanent monitoring station as one that has employed Federal Reference Method monitors over the course of at least one CO season. Temporary monitoring was conducted with bag samplers in the 1980's and more recently with portable industrial hygiene-type CO monitors. Temporary monitoring has been conducted at more than 30 locations in the Municipality.

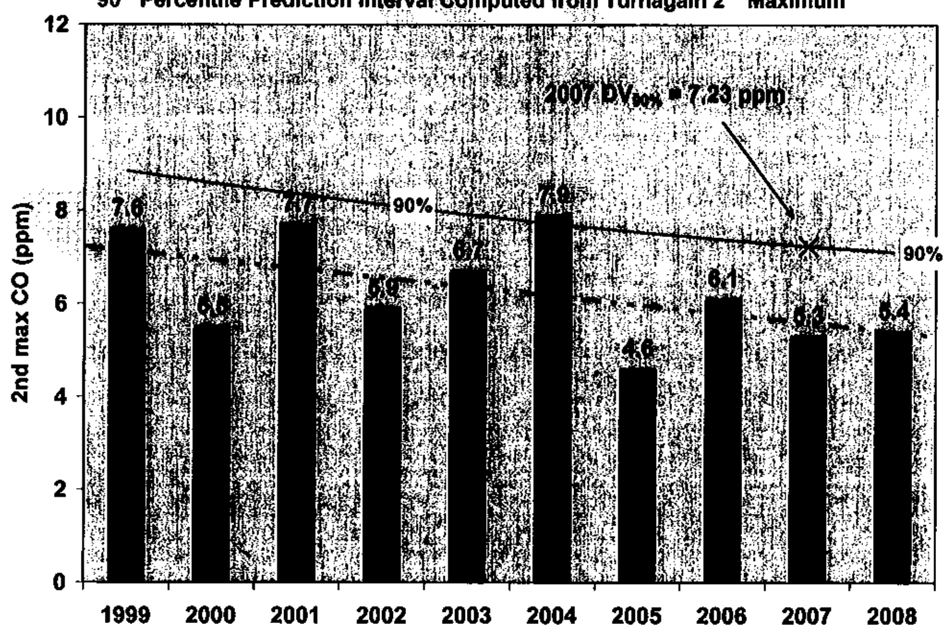
§ The Turnagain station began operation October 16, 1998; thus 1999 was the first complete year of data collected at this site.

Table 1
1st and 2nd Maximum CO Concentrations at Turnagain Station (1999-2008)

	Highest 8-hour average CO Concentration (ppm)	2nd Highest 8-hour average CO Concentration (ppm)
1999	10.1	7.6
2000	7.2	5.5
2001	9.8	7.7
2002	6.5	5.9
2003	8.3	6.7
2004	8.1	7.9
2005	5.7	4.6
2006	6.5	6.1
2007	5.5	5.3
2008	6.3	5.4

An Excel spreadsheet was used to compute the upper 90th percentile prediction interval from the second maximum concentrations at Turnagain using Equation [illegible]. The results of this computation are plotted in Figure 1. Figure 1 shows that there was [illegible]0% probability that the base year 2007 value would be less than or equal to 7.23 ppm. This computed concentration will serve as the base year 2007 design value for the roll forward analysis discussed later in this report.

Figure 1
90th Percentile Prediction Interval Computed from Turnagain 2nd Maximum



The precise probability of complying with the 9 ppm NAAQS in 2007 was also estimated with the spreadsheet. The probability associated with a second maximum of less than or equal to

9.0 ppm can be estimated through iteration. The one sided t-statistic associated with various probabilities can be used in Equation 1 until the desired 9.0 ppm value is bracketed within two prediction intervals (see Table 2). In this case the desired 9.0 ppm value falls very nearly at the 99.0% interval. Thus, the probability of complying with the NAAQS in 2007 was estimated to be approximately 99%. The chance of violating the NAAQS in 2007 was about 1-in-100.

Table 2
Second Maximum CO Concentration Associated with Various Upper Bound Prediction Intervals

Probability that 2007 CO Concentration will be less than Computed 2[nd] Max Concentration	Computed Second Maximum CO Concentration (ppm)
80.0%	6.64
90.0%	7.23
95.0%	7.78
97.5%	8.30
99.0%	8.99
99.9%	[illegible]

Estimating the Probability of Complying with [illegible] NAA[illegible]tween 2007 - 2[illegible]3

One assumption implicit in using t[illegible]ll forward [illegible] is that the second ma[illegible]num CO concentration in any future year will [illegible]oportiona[illegible]he magnitude of the CO emissions in that year relative to base year emiss[illegible]007. In o[illegible]r words, if CO emissions in a future year are projected to decrease by 10% [illegible]la[illegible]o base y[illegible] 2007, the expected CO concentration in th[illegible] year will als[illegible]ecr[illegible]by 10%. [illegible]this occurs, there will be concurrent incr[illegible]ability of c[illegible]h the N[illegible]S in that year.

CO emissions w[illegible]stimated [illegible]he 9 kilo[illegible] area [illegible]undi[illegible] the Turnagain CO monitoring station fo[illegible]se year 2[illegible]7 using [illegible]-prescribe[illegible]odels such as the MOVES, NONROAD, AP-42 an[illegible] FHW[illegible]odel EDM[illegible]o estimate CO emissions.[**]

CO[illegible]007 wer[illegible] to be 10.2[illegible]ns per day (tpd) in the "micro-inventory area [illegible]gain.[illegible]0th p[illegible]rcentile concentration or 2007 $DV_{90\%}$ was 7.2[illegible]pm. If one a[illegible]es [illegible] CO conc[illegible]tions increase in direct proportion to emissions, [illegible] amount of C[illegible]hat [illegible]ld be emitted in the Turnagain area and retain a 90% probability o[illegible]plying with t[illegible] sta[illegible]d can be computed as follows:

Amount of CO emiss[illegible]s associat[illegible]ith a 90% probability of co[illegible]ng with [illegible]AAQS $= (9.0\ ppm / 2007\ DV_{2007}) \times CO\ emissions\ in\ 2007$

$= (9.0\ ppm / 7.23\ ppm) \times 10.20\ tpd = \mathbf{12.70\ tpd}$

This computation suggests that if CO emissions in the Turnagain area increased from 10.20 tpd to 12.70 tpd, the probability of complying with the NAAQS would be 90%. In the same manner as shown above, the amount of emissions corresponding with other

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[**] The MOVES model is used to estimate vehicle emissions, NONROAD us used to estimate various nonroad sources such as snowmobiles and portable electrical generators, EDMS is used for airport operations and AP-42 is used to estimate various area sources such as natural gas space heating, fireplaces and wood stoves. These models and emission inventory procedures are described more fully in the *Anchorage CO Emission Inventory and Emission Projections 2007-2023*, included as Appendix A of the Anchorage SIP submittal.

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probabilities of compliance (i.e. 90%, 95%, 99%, etc.) can be readily computed with the spreadsheet. The spreadsheet was used to create a lookup table listing probabilities along with corresponding quantity of emissions. Table 3 shows the results of these spreadsheet computations. As would be expected, the probability of complying with the NAAQS increases with lower emission rates.

Table 3
CO Emission Rates Associated with Varying Probabilities of Compliance with the NAAQS at the Turnagain Station

Probability that 2nd Max CO Concentration will be less than 9.0 ppm	Corresponding CO Emission Rate (tpd)
99.9%	8.44
99.5%	9.15
99.0%	10.22
98.0%	10.77
97.0%	11.21
96.0%	11.50
95.0%	11.81
94.0%	11.98
93.0%	12.15
92.0%	12.33
91.0%	12.51
90.0%	12.70

In addition to es[illegible] year 2007 [illegible] in the [illegible]ilometer² area surrounding Turnagain, emiss[illegible]s were pro[illegible]ted throu[illegible] year [illegible]3. Pro[illegible]ctions were prepared using the aforemen[illegible]ed MOVE[illegible] NONRO[illegible] AP-42, a[illegible]EDMS modeling procedures. Population and employ[illegible]nt forec[illegible]s prepare[illegible]y the University of Alaska Institute of Economic and Social Res[illegible]rch ([illegible]R) were us[illegible] to estimate key parameters necessary to esti[illegible]ehicle t[illegible] heating, [illegible]replace and woodstove use and other CO emiss[illegible] sources. [illegible] MOVE[illegible]figured to reflect that the four-year new car exemptio[illegible] will be extend[illegible] to si[illegible]ears beginn[illegible] January 2010 and discontinued in 2012..

The results o[illegible]his "micro-inve[illegible]ory" [illegible] forecast of CO emissions in the Turnagain area are shown in Table [illegible]. The probab[illegible] of co[illegible]plying with the NAAQS at the level of emissions projected for each [illegible]ar was det[illegible]ined from the lookup table (Table 3).

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†† The Anchorage Transportation Model was used to provide information on vehicle travel. It relies in large part on ISER projections in the development of travel forecasts.

Table 4
Projected CO Emissions and Probabilities for Compliance with the NAAQS (2007-2023)

	CO Emissions from Various Sources in the 9 km^2 Area Surrounding the Turnagain Station (all emissions in tons per day)					
Year	Motor Vehicles	Fireplace or Woodstove	Space Heating	Other	**TOTAL CO EMISSIONS**	**Probability of Compliance**
2007	8.61	0.62	0.28	0.70	**10.20**	99.1%
2008	8.51	0.62	0.28	0.70	**10.12**	99.1%
2009	8.42	0.63	0.28	0.71	**10.03**	99.1%
2010	8.38	0.63	0.28	0.71	**10.00**	99.1%
2011	8.34	0.64	0.28	0.71	**9.97**	99.2%
2012	8.49	0.65	0.28	0.72	**10.13**	99.1%
2013	8.63	0.65	0.28	0.72	**10.29**	98.9%
2014	8.57	0.66	0.28	0.73	**10.24**	99.0%
2015	8.51	0.66	0.29	0.73	**10.19**	99.1%
2016	8.42	0.67	0.29	0.73	**10.11**	99.1%
2017	8.34	0.67	0.29	0.74	**10.03**	99.1%
2018	8.28	0.68	0.29	0.74	**9.99**	99.1%
2019	8.22	0.68	0.29	0.74	**9.94**	99.2%
2020	8.16	0.68	0.29	0.75	**9.88**	99.2%
2021	8.10	0.68	0.29	0.75	**9.83**	99.2%
2022	8.03	0.69	0.29	0.75	**9.77**	99.2%
2023	7.97	0.69	0.30	0.76	**9.71**	99.3%

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Table 4 suggests that there is a very high likelihood of complying with the NAAQS at the Turnagain station. CO emissions are projected to increase slightly in 2013 if the I/M program is terminated as assumed, but the probability of compliance remains at or near 99% through the 2007-2023 period. Although not shown here, a similar analysis was performed for the Garden station. That analysis indicated that there is an even greater likelihood of compliance at that site. The probability of compliance was greater than 99.9% each year between 2007 and 2023.

Sensitivity Analysis

The roll forward probability analysis presented in the last section relies on modeled projections of future emissions. What happens to the estimated probabilities if these projections underestimate the growth in CO emissions between 2007 and 2023?

This sensitivity analysis investigates the sensitivity of the probability estimates presented in Table 4 to assumptions regarding:

1. future growth in vehicle miles traveled (VMT), vehicle starts and idling, and;
2. future growth of wood stove and fireplace use.

For the purpose of this analysis, we will adjust initial assumptions regarding VMT, and wood stove and fireplace use and re-compute the estimated probability of complying with the NAAQS during the 2007-2023 period. The manner in which each of these assumptions was revised is described in the next section.

Revised Assumptions Used in Sensitivity Analysis:

Future Growth in VMT, Vehicle Starts and Idling

Imbedded in these emission computations is the assumption that amount of vehicle miles traveled (VMT) on streets in the 9 $kilometer^2$ area surrounding the Turnagain station will grow by about than 4% from 2007 levels. Although this appears to be a sensible assumption because the Turnagain area is an older area with little opportunity for significant growth in population, in this sensitivity analysis we will assume that the growth in VMT will be three times that projected by the Anchorage Transportation Model. In other words, we will assume that VMT and vehicle starts and idling will grow by 12% between 2007 and 2023 and determine how this affects the probability of compliance.

Future Growth in Wood Stoves and Fireplace Use

Woodstove and fireplace emissions were assumed to grow in proportion to the growth in the number of households in the Turnagain micro-inventory area. During the 2007-2023 inventory period, wood heating emissions were projected to increase by about 11%. Although recent telephone data suggest that Anchorage households do not plan to change their habits with regard to wood burning, there is a possibility that wood burning rates could increase in the next decade if households decide to heat with wood to avoid rising costs of heating with natural gas. For the purpose of this analysis, we will assume that wood heating will grow 2% per year per household during the inventory period.

Results of Sensitivity Analysis

The two revised assumptions used in this sensitivity analysis are summarized in Table 5. The *combined* impact of these revised assumptions on CO emissions in the Turnagain micro-inventory [illegible] consequent effect on probabilities of compliance during the 2007-2023 maintenance plan period is shown in Table 6.

Table 6 suggests that even when the assumptions used in the sensitivity analysis are combined to create a "worst case scenario", the probability of compliance with NAAQS is well above [illegible] each year. Even with higher rates of growth in vehicle travel and wood burning, CO [illegible] to d[illegible] probability of compliance remains at 98% or higher even with these higher growth [illegible].

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Table 5
Comparison of Original Assumptions used in Maintenance Demonstration with Revised Assumptions used in Sensitivity Analysis

	Original Assumptions used in Maintenance Demonstration and Probability Computations	Revised "Worst Case" Assumptions Used in Sensitivity Analysis
Growth in VMT and Vehicle Starts and Idling	4% increase between 2007 and 2023	12% increase between 2007 and 2023
Fireplace and Woodstove Use	No change in wood burning rates per household between 2007-2023	2% growth in wood heating per year

Table 6

Comparison of CO Emissions and Probabilities of Compliance with the NAAQS

Original Assumptions used in Maintenance Demonstration vs.
Revised Assumptions used in Sensitivity Analysis

	Original Assumptions		Revised Assumptions in Sensitivity Analysis	
	Estimated Total CO Emissions (tpd)	Probability of Compliance	Estimated Total CO Emissions (tpd)	Probability of Compliance
2007	10.20	99.1%	10.20	99.1%
2008	10.12	99.1%	10.16	99.1%
2009	10.03	99.1%	10.12	99.1%
2010	10.00	99.1%	10.14	99.1%
2011	9.97	99.2%	10.15	99.1%
2012	10.13	99.1%	10.36	98.8%
2013	10.29	98.9%	10.57	98.4%
2014	10.24	99.0%	10.57	98.4%
2015	10.19	99.1%	10.56	98.4%
2016	10.11	99.1%	10.53	98.5%
2017	10.03	99.1%	10.50	98.5%
2018	9.99	[illegible]9.1%	10.49	[illegible]5%
2019	9.94	9[illegible]	10.49	98.[illegible]%
2020	9.88	99[illegible]	10.47	98.6%
2021	9.83	99.2[illegible]	10.46	98.6%
2022	9.77	99.2%	10.45	98.6%
2023	9.71	99.3%	10.43	98.6%

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Attachment

Rank-Pair Order Comparison of CO Concentrations at Turnagain with Garden and Seward Highway Monitoring Stations

Permanent monitoring at Turnagain station began in October 1998 following the completion of a CO Saturation Monitoring Study during the winter of 1997-98. This study monitored CO concentrations at some 20 locations using temporary industrial hygiene-type monitoring devices. The saturation study indicated that the Turnagain site had the highest concentrations of all the sites in the study.

The permanent monitoring stations at Turnagain and Garden are located in older residential neighborhoods with relatively low traffic volumes on the roadways adjacent to the monitoring probe. The Seward Highway station (decommissioned in December 2004) was located at the intersection of two heavily traveled arterials, the Seward Highway and Benson Boulevard. In Anchorage CO monitoring is conducted at these permanent stations during the winter months defined as October through March.

Non-overlapping 8-hour maximum CO concentrations measured at the Turnagain, Garden and Seward Highway monitors were compared in rank-order to determine which site has the highest CO concentrations and the greatest potential for exceeding the national ambient air quality standard (NAAQS) for CO. A rank-order comparison involves sequentially ranking non-overlapping 8-hour average concentrations at the two sites being compared in descending order. In other words, the highest concentration measured at one site is compared to the highest concentration at the other, the second highest at the one site is compared to the second highest at the other, the third highest at one site is compared to the third highest at the other, and so on.

Rank-pair comparisons of data were performed only in time periods when data were available from both sites. In other words, in order to perform a fair comparison between two sites, the data compared was limited to periods when both sites were in operation and collecting valid data. Table 1 show the time periods when paired-data from Turnagain was compared to the other two stations.[‡‡]

Table A-1

Comparison Periods for Rank-Pair Analysis

Stations Compared	Comparison Period
Turnagain with Garden	10/16/98 – 12/31/07
Turnagain with Seward Hwy	10/16/98 – 12/31/05

A spreadsheet program was constructed to identify the highest 50 non-overlapping 8-hour maximum CO concentrations at each site for the comparison periods shown in Table 1.

[‡‡] The Turnagain site did not begin operating until October 16, 1998 and monitoring was discontinued at the Seward Highway site on December 31, 2004. Garden has been in more-or-less continuous operation since late 1970's. When data comparisons between two sites were performed the analysis was limited to time periods when both sites were collecting data.

Comparison of Turnagain and Garden Station CO Concentrations - October 1998 through December 2007

Results of the rank-order comparison between the Turnagain and Garden CO stations are shown in Figure 1. (Data used to construct this plot can be found at the end of this report.)

Figure A-1

Rank-Order Comparison of Highest Fifty Non-Overlapping 8-hour Average CO Concentrations Measured at the Turnagain and Garden Monitoring Stations October 1998–December 2007

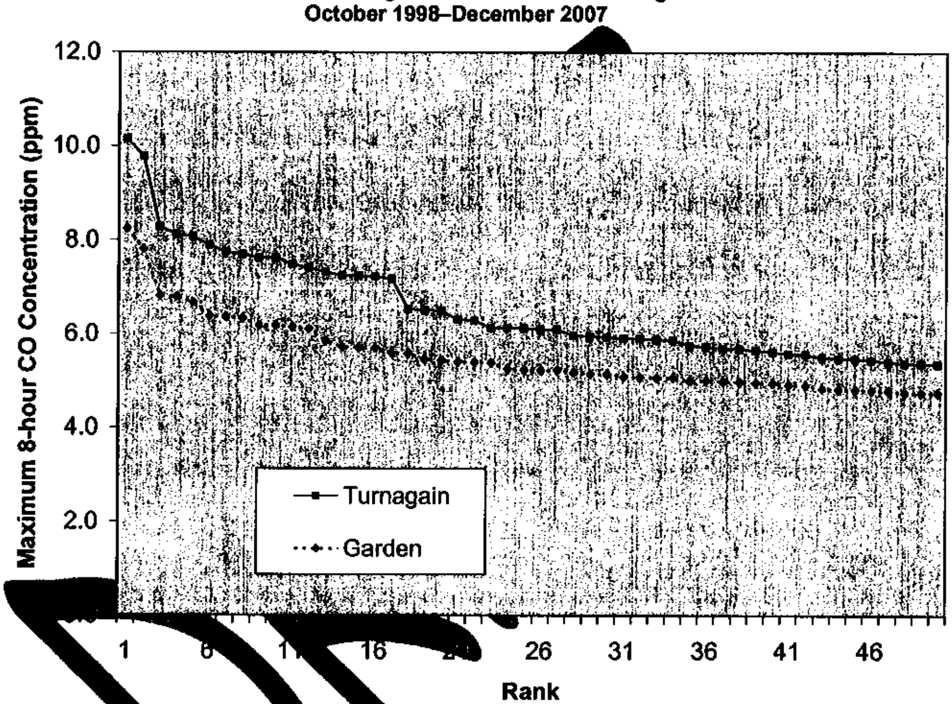


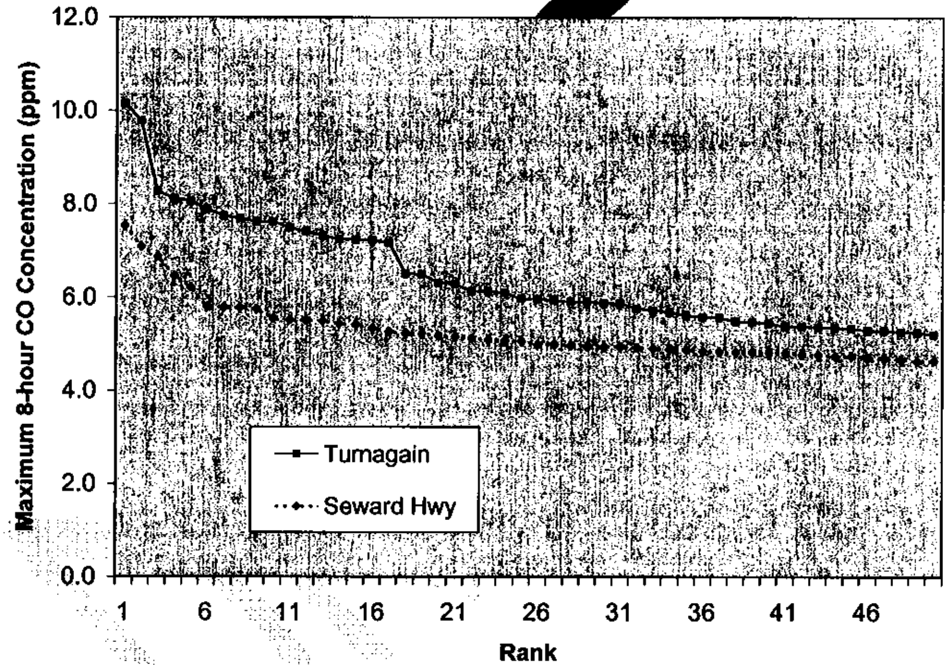
Figure 1 shows that [illegible] 50 highe[illegible]-hour average concentrations at the Turnagain station are about 12% to 25% [illegible]er t[illegible]e corresponding rank-pair value at Garden. The greatest differences occu[illegible]e highest ranks. For example the highest 8-hour concentration at Turnagain is 23% higher than the highest value at Garden while the 50th highest value at Turnagain is 13% higher than the corresponding 50th highest value at Garden. On a rank-pair basis, the values at Turnagain are significantly and consistently higher than those at Garden. This is particularly true at the extreme (i.e. highest) concentrations. This would suggest that Turnagain has a greater potential of exceeding or violating the NAAQS than Garden. For this reason, data from the Turnagain station were used to perform the probabilistic analysis for the maintenance demonstration.

Comparison of Turnagain and Seward Highway Station CO Concentrations
October 1998 through December 2004

A similar analysis was performed comparing data from the Turnagain station to Seward Highway. In this case the analysis was confined to the period October 16, 1998 to December 31, 2004 because the Seward Highway station was decommissioned at the end of 2004. The results of this analysis are shown in Figure 2.

Figure A-2

Rank-Order Comparison of Highest Fifty Non-overlapping 8-hour Average CO Concentrations measured at the Turnagain and Seward Highway Monitoring Stations
October 1998 – December 2004



Among the highest 50 paired 8-hour concentrations, concentrations at Turnagain are 12% to 38% higher than Seward. The largest differences between the two sites are observed in the very highest 8-hour concentrations where differences between rank-pairs are typically 30% or more. This would suggest that Turnagain has a considerably greater potential of exceeding or violating the NAAQS than Seward.

Conclusion

This analysis demonstrates that the Turnagain site exhibits the highest CO concentrations and greatest potential for violating the NAAQS in the Anchorage network. It is therefore appropriate to use this site for analysis of long-term prospects for continued compliance with the NAAQS.

Turnagain Oct 1998 – Dec 2007				Garden Oct 1998 – Dec 2007				
rank	8-hr avg (ppm)	date	end hour	rank	8-hr avg (ppm)	date	end hour	% Diff
1	10.14	1/6/99	19	1	8.23	1/6/99	18	23.3%
2	9.78	12/16/01	20	2	7.80	12/6/99	14	25.3%
3	8.27	12/6/03	1	3	6.80	12/24/98	19	21.6%
4	8.11	1/5/04	18	4	6.78	1/13/04	21	19.5%
5	8.06	12/24/98	23	5	6.66	2/12/99	12	21.0%
6	7.88	1/4/04	20	6	6.37	2/9/99	14	23.7%
7	7.74	11/14/01	12	7	6.36	1/3/04	21	21.7%
8	7.69	12/16/98	24	8	6.33	1/5/04	20	21.5%
9	7.61	1/3/04	21	9	6.18	1/27/99	13	23.3%
10	7.61	2/23/99	12	10	6.17	1/4/04	21	23.3%
11	7.48	1/1/04	22	11	6.14	12/5/03	23	21.9%
12	7.40	12/18/01	17	12	6.10	12/16/01	22	21.3%
13	7.31	2/8/99	11	13	5.84	1/1/04	23	25.2%
14	7.24	12/6/99	14	14	5.72	1/2/04	22	26.6%
15	7.23	12/5/01	15	15	5.70	11/27/99	24	26.8%
16	7.21	1/16/00	3	16	5.69	12/20/03	19	26.7%
17	7.16	11/28/99	1	17	5.59	10/22/98	11	28.2%
18	6.53	11/29/06	16	18	5.58	12/3/01	15	17.0%
19	6.50	2/23/99	3	19	5.45	1/15/04	14	19.2%
20	6.49	2/6/02	12	20	5.43	1/5/99	13	19.6%
21	6.30	12/3/01	16	21	5.40	1/7/04	14	16.6%
22	6.28	12/8/01	1	22	5.39	1/13/00	14	16.5%
23	6.13	2/18/01	6	23	5.38	1/12/00	15	14.0%
24	6.13	11/14/01	3	24	5.25	3/18/02	23	16.7%
25	6.11	1/24/06	12	25	5.23	2/22/99	12	17.0%
26	6.09	2/11/99	9	26	5.21	12/26/98	24	16.8%
27	6.09	1/17/06	14	27	5.21	2/11/00	15	16.8%
28	5.96	2/22/99	13	28	5.18	1/15/00	24	15.2%
29	5.95	12/4/01	16	29	5.14	1/14/99	14	15.7%
30	5.93	11/10/99	12	30	5.14	2/10/00	13	15.3%
31	5.90	1/4/99	24	31	5.09	11/29/01	15	16.0%
32	5.90	12/1/01	5	32	5.08	11/14/01	13	16.3%
33	5.87	1/13/04	1	33	5.06	2/13/99	1	16.0%
34	5.86	1/25/02	12	34	5.06	1/17/06	14	15.8%
35	5.75	12/27/98	4	35	5.00	11/22/99	14	15.0%
36	5.71	12/1/01	24	36	5.00	1/23/03	14	14.3%
37	5.69	1/28/05	11	37	4.99	2/10/99	12	14.1%
38	5.68	11/15/98	24	38	4.98	1/16/00	17	14.1%
39	5.65	11/25/06	12	39	4.96	12/4/01	16	13.9%
40	5.61	2/9/99	13	40	4.94	12/14/04	20	13.6%
41	5.58	12/14/01	15	41	4.91	11/20/98	15	13.5%
42	5.56	12/12/99	3	42	4.90	1/22/03	14	13.5%
43	5.50	12/19/07	14	43	4.83	11/10/99	13	14.0%
44	5.48	11/7/98	2	44	4.81	2/8/99	12	13.8%
45	5.46	1/12/00	13	45	4.81	1/18/05	13	13.7%
46	5.44	2/1/02	13	46	4.79	1/27/05	14	13.5%
47	5.40	11/25/06	3	47	4.78	1/7/04	23	12.9%
48	5.37	1/14/04	2	48	4.74	2/9/99	2	13.3%
49	5.36	12/26/03	16	49	4.74	12/18/01	16	13.2%
50	5.35	12/27/02	15	50	4.74	2/6/02	13	12.9%