WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

A Plan for Attaining Carbon Monoxide National Ambient Air Quality Standards in the Spokane Serious Nonattainment Area

A Washington State Implementation Plan Revision

September 2001
Publication No. 01-02-009

printed on recycled paper

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

A Plan for Attaining Carbon Monoxide National Ambient Air Quality Standards in the Spokane Serious Nonattainment Area

A Washington State Implementation Plan Revision

September 2001
Publication No. 01-02-009

printed on recycled paper

A Plan for Attaining Carbon Monoxide National Ambient Air Quality Standards in the Spokane Serious Nonattainment Area

---

A Washington State Implementation Plan Revision

Prepared by:

Washington State Department of Ecology
Air Quality Program,

Spokane County Air Pollution Control Authority

and

Spokane Regional Transportation Council

September 2001
Publication No. 01-02-009

Contents

Executive Summary

This document is a plan to attain the federal health standard for carbon monoxide (CO) in Spokane, Washington. Spokane was already designated nonattainment for CO when the 1990 Amendments to the Clean Air Act were enacted on November 15, 1990. Under the Amendments, Spokane was classified "moderate" and required to submit a plan meeting nonattainment requirements established by the 1990 Amendments. Because of violations of the CO standard in 1995, Spokane was reclassified to "serious" and required to submit a new plan to meet additional nonattainment requirements to ensure that the area would meet the CO standard.

The Spokane County Air Pollution Control Authority, the Spokane Regional Transportation Council, and the Washington State Department of Ecology developed this "serious" CO attainment plan to satisfy these additional requirements. The requirements addressed by this plan are as follows:

- a demonstration that Spokane will attain the CO standard by December 31, 2000, the attainment date specified by the 1990 Amendments
- contingency measures that will be implemented if the area fails to meet the CO standard by the attainment date
- annual Vehicle Miles Traveled (VMT) forecasts for 1996 to 2000 and a process for tracking and reporting VMT
- a justification that transportation control measures (TCMs) and strategies to offset any growth in CO emissions resulting from growth in VMT or number of vehicle trips are not required because of decreasing CO emissions
- a Motor Vehicle Emissions Budget for transportation conformity
- a commitment for submission of periodic emission inventories to the Environmental Protection Agency (EPA) for every third year starting with 1996

A TCM was required to demonstrate attainment. This TCM, a new eastbound on-ramp to Interstate 90, is targeted for completion in October of 2002.

Preface

This document is a plan to attain the federal health standard for carbon monoxide (CO) in Spokane, Washington. The United States Environmental Protection Agency (EPA) has established ambient air quality standards for CO and five other pollutants to protect public health. EPA designates an area that violates the CO standard as nonattainment for CO. The Clean Air Act then requires state submittal of a plan for attaining the CO standard. This plan must satisfy the plan reqnirements set forth in the Clean Air Act.

This serious CO attainment plan is the most complex CO plan — and one of the two most complex attainment plans — produced to date in the state of Washington. The ability of this plan to meet the requirements of the Clean Air Act is ultimately the result of the efforts of staff from Spokane County Air Pollution Control Authority (SCAPCA), Spokane Regional Transportation Council (SRTC), Region 10 of the United States Environmental Protection Agency (EPA), and Ecology. Singling out individuals runs the significant risk of omitting someone who is deserving. I acknowledge that risk and apologize to anyone who has been overlooked. Certainly, any failure on my part to recognize efforts of any individual does not diminish the value of the efforts.

I would like to express appreciation to the following individuals, because without them this plan would never have been completed:

> Ron Edgar and April Westby of SCAPCA
> Pam Tsuchida, Ed Hayes and Eve Nelson of SRTC
> Montel Livingston, Mahbubul Islam, Wayne Elson, and Christi Lee of EPA
> Clint Bowman and Sally Otterson of Ecology

Again, my thanks to these individuals and my apologies to anyone I have overlooked.

Douglas L. Schneider
Air Quality Program
Washington State Department of Ecology

Chapter 1. Introduction

This plan for attaining the 8-hour National Ambient Air Quality Standard for carbon monoxide (CO) in Spokane, Washington is a joint product of the Spokane County Air Pollution Control Authority (SCAPCA), the Spokane Regional Transportation Council (SRTC) and the Washington State Department of Ecology. The United States Environmental Protection Agency (EPA) currently designates the Spokane urban area as nonattainment for CO and classifies it as serious. The federal Clean Air Act requires a serious CO nonattainment area to develop a plan to show that the area will attain the CO standard by December 31,2000.

This introductory chapter reviews Spokane's legal status under the Clean Air Act, summarizes Spokane's previous plan for attaining the CO standard, and outlines the Clean Air Act requirements that this serious CO attainment plan must meet. The chapter also reviews the organization of this document.

1.1 CO Nonattainment and the Clean Air Act

EPA designated Spokane as nonattainment for CO in the 1970s due to numerous violations of the 8-hour CO standard. The number of CO exceedances in Spokane has decreased dramatically since that time. Still, CO monitoring showed that Spokane continued to violate the CO standard when the 1990 Amendments to the Clean Air Act were enacted on November 15,1990.

The 1990 Amendments to the Clean Air Act reaffirmed the nonattainment designation of all areas of the country previously designated nonattainment for CO. This reaffirmation continued the nonattainment designation of Spokane and three other areas in the state of Washington. EPA requested that the state provide recommendations on CO nonattainment area boundaries by March 15, 1991. Ecology coordinated with representatives from City of Spokane, Spokane Regional Council, SCAPCA, Spokane County Planning, and Washington State Department of Transportation (WSDOT) on the review of the Spokane boundary. The review considered air quality data, traffic, population, density, growth patterns, and the location of major industries. As a result, the state recommended, and EPA accepted, the Spokane urban area as defined on WSDOT urban area maps as the CO nonattainment area (see Figure 1-1). This area is also referred to as the 1980 Federal Aid Urban Area.

In addition to the nonattainment area, Figure 1-1 shows locations of key monitored intersections, the background Gonzaga monitor, and the meteorological monitoring sites within the nonattainment areas that were used in the technical analysis. Two additional meteorological stations used in the technical analysis lie outside the area shown on the map. The upper air balloon release point for Spokane International Airport is located 8.4 miles northwest of the junction of Interstate 90 and U.S. Route 2 near Spokane International Airport. The Deer Park meteorological site is located about 16 miles north of the intersection of U.S. Route 395 and U.S. Route 2.

The 1990 Amendments required EPA to classify all CO nonattainment areas according to the severity of pollution. EPA based a "moderate plus" classification on 1988-89 monitoring data.' The classification required the state to develop, submit, and implement a plan to attain the CO standard in Spokane that met all of the requirements specified in the Clean Air Act for a moderate CO nonattainment area.[2] The 1990 Amendments established December 31, 1995, as the date for attainment of the 8-hour CO standard by a moderate plus CO nonattainment area.

In the 1995 attainment year, the 8-hour CO standard was exceeded four times at thk monitor located at the intersection of Third & Washington in Spokane.[3] The CO standard allows only one exceedance a year at a monitor. An April 24, 1996, letter from EPA Region 10 in Seattle informed Ecology that a review of monitoring data confirmed that Spokane had not met the CO standard. EPA stated its intention to proceed with rulemaking action in the Federal Register to reclassify Spokane from "moderate plus" to "serious".

As a result of EPA's letter, SCAPCA implemented the contingency measure specified in the moderate plus attainment plan. The measure requires the maximum allowable oxygenate in wintertime gasoline beginning with the 1996-97 CO season. This requirement raised the amount of ethanol, the oxygenate normally used in Spokane, to 3.5 percent by weight.

On July 1, 1996, EPA formally proposed reclassification of the Spokane CO nonattainment area to serious with publication of a proposed rule in the Federal Register.[4] The 1990 Amendments require EPA to reclassify moderate CO areas to serious if they have not attained the CO standard by the attainment date.

Even prior to EPA's proposed reclassification, stakeholders in Spokane had raised issues about CO monitoring. Recognizing the importance of an informed decision and the need to protect public health fiom unhealthful levels of CO, Ecology, SCAPCA, SRTC and EPA entered into a memorandum of agreement (MOA) in January 1997 with a three-fold purpose. The MOA was implemented (1) to provide an opportunity to develop information relevant to the proposed reclassification, (2) to take proactive steps directed toward attainment and maintenance of the CO standard, and (3) to prevent future exceedances of the standard. The MOA concluded in July 1997 with an interagency review of information and control measures developed under the agreement.

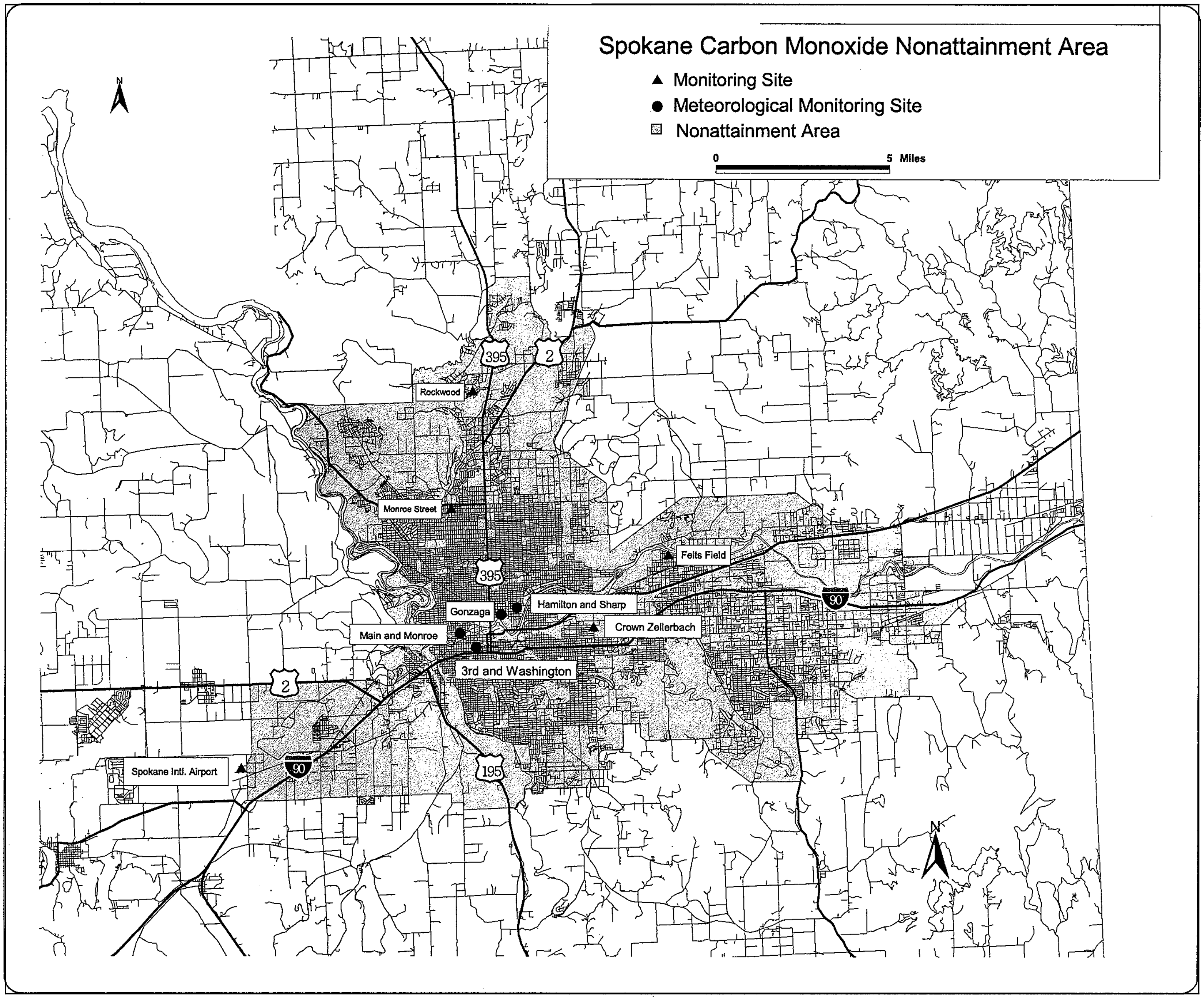
---

[1] Spokane's classification is based on a design value of 13.8 pprn derived from monitoring data. An area is classified moderate plus when the design value is above 12.7 pprn but less than or equal to 16.4 ppm. A design value higher than the CO standard of 9 pprn indicates that an area is violating the standard.

[2] The 1990 Amendments exempt areas that are classified as "moderate" from certain requirements that a "moderate plus" area must meet.

[3] The four exceedances of the 9 pprn CO standard occurred as follows: 10.4 pprn on January 9, 1995; 13.1 pprn on December 11,1995; 11.2 ppm.on December 12,1995, and 9.6 pprn on December 15, 1995.

[4] 61 FR 33879.


Spokane Carbon Monoxide Nonattainment Area
Monitoring Site
Meteorological Monitoring Site
Nonattainment Area
0
5 Miles
N
395
2
Rockwood
Monroe Street
Felts Field
395
Gonzaga
Hamilton and Sharp
90
Crown Zellerbach
Main and Monroe
3rd and Washington
2
Spokane Intl. Airport
90
195
N

EPA ultimately determined that Spokane had not met CO standard by the Clean Air Act attainment date and reclassified the Spokane urban area as "serious." The reclassification became effective on April 13, 1998.[5] The reclassification resulted in new requirements for an attainment plan and a new date for attaining the standard. The 1990 Amendments require serious CO nonattainment areas attain the 8-hour CO standard by December 31,2000.

1.2 Spokane's Moderate Plus CO Attainment Plan

The Clean Air Act requires each state to develop air pollution regulations and control strategies to meet federal health-based standards. These regulations and strategies constitute the State Implementation Plan (SIP). The plan may also contain supporting materials such as emission inventories and modeling demonstrations. The Clean Air Act requires that the SIP be submitted to EPA for review and approval.

When EPA designates an area nonattainment for a federal health-based standard, a plan to attain the standard is required as a revision to the SIP. Basically, the plan must provide an inventory of the sources and amounts of pollutant emissions, project the inventory to the attainment year, apply a control strategy, and demonstrate that the control strategy is adequate to bring the area into attainment. Contingency measures must be implemented if the area fails to attain the standard by the attainment date.

The 1990 Amendments tie specific requirements for the attainment plan to the moderate plus CO classification. The control strategy must include winter-time oxygenated fuel and a low-enhanced vehicle inspection and maintenance (I/M) program. The plan must also forecast and track vehicle miles traveled (VMT) and include a contingency measure to reduce CO emissions if VMT increases considerably faster than forecast. VMT is a statistical measure of the total miles driven by all highway vehicles in an area.

The 1990 Amendments also include other related requirements that are tied to the CO nonattainment designation. These include permitting rules and transportation conformity rules. Transportation conformity requires that the attainment plan define a Motor Vehicle Emissions Budget (MVEB) for transportation planning. Projected mobile source emissions may not exceed the emissions budget.

The 1990 Amendments require moderate CO nonattainment areas to submit periodic emission inventories to EPA for every third year starting with 1993. The requirement continues until the area is redesignated to attainment.

A full listing of the components of a moderate plus CO attainment plan are as follows:

- a comprehensive, accurate, current inventory of actual CO emissions from all sources
- wintertime oxygenated gasoline
- low-enhanced I/M program

[5] 63 FR 12007, March 12,1998.

- a demonstration that the plan provides for attainment of the CO standard by the attainment date of December 31, 1995
- contingency measures to be implemented if the area fails to meet the CO standard by the attainment date
- VMT forecasts for each year until attainment year 1995
- a process,for tracking and updating VMT forecasts
- contingency measures to be implemented if actual VMT significantly exceeds forecasts
- New Source Review rules for permitting major new sources and major modifications to existing sources
- provisions for implementation of Reasonably Available Control Measures (RACM) and Reasonably Available Control Technology (RACT)
- state transportation conformity rule
- MVEB for transportation conformity
- periodic emission inventories for every third year beginning with 1993

The state of Washington submitted its attainment plan for Spokane to EPA on January 22, 1993. The plan met most of the moderate plus CO requirements. In response to EPA comments, the state submitted corrections to the emission inventories on September 14, 1993. On September 1, 1994, the state submitted an explanation of how state law provided for RACT. The state submitted a SIP revision that addressed EPA's comprehensive requirements for low-enhanced I/M programs under 1990 Amendments on August 21, 1995. The state completed the moderate plus attainment plan requirements with the submittal of a contingency measure on April 30, 1996. The contingency measure required the maximum allowable oxygenate in wintertime gasoline (3.5 percent for ethanol) if EPA made a finding of failure of timely attainment of the CO standard provided that EPA, in consultation with SCAPCA and Ecology, also determined that motor vehicles are a contributing factor. The contingency measure was implemented beginning with the 1996-97 winter-time CO season.

The April 30, 1996, SIP revision also addressed changes to the attainment plan resulting from EPA's replacement of its mobile model with a new regulatory model. The mobile model is a tool used in the development of the emission inventory for highway vehicles. The changeover from mobile model MOBILE4.1 to mobile model MOBILE5a_H resulted in revisions to emission inventories and the attainment demonstration. It also resulted in a revised winter-time oxygenated gasoline requirement. For the period from September 1, 1995, to February 29, 1996, the oxygenate content of winter-time gasoline was increased from 2.7 to 3.2 percent. The 1996 SIP revision specified an emissions budget for transportation conformity. SRTC used this budget to determine whether transportation plans and projects conformed with the SIP until May 1999. As the result of a court suit that required EPA to make formal determinations on whether SIP emission budgets were adequate for use in conformity, EPA determined the budget for Spokane was inadequate.

A serious CO nonattainment area must meet moderate attainment plan requirements as well as additional requirements related to the serious classification. As a prelude to the presentation of serious requirements in the next subsection, Table 1-1 summarizes moderate area attainment plan requirements, the dates of submittals to EPA, and the approval status.

Table 1-1. Approval Status of the Moderate Plus CO Attainment Plan

Requirement	Submittal Date	Federal Register Approval
Emission inventories • 1990 base year • 1995 projected	January 22,1993 Corrections September 14, 1993 Revised April 30,1996	62 FR 49442, September 22,1997
Oxygenated Gasoline	January 22,1993	59 FR 2994, January 20,1994
Vehicle Emission Inspection and Maintenance Program	January 22, 1993 Final August 21, 1995	61 FR 50235, September 25,1996
Attainment Demonstration	January 22,1993 Revised April 30,1996	Deferred due to the proposed reclassification to serious (62 FR 49442, September 22, 1997)
Contingency Measure	April 30,1996	62 FR 49442, September 22,1997
VMT • forecasts to 1995 • tracking process • contingency measures	January 22,1993 Revised VMT forecasts, April 30,1996	62 FR 49442, September 22,1997
New Source Review	January 22,1993 Revised March 8,1994	60 FR 28726, June 2,1995
RACM for Residential Wood Combustion	January 22,1993 Revised December 9, 1994	62 FR 3800, January 27, 1997 (see 62 FR 49442, September 22,1997)
RACT	January 22,1993 Revised September 1, 1994	61 FR 53323, October 11,1996 and 61 FR 54560, October 21, 1996 (see 62 FR 49442, September 22,1997)
Transportation Conformity Rule	January 22, 1993 Revised May 30,1995 Revised November 30,1995	Deferred for separate action (62 FR 49442, September 22, 1997)
Motor Vehicle Emissions Budget	January 22,1993 Revised April 30,1996	• Deferred until approval of the attainment demonstration (62 FR 49442, September 22, 1997) • Found inadequate (May 14,1999)
Periodic Emission Inventory - 1993	September 29, 1995	62 FR 49442, September 22,1997

1.3 Serious CO Attainment Plan Requirements

Effective April 13, 1998, EPA reclassified the Spokane area as a serious CO nonattainment area for not meeting CO standard by the moderate area attainment date of December 31, 1995. The 1990 Amendments require an area reclassified as serious to submit a serious CO attainment plan 18 months after reclassification. The reclassification set the submittal date as October 13, 1999. The 1990 Amendments mandate that a serious CO nonattainment area must meet moderate attainment plan requirements as well as additional requirements related to the serious classification. SCAPCA, SRTC and Ecology began consulting with EPA on serious area requirements after the 1995 exceedances. The three agencies wanted to understand the implications of reclassification and be prepared, should EPA determine that Spokane had not met the moderate attainment date. EPA outlined the requirements that Spokane's serious CO attainment plan would have to meet in a letter dated June 11, 1996. This letter, along with the Technical Analysis Protocol developed by Ecology, SCAPCA, and SRTC to meet these requirements, is found in Appendix A.

The requirements specified by EPA are as follows:

- a demonstration that the plan provides for attainment of the CO standard by the attainment date of December 31,2000
- contingency measures to be implemented if the area fails to meet the CO standard by the attainment date
- VMT forecasts for each year until attainment year 2000 — specifically, 1996-2000
- transportation control measures (TCMs)[6] and strategies to offset any growth in CO emissions from growth in VMT or number of vehicle trips
- MVEB for transportation conformity
- periodic emission inventories for every third year starting with 1996 to be submitted to EPA the following year

This plan is designed to meet all of these requirements.

1.4 Organization of the Attainment Plan

This document and its appendices are the revision to the Washington State SIP that constitutes the serious CO attainment plan for Spokane, Washington.

Chapter 1 reviews Spokane's current designation of CO nonattainment, summarizes the moderate plus attainment plan developed to attain CO standard, and outlines the serious CO attainment plan requirements.

[6] TCMs reduce CO emissions from motor vehicles by improving traffic flow, reducing congestion or reducing vehicle use.

Chapter 2 provides information on the CO standard and effects of CO on health. In addition, the chapter provides specific information on conditions conducive to exceedances in Spokane and on Spokane's monitoring network.

Chapter 3 summarizes emission inventories used in this plan. The periodic inventory for 1996 with some minor revisions serves as a base year inventory. The inventory is projected to 2000, the attainment year, for use in the attainment demonstration. An explanation is provided on why TCMs and strategies are not required to offset growth in CO emissions caused by growth in VMT or number of vehicle trips.

Chapter 4 provides an overview of VMT forecasts and tracking. The chapter also includes a contingency measure that will be implemented if actual VMT differs substantially from forecast VMT.

Chapter 5 addresses the demonstration of attainment of the CO standard. The chapter provides information on the TCM needed to demonstrate attainment and defines the MVEB for transportation conformity.

Chapter 6 provides contingency measures that will be implemented if validated air quality shows that Spokane has failed to meet the CO standard by December 31,2000.

Finally, Chapter 7 reviews commitments to meet ongoing nonattainment plan requirements and outlines plans for future SIP planning.

Chapter 2. Air Quality Overview

This plan deals with the National Ambient Air Quality Standard (NAAQS) for carbon monoxide (CO). This chapter provides information on the CO standards and health effects. It also provides specific information on CO monitoring, exceedances and meteorology in Spokane.

2.1 Standards

In 1967, Congress passed the first Clean Air Act. A major provision of the Act directs the U.S. Environmental Protection Agency (EPA) to identify priority pollutants, which, if unregulated, would cause adverse health effects. The Act also specifies that EPA set and enforce a NAAQS for each of these priority pollutants. The EPA has identified and set NAAQS for six pollutants: ozone, nitrogen dioxide, sulfur dioxide, PM_{10}, $PM_{2.5}$, CO, and lead.

The NAAQS for CO was set in 1971. The CO NAAQS consists of two standards, a rolling 8-hour average concentration of 9 parts per million (ppm), and a 1-hour concentration of 35 ppm. The CO NAAQS allows for no more than one exceedance of either standard in each calendar year. A violation occurs when two or more exceedances are recorded at the same monitoring site during a calendar year. EPA is mandated by the Clean Air Act to review the standards every 5 years. EPA has periodically reviewed the CO standards and has made no changes to the current standards. EPA is currently reviewing the standard.

2.2 Health Effects

Carbon monoxide is a colorless, odorless, tasteless gas. Carbon monoxide interferes with the blood's ability to carry oxygen. It enters the body through the lungs, where it is absorbed into the bloodstream and then combines with hemoglobin in the red blood cells. Hemoglobin is the compound in the red blood cells that normally picks up oxygen from the lungs and carries it to the tissues. Carbon monoxide has an affinity for hemoglobin in the blood approximately two hundred times greater than oxygen's. Upon exposure to carbon monoxide, the hemoglobin sites normally available for carrying oxygen are bound instead to carbon monoxide, resulting in a deprivation of oxygen in the bloodstream. Carbon monoxide also affects the central nervous system by depriving it of oxygen.

The health effects of carbon monoxide are similar to those experienced from any deprivation of oxygen and can be exacerbated by exercise when a greater amount of air is taken into the body. At greatest risk from carbon monoxide exposure are individuals with cardiovascular disease, chronic obstructive pulmonary disease, pregnant women, and children. Exposures to high concentrations may result in headache, nausea, and sometimes death due to asphyxiation. Chronic low level exposures lead to decreases in attentiveness, judgment of time, and driving performance. Persons with cardiovascular disorders, who cannot compensate for a lack of oxygen by increasing the blood flow to the body, are especially susceptible. For example, persons with angina (chest pains) have been shown to experience pain during exercise when exposed to low levels of carbon monoxide.

2.3 Monitoring

EPA has established ambient air quality monitoring requirements and standards for State and Local Monitoring Stations (SLAMS) and for National Air Monitoring Stations (NAMS). These requirements and standards provide operating schedules, data quality assurance guidelines, and design and siting criteria for carbon monoxide monitors.

Table 2-1 lists the carbon monoxide air monitors that have been operated in Spokane County since 1993. Figure 2-1 shows the locations of these carbon monoxide monitors. Several other carbon monoxide monitors were operated in Spokane County prior to 1,993. However, since this document only covers carbon monoxide levels since 1993, these monitors were not included in Table 2-1 or Figure 2-1.

The Washington Department of Ecology operates and administers the carbon monoxide monitoring program. Each of the carbon monoxide monitoring sites utilizes a Thermo Environmental Instruments Model 48 or 48C Gas Filter Correlation Ambient CO Analyzer. The monitoring schedule is continuous. Quarterly air quality monitoring reports are prepared and submitted to EPA.

DESCRIPTION AND HISTORY

The following is a short description and history of the monitoring sites.

Jack and Dan's Tavern established in 1983, also called Hamilton St. or Hamilton & Sharp, is located along a very busy north/south arterial street just east of the central business district (CBD) of the Spokane. Just after being sited Hamilton Street became a major route to Interstate 90. There was considerable controversy over the siting of this monitor due to the location of the probe, which is just over the minimum setback from the intersection.

Backdoor Tavern established in 1989, also called Division and Sharp, is located along the major north/south route in Spokane, just north of the CBD. There have never been many exceedances at this site, which is located at mid-block. When Division Street was rebuild as a couplet, CO concentrations declined further as the evening peak traffic moved to the north bound Ruby Street leg. In July of 1999 the site was discontinued.

3rd Avenue established in 1989, also called Empire Ford, or Third & Washington, is located along a major east bound one-way arterial street next to the 1-90 viaduct on the south edge of the CBD. This site had the highest CO concentrations during the period of interest. It is also the site that has raised the most controversy over its location. This site is at a automobile dealership with auto repair facilities, a three story parking structure and a customer pickup and drop-off area at street level under the parking structure. The probe was located adjacent to the driveway into the off street parking, next to on street parking and an awning was placed near the probe inlet. Still, when reviewed by EPA the site did meet siting criteria. In October of 1996 the lease for

Table 2-1. Carbon Monoxide Monitoring Sites (In Operation Since 1993)

DESIGNATION [1] / AIRS ID / STATE ID	MONITORING SITE / LOCATION	PERIOD OF RECORD
NAMS / 530630040 / 3278039A	Jack & Dan's Tavern/ (Hamilton & Sharp) 1226 N. Hamilton Street Spokane	12101/83 - Present
SLAMS / 530630043 / 3278043A	Backdoor Tavern/ 1227 N. Division Street Spokane	12/19/89 – 7/22/99
SPMS / 530630044 / 3278044A	3rd Avenue/ (Third & Washington) 423 W. 3rd Ave. Spokane	12/07/89 – 10/4/96
SLAMS 1530630045 / 3278045A	Spokane Club/ (Main & Monroe) Spokane	05/02/90 – Present
SLAMS / 530630048 / 3278047A	3rd & Washington (north)/ (Third & Washington) Spokane	11/5/96 – 9/20/99
SPMS / 530630049 / 3278048A	3rd & Washington (south)/ (Third & Washington) Spokane	1/1/97 – Present
SPMS / 530630005 / 3278049A	Gonzaga Spokane	12121/98 – Present

[1] NAMS, National Air Monitoring Sites; SLAMS, State and Local Air Monitoring Sites; SPMS, Special Purpose Monitoring Sites

this location was canceled and the site was discontinued. However, two other monitors close by replaced it. (See 3rd and Washington sites below.)

Spokane Club established in 1990, also called Monroe & Riverside or Main & Monroe, is located on the west side of the CBD on a rather complex intersection of Monroe St., a major north/south arterial, and Riverside Ave. and Main Ave. This site is just south of the Monroe St. Bridge and the Spokane River. There have been few exceedances at this site.

3^{rd} and Washington (north) established in November of 1996 as a substitute for the original *3″* Avenue site, is located directly north, about *40* feet, of the original site on the opposite side of 3rd Ave.

3^{rd} and Washington (south) established in January of 1997 is a replacement for the original 3^{rd} Ave. site and the probe intake is located *43* feet west of the location of the intake of the original. The sampling line for the south probe runs from the same shelter as the north probe up and over 3^{rd} Avenue to a utility pole on the south side of 3^{rd}. The two sites 3^{rd} and Washington north and south were operated together until September of 1999 when the north site was discontinued. The north side would normally run 1 to 2 ppm lower than the south. Wind direction would influence which site was higher and by how much.

Gonzaga established in December of 1998 is a background site located in the middle Gonzaga University Campus away from streets, east of the CBD not far from the Hamilton site. Data from this site was used to calibrate the UAM modeling done for this SIP.

City of Spokane Carbon Monoxide (CO)
Monitoring Sites

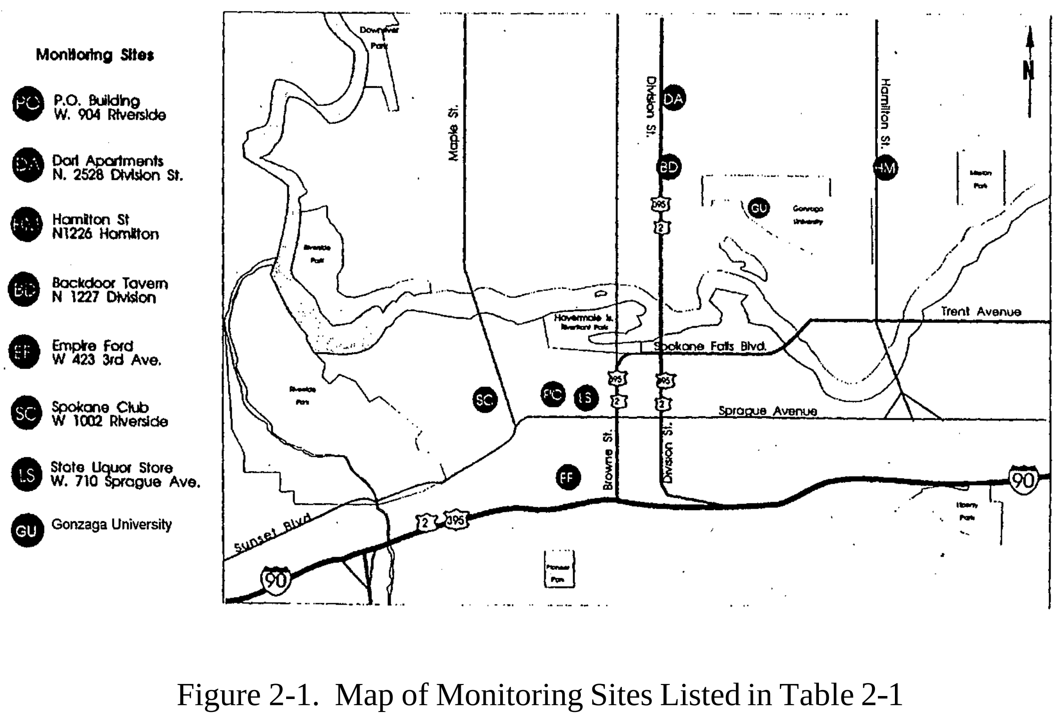


Figure 2-1. Map of Monitoring Sites Listed in Table 2-1

In addition to the permanent monitoring sites defined in Chapter 2, Spokane has a long history of special studies. Information on these studies is provided in Appendix B.

2.4 Exceedances

From January 1,1993 through the serious attainment date of December 31,2000, the Spokane nonattainment area has had ten monitored exceedances and five violations of the 8-hour carbon monoxide standard of 9 ppm. Violations occur when there is more than one exceedance at a monitoring site in a calendar year.

The area has had no exceedances of the standard since 1996 and no violations of the standard since 1995. In 1993, two exceedances at both Jack and Dan's Tavern and 3rd Avenue resulted in a violation of the standard at both sites. More significantly, in 1995, four exceedances of standard at 3rd Avenue resulted in three violations and failure of the Spokane nonattainment area to attain the standard by the moderate plus attainment date of December 31, 1995. Single exceedances of the standard occurred at Jack and Dan's Tavern and 3rd Avenue in 1996. Table 2-2 presents the six highest ambient CO concentrations recorded at the four long-term monitoring sites in the nonattainment area.

An exceedance of the 1-hour carbon monoxide standard of 35 ppm has never been recorded within Spokane County.

Overall, the Spokane nonattainment area has experienced a substantial improvement in CO air quality over the past 20 years. On an annual basis, there has been a trend toward a reduction in the number of exceedance events. During the past four years (1997–2000), the CO standard has not been exceeded. Figure 2-2 illustrates this improving CO trend graphically.

2.5 Meteorology

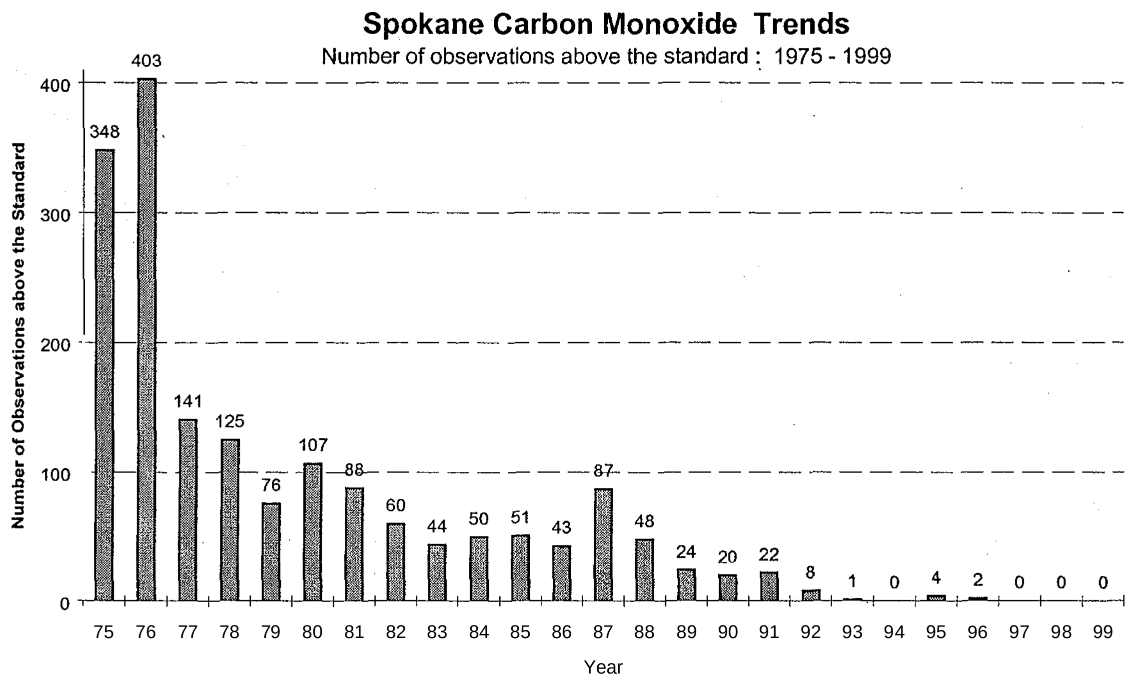
Spokane County is situated in a broad river valley that extends eastward into the Idaho panhandle. The area, characterized by its "bowl-shaped" topography, often experiences long periods of air stagnation in winter months, which leads to temperature inversion conditions. During these inversions, cold air is trapped near the valley floor with warmer air aloft, preventing pollutants like CO from escaping into the air above it. **As** a result, CO levels can build to unhealthy levels that exceed the national standard.

In general, exceedances of the CO standard in Spokane County have occurred on weekdays (Monday – Friday) between the hours of 5:00 PM and 10:00 PM. High stability, low wind speeds, and cool temperatures characterize the meteorological conditions during the exceedances (45° F or lower).

The meteorological data from the Crown Zellerbach monitoring site for the ten monitored 8-hour CO exceedances since 1993 are summarized below. The site is centrally located and provides a general representation of meteorological conditions in Spokane. The purpose of the summary is not to provide a detailed analysis, but to highlight the general meteorological trends that are present during CO exceedances in Spokane. The summary is based on the total of 72 hours with calculated 8-hour averages of 9.5 ppm or above. The 8 exceedances occurred on 6

Table 2.2. Six Highest CO Concentrations at Long-Term Monitoring Sites, January 1993–December 2000
(Non-overlapping 8-hour averages in ppm)

MONITORING SITE	January 1993–December 2000	
	DATE	CONCENTRATION
Jack & Dan's Tavern (established December 1, 1983)	November 10, 1993 December 30, 1996 November 11, 1993 March 6, 1993 February 14, 1996 December 15, 1995	10.1 10.0 9.8 9.0 9.0 8.8
Backdoor Tavern (established December 19, 1989; terminated July 22, 1999)	November 11, 1993 November 10, 1993 November 8, 1993 January 31, 1993 February 10, 1994 December 15, 1995	8.5 7.8 7.6 7.3 7.0 6.7
3rd Avenue (established December 7, 1989; terminated October 4, 1996)	December 11, 1995 November 11, 1993 November 10, 1993 December 12, 1995 January 9, 1995 December 15, 1995 February 12, 1996	13.1 12.7 11.8 11.2 10.4 9.6 9.6
3rd & Washington (south) (established January 1, 1997 as a replacement for the 3rd Avenue site)	December 30, 1998 November 14, 1997 January 11, 1999 October 27, 1998 November 11, 1997 January 6, 1999	7.7 7.3 7.3 6.8 6.5 5.6
Spokane Club (established May 1, 1990)	March 22, 1993 January 9, 1995 January 13, 1995 December 11, 1995 December 12, 1995 November 29, 1993	7.9 7.6 6.7 6.7 6.7 6.4



Note:
1. More than one exceedance during a single year at any one site is a violation of the Federal Carbon Monoxide Standard of 9 parts per million (ppm)
2. Because the CO standard is based on an eight hour average it is possible to have as many as three exceedance in a single day at one site. Spokane also has multiple monitoring sites.

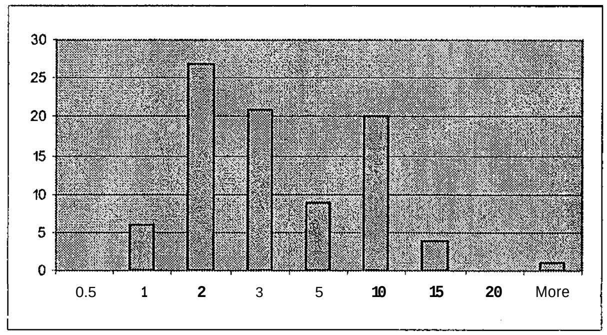
Figure 2-2. Carbon Monoxide Exceedances, 1995-1999 days. For a detailed analysis of the meteorology during the exceedances, see the Systems Applications Incorporated modeling report presented in Appendix B.

Wind Speed

In general, the wind speeds observed during the CO exceedances were low, with over 90% of the hourly wind speeds below 10 mph.

Wind Speed

Wind Speed Bin (mph)	*Frequency*	*Cumulative %*
0.5	0	.00%
1	6	6.82%
2	27	37.50%
3	21	61.36%
5	9	71.59%
10	20	94.32%
15	4	98.86%
20	0	98.86%
More	1	100.00%

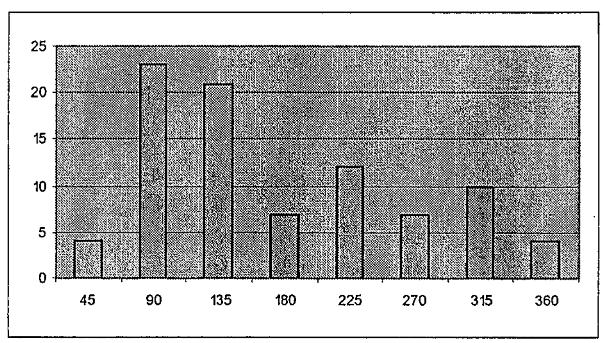


Wind Direction

The predominant winds observed during the CO exceedances were from the east, which is consistent with winds typically observed during periods of low wind speed in Spokane.

Wind Direction

Wind Direction Bin (°)	*Frequency*	*Cumulative %*
45	4	4.55%
90	23	30.68%
135	21	54.55%
180	7	62.50%
225	12	76.14%
270	7	84.09%
315	10	95.45%
360	4	100.00%
All others	0	100.00%

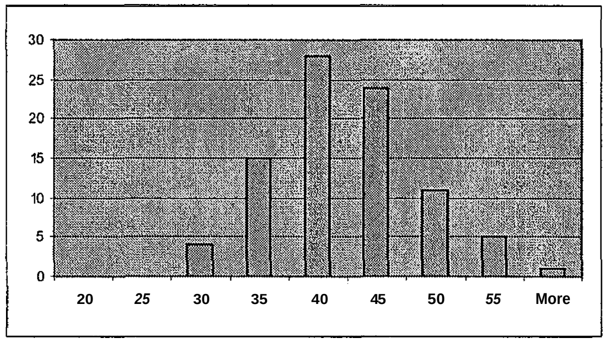


Temperature

Cool temperatures characterize the monitored CO exceedances, with over 90% of the temperatures below 50° F.

Temperature

Temperature Bin (° F)	*Frequency*	*Cumulative %*
20	0	.00%
25	0	.00%
30	4	4.55%
35	15	21.59%
40	28	53.41%
45	24	80.68%
50	11	93.18%
55	5	98.86%
More	1	100.00%



Time Period

The majority of the CO exceedances occurred during the evening hours (between 5:00 – 10:00 pm). A break down of the beginning hour for all one-hour values greater than 9.0 ppm on the eight exceedance dates is given below.

Beginning Hour	*Frequency*	*Cumulative %*
16	6	15.00%
17	6	30.00%
18	4	40.00%
19	4	50.00%
13	3	57.50%
14	3	65.00%
15	3	72.50%
20	2	77.50%
21	2	82.50%
7	1	85.00%
8	1	87.50%
9	1	90.00%
10	1	92.50%
11	1	95.00%
12	1	97.50%
22	1	100.00%
23	0	100.00%
More	0	100.00%

Weekend vs. Weekday

The eight exceedances from 1993 to present occurred on weekdays.

2.6 Street Canyon Effects

While the Crown Zellerbach data provides a picture of the overall meteorological conditions during CO exceedances, monitored CO concentrations are actually influenced more by the local meteorological conditions near the CO monitors. The meteorology near downtown CO monitoring locations such as 3rd Avenue & Washington Street is influenced by the nearby multi-story buildings (called "street canyon effects"). The downtown buildings affect the transport and dispersion of CO emissions, which can create localized "hot spots." With a regional scale model, such as the Urban Airshed Model, there is no way to quantify the localized effects of the street canyons on the transport of CO emissions. A local scale model, such as CAL3 QHC, is needed to account for micro-scale dispersion.

Chapter 3. Emission Inventories

The Washington State Department of Ecology has submitted several carbon monoxide (CO) emissions inventories for the Spokane nonattainment area to the Environmental Protection Agency (EPA). The moderate attainment plan submitted in 1993 included a base year 1990 inventory and a 1995 attainment year projection. In 1996 revised moderate plan, revisions of these inventories were submitted to EPA. Ecology submitted periodic update inventories representing base years 1993 and 1996, in 1995 and 1998, respectively. This chapter deals with inventories for the serious attainment plan.

3.1 Serious Attainment Plan Inventories

Four types of inventories are required for areas classified as serious: base year, periodic, modeling, and onroad mobile source projection. Ecology developed two documents—an inventory preparation plan (IPP) and a quality assurance plan (QA Plan>–to guide inventory development. The IPP outlines procedures and data sources used to develop the inventory. The QA Plan identifies the quality assurance activities that ensure a comprehensive, good-quality inventory that supports decision-making. EPA has approved both the IPP and the QA Plan. (See Appendix B for the two documents and associated approvals.)

The base year and periodic inventories are estimates of actual emissions representative of a typical peak CO season day. The peak CO season occurs primarily in the winter months, ranging from October to February.

A new base year inventory was constructed using 1996 as the base year, replacing the original 1990 inventory. The new base year inventory is the 1996 periodic inventory with some minor modifications. As stated above, the 1996 periodic inventory was completed and submitted to EPA in September of 1998. The next periodic inventory, the 1999 inventory, will be submitted to EPA in 2001. Periodic inventories are due every three years.

Modeling inventories are estimates of episode-specific emissions. They consist of actual emissions on selected base case days and projections to the attainment year. The projections are based on allowable emissions where they exist, and expected emission projections where allowable emissions have not been established. Modeling inventories were developed for ten base case days during 1993-96 and projected to the year 2000.

The onroad mobile source projection is an inventory of expected emissions on a typical peak CO season day in the attainment year 2000. The inventory is used to set the Motor Vehicle Emissions Budget for conformity. For comparative purposes, typical daily emissions from other sources are also compiled. They are based on allowable emissions where they exist, and expected emission projections where allowable emissions have not been established.

The carbon monoxide emission inventory for the nonattainment area is divided into four major components: point, area, nonroad mobile and onroad mobile sources. Point sources are stationary sources emitting at or above a cutoff level. Ecology and the Spokane County Air Pollution Control Authority set the cutoff level at 50 tons per year. Area sources include emissions from stationary sources that are too small to be included in the point source inventory. Area sources include such diverse sources as residential space heating, outdoor burning, and small industrial facilities. Nonroad mobile sources include sources such as aircraft, locomotives, lawn and garden equipment, and construction and industrial equipment. Onroad mobile sources include cars, trucks, buses and motorcycles.

Onroad mobile sources represent the largest component of both the 1996 and 2000 peak CO season emissions (Table 3-1; Figure 3-1). Point sources, nonroad mobile sources, and woodstoves/fireplaces contributed almost all of the remaining emissions.

In the year 2000, all of the emission sources except onroad mobile showed modest increases. The increases in area and nonroad mobile source emissions were based on the assumption that emissions would increase at the same rate as population or employment, whichever measure most closely matched the source. Point source projections are based upon allowable emissions, and therefore showed an increase over the 1996 actual emissions. Onroad mobile source emissions decreased 20% from 1996 to 2000 due to the turnover of motor vehicles from older to newer models, enhancements to the vehicle inspection and maintenance program, and an increase in the oxygen content of gasoline. Overall, there is an estimated 4% decrease in emissions fi-om 1996 to 2000. Detailed information on the emissions inventories is found in Appendix C.

Table 3-1: Daily Peak CO Emissions in Pounds per Day

Category	Base Year 1996		Projection Year 2000	
Onroad Mobile	334,000	(48 %)	269,000	(40 %)
Point Sources	160,000	(23 %)	188,000	(28 %)
Woodstoves/Fireplaces	121,000	(17 %)	128,000	(19 %)
Other Area Sources	20,000	(3 %)	21,000	(3 %)
Nonroad Mobile	63,000	(9 %)	66,000	(10 %)
Total	698,000		672,000	

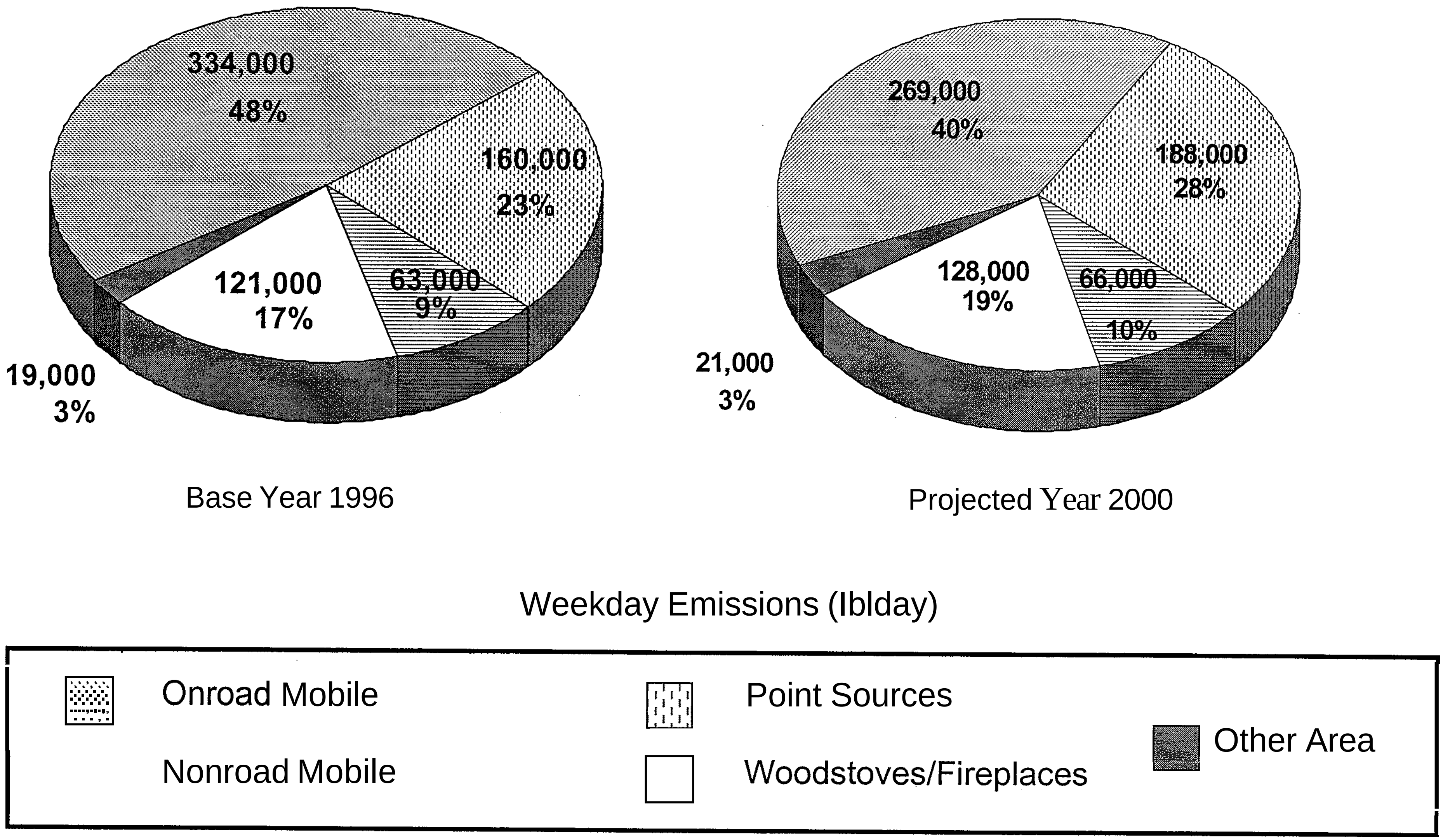
3.2 CO Emission Growth SIP Requirements

The Clean Air Act requires a serious CO nonattainment area to adopt transportation control measures (TCMs) and strategies to offset any growth in CO emissions resulting from growth in vehicle miles traveled (VMT) and numbers of vehicle trips. The offset requirement is not applicable to the Spokane nonattainment area. The decrease in onroad mobile source CO emissions between 1996 and 2000 means that no TCMs or strategies are needed to offset growth.

3.3 Periodic Emission Inventories

The Clean Air Act requires the State of Washington to submit a periodic inventory of CO emissions for Spokane every three years until EPA redesignates Spokane to attainment. Ecology submitted an inventory for 1996 to EPA in 1998. Ecology commits to submitting the periodic inventory for 1999 to EPA by September 30,2001.

Carbon Monoxide (CO) Emissions In the Spokane Nonattainment Area



Chapter 4. Forecasting and Tracking Vehicle Miles Traveled

This chapter reviews Clean Air Act requirements for forecasting and tracking vehicle miles traveled (VMT), outlines the process for reporting actual VMT to the U.S. Environmental Protection Agency (EPA), provides forecasts through 2000, summarizes tracking to date, and provides a contingency measure that will only be implemented if actual VMT differs significantly from forecast VMT.

4.1 Serious Attainment Plan Requirements

The 1990 Amendments to the Clean Air Act established VMT forecasting and tracking requirements for carbon monoxide (CO) attainment plans. VMT, a statistical measure of the total miles driven by all highway vehicles in an area, is related to mobile source emissions, though, the relationship is not simple. Mobile source emissions are a significant consideration for the development of an attainment plan because motor vehicles are the dominant source of CO emissions in most areas. The emission inventories developed for this plan show VMT increased and mobile source emissions decreased between 1996 and 2000.

The 1990 Amendments established four requirements related to VMT. States are required to address three of these four requirements — VMT forecasts through the attainment year, a process for tracking VMT and contingency measures — in attainment plans. The attainment plan for a moderate plus CO nonattainment area had to include VMT forecasts for the years 1993, 1994 and 1995. Reclassification of a CO nonattainment area to serious extends the attainment plan requirement for VMT forecasts to each year through 2000. EPA guidance (January 1992), interpreting the tracking process requirement, specifies that the attainment plan is to identify the agency responsible for submitting the annual report and also a procedure for consultation on report development and submission, consistent with Section 121 of the Clean Air Act. The attainment plan must also identify those contingency measures that will be implemented if actual VMT is significantly greater than forecast VMT.

The fourth VMT requirement is annual reporting. An annual report must be submitted by September 30 of each year on the previous year's VMT forecast. The report evaluates the accuracy of past forecasts and provides an opportunity to update VMT forecasts.

4.2 VMT Forecasts

VMT is forecast and tracked for the entire CO nonattainment area to meet Clean Air Act requirements. Spokane Regional Transportation Council (SRTC) develops VMT forecasts by using a network-based travel demand model. Information on the methodology is found in Appendix D.

The moderate attainment plan for Spokane contained daily VMT forecasts for the years 1993, 1994, and 1995 as required. SRTC developed forecasts for later years in conjunction with the annual report (see Appendix D for the report on 1999 VMT). Forecasts through the year 2000 are presented in Table 4-1 to satisfy Clean Air Act requirements.

Table 4-1. VMT Forecasts for the Spokane CO Nonattainment Area

Year	Moderate Attainment Plan Forecast (miles traveled)	Revised and New Forecasts (miles traveled)
1993	6,982,200	6,283,980
1994	7,089,700	6,380,730
1995	7,232,300	6,511,252
1996		6,613,806
1997		6,727,365
1998		6,603,756
1999		6,838,481
2000		6,918,031

The 1998 forecast reflects a change from the trend of increasing VMT. This decrease reflects SRTC's use of newly developed land use forecasts in its transportation demand model. Land use forecasts dictate the supply (people) and demand (places of work, schools, and shopping centers) over the roadway network. Changes in the locations of these parameters shift travel patterns and VMT. Washington's Growth Management Act has required Spokane to plan locations where growth will occur. As a result of the Act, land-use changes in the transportation demand model have been updated. For example, residences that were previously expected to occur in rural areas are now allocated closer to the urban boundary.

4.3 VMT Tracking Process

The Washington State Department of Transportation (WSDOT), SRTC and the Washington State Department of Ecology entered into a memorandum of understanding (MOU) to meet the Clean Air Act requirement for a tracking process. Under the MOU, WSDOT supplies SRTC with data on the actual VMT for the previous year by June 15. SRTC develops a peer review tracking report that meets the contents specified in EPA's January 1992 guidance by July 15 and the final tracking report by August 15. Ecology is responsible for submitting the final report to EPA Region 10 by September 30.

The MOU covered VMT tracking and reporting for the years 1993,1994, and 1995. The same process was followed for 1996, 1997, 1998, and 1999 tracking and reporting. The process will be used for 2000. To replace this MOU, SRTC has incorporated VMT tracking and reporting into a recent MOU with Ecology on interagency coordination pursuant to the Transportation Equity Act for the 21" Century. The signed MOU is found in Appendix D.

4.4 VMT Reporting

EPA has specified that annual VMT reports are to be submitted by September 30. The reports compare the actual VMT for the previous year with the forecast VMT. Ecology has submitted reports for each forecast year through 1999. Ecology commits to submitting the report for 2000 as required by the Clean Air Act. Tracking results presented in Table 4-2 show that actual VMT is consistently less than forecast.

Table 4-2. VMT Tracking for the Spokane CO Nonattainment Area

Year	**Actual VMT** (miles traveled)	**Moderate Attainment Plan Forecast** (miles traveled)	**Percent Difference**	**Revised and New Forecasts** (miles traveled)	**Percent Difference**
1990	5,712,886				
1993	6,010,000	6,982,200	–13.9 %	6,283,980	-4.36 %
1994	6,232,000	7,089,700	–12.1 %	6,380,730	–2.32 %
1995	6,057,000	7,232,300	n/a	6,511,252	–6.95 %
1996	6,182,000			6,613,806	–6.50 %
1997	6,365,000			6,727,365	–5.39 %
1998	6,520,000			6,603,756	–1.27 %
1999	6,635,000			6,838,481	–2.98 %

4.5 VMT Contingency Measures

The 1990 Amendments require the implementation of contingency measures if actual VMT for a specific year exceeds the most recent forecast VMT. EPA guidance (January 1992) interprets the Act as requiring contingency measures if actual VMT significantly exceeds forecast VMT. For the forecast years covered by the serious attainment plan (1996-2000), actual VMT must exceed forecast VMT by 3.0 percent before EPA requires implementation of a contingency measure. EPA recommends that emission reductions from VMT contingency measures should counteract the effect of one year's growth in VMT. EPA specifies that contingency measures are to be implemented with minimal further action by the implementing agency. Since actual VMT has been consistently less than forecast VMT, VMT contingency measures have not been implemented in Spokane.

The following early implementation contingency measure, Spokane's AirWatch, replaces the contingency measures included in the Spokane's moderate attainment plan. The contingency measure is referred to as "early implementation" since it is already being implemented in the Spokane area but no credit is being claimed for resulting emission reductions in the attainment demonstration.

AirWatch, a voluntary no drive day program, has thus far been a three-year pilot program to notify the public of poor air quality days and to encourage alternatives to single occupancy vehicles. Public education along with daily carbon monoxide forecasts for the following days drive time and funds for free bus rides are used to encourage motorists to reduce their use of motor vehicles on bad days. Plans are in the works for continuing the funding for the program.

Over the past three years AirWatch has been refined and surveys show that the public is becoming aware of the program. In the last three years, however, Spokane has not had high enough CO levels to call an "Alert" under the guidelines set by the program. An "Alert" triggers the free bus rides. On several occasions Spokane County Air Pollution Control Authority (SCAPCA) has called a "Watch." Under a Watch, media and businesses are notified that possible stagnant conditions could cause a build up of CO and drivers are encouraged to find an alternative to driving alone.

An ongoing program such as AirWatch provides a degree of "overcontrol." AirWatch reduces actual VMT and resulting emissions on the worst air quality days below projected VMT and emissions because the program is already in place and operational. Plans are in place to measure the effectiveness of the program from increased bus ridership during Alerts. Thus far, these plans have fallen through since no Alerts have been called during the three-year existence of AirWatch. Still, AirWatch remains a reasonable measure for enlisting the public to do their share to clean up the air and protect public health. In that spirit, SCAPCA, SRTC and Ecology submit AirWatch as the VMT contingency measure for this attainment plan.

The following excerpts from the AirWatch campaign materials provide an overview of the program.

What is AirWatch?

AirWatch is Spokane's winter air quality public awareness program. The program has several components, including:

- Daily air quality reports to the local media;
- Advertising campaign on television, radio, transit, billboards and in newspapers; and
- Promotional materials for employer participation

SCAPCA has been reporting pollution levels and wood burning status to the media for over a decade. The reporting was expanded in 1998 as AirWatch, to incorporate CO levels and notifications to motorists to reduce driving when air pollution levels increase.

AirWatch grew out of a desire by local public agencies to develop a pro-active campaign to predict high CO days, inform the public and encourage the use of commute alternatives. The AirWatch program runs from November through February and includes daily air quality reports to the media, along with opportunities for employer and community involvement.

How does AirWatch work?

The cold winter months are the worst for Spokane's air quality. Strong, stubborn inversions and stable weather patterns cause pollutants, like carbon monoxide from automobiles and smoke particles from wood burning, to build up to potentially unhealthful levels.

Daily monitoring by SCAPCA tracks the build-up of air pollutants. When CO pollutants begin to rise and stagnant weather conditions are predicted, a CO Watch or CO Alert will be called. A CO Watch informs citizens of potential air quality problems and encourages the use of transit, carpooling, or another form of alternative transportation to work the following day. A CO Alert means carbon monoxide is approaching unhealthy levels. Spokane Transit will offer free rides on fixed routes and paratransit on CO Alert days. This community-wide effort to inform residents and reduce air quality problems will be broadcast during local television and radio weather reports.

Where will I hear about **AirWatch?**

In addition to weather reports on local television and radio stations, a multi-media campaign will be launched in mid-November that includes television, radio, billboards, transit and newspaper advertising. Featuring the popular AirWatch jingle, each message is designed to heighten awareness about the combined impact of winter weather and automobile emissions on Spokane's air quality and encourage the use of alternative transportation, instead of driving alone.

Spokane's largest employers will also be asked to help spread the AirWatch message, through voluntary worksite education programs. Using materials provided by SCAPCA and the Spokane County Commute Trip Reduction (CTR) Office, employers can educate employees about Spokane's air quality issues and encourage the use of commute alternatives when a CO Watch or CO Alert is called.

Who are the agencies involved with **AirWatch?**

AirWatch was developed using grant funding and implemented by a consortium of public agencies including Spokane Transit, SRTC, SCAPCA, American Lung Association of Washington and the Spokane County CTR Office.

4.6 Reference

U.S. Environmental Protection Agency, *Section* 187: *Forecasting and Tracking Guidance* (January 1992).

Chapter 5. Demonstration of Attainment

A major attainment plan requirement for a serious carbon monoxide (CO) nonattainment area is demonstration of attainment of the CO standard by the date specified in the federal Clean Air Act. The Act establishes December 31,2000 as the attainment date for a reclassified serious nonattainment area such as Spokane. The demonstration provides assurance that implementation of the control strategies specified in the plan will lead to attainment of the standard. The demonstration also provides a basis for establishment of a regional motor vehicle emissions budget for use in transportation conformity.

This chapter reviews the modeling conducted for this attainment plan, demonstrates attainment of the CO standard through the use of a transportation control measure (TCM), documents the TCM, and sets a mobile source emissions budget for transportation conformity.

5.1 Approach to Modeling the Attainment Demonstration

CO is usually a localized air quality problem. Elevated concentrations generally occur at intersections where traffic is slowed or delayed under weather conditions that favor CO accumulation. The U. S. Environmental Protection Agency (EPA) strongly recommends the combined use of areawide and intersection models for demonstrations of attainment (EPA, July 1992). Gridded areawide modeling is used to assess the cumulative impact of all sources of CO in an urban area. The modeled concentrations define the background CO concentration for each grid square. Intersection modeling assesses the direct impact of traffic on CO concentrations at intersections. The models are run separately and the results summed to demonstrate attainment of the CO standard. If the sum of two models is below the CO standard, attainment is demonstrated. If the sum exceeds the standard, additional control measures are identified to reduce CO emissions and the demonstration is repeated after accounting for these additional emission reductions in the models.

The Washington State Department of Ecology, Spokane County Air Pollution Control Authority (SCAPCA) and Spokane Regional Transportation Council (SRTC) developed a modeling protocol for the attainment demonstration with major assistance from EPA Region 10. Based on the best scientific judgment and concurrence of the EPA, the protocol was revised several times during the course of modeling. Some of these changes are not reflected in the protocol, but documented in this chapter and Appendix E. The modeling protocol itself is found in Appendix A as Attachment B to the Technical Analysis Protocol.

Modeling for the attainment demonstration used two EPA-approved models (40 CFR Part 51 Appendix W). These are Urban Airshed Model V (UAM-V) for areawide modeling and CAL3QHC (Version 2.0) for micro-scale intersection modeling. As discussed below in Section 5.4, Washington State also received permission from EPA to use CAL3QHCR. A contractor, Systems Application International, Inc. (SAI) performed the UAM-V modeling on a one-kilometer square grid for the entire nonattainment area. The contractor's report (SAI, October 1999) is included in Appendix E. SRTC performed all CAL3QHC modeling and modeled the demonstration of attainment using results from both models. SAI's report includes an evaluation of the performance of the areawide modeling. Ecology worked with SRTC and SCAPCA on additional analysis of the areawide model and on the performance evaluation of the combined models.

Modeling for this attainment plan involved four distinct phases. These phases are the following:

1. Areawide modeling of background concentrations
2. Evaluation of worst-case combined areawide concentrations and intersection concentrations
3. Comparison of modeling results from different approaches to intersection modeling
4. Demonstration of attainment

These phases are discussed in turn in the remainder of this chapter.

5.2 Areawide Modeling of Background Concentrations

SAI performed areawide modeling first by modeling five days from the winter of 1998-99 to evaluate the performance of the model in simulating monitored concentrations. The ability of the model to simulate monitored concentrations establishes a degree of confidence in the ability of the model to later simulate background concentrations for days in 1993-95 and 2000 when no monitored background concentrations are available for comparison. The modeled background concentrations for 1993-95 and 2000 are later used in the attainment demonstration. The days selected for modeling and the rationale for their selection are found in the modeling protocol.

In anticipation of the need to evaluate model performance, Ecology established a single monitoring site at Gonzaga University during the winter of 1998-99 that qualified as an areawide background monitor. As it turned out, there were no CO concentrations near or over the level of the standard during that winter. While this was good news from the standpoint of air quality, it was problematic for purposes of model validation. SAI found the overall model performance for selected days of relatively high CO concentrations to be acceptable and proceeded with areawide modeling of ten episode days from 1993-95 and projections of those days to the attainment year 2000. Ecology's supplementary analysis of the 1998-99 areawide modeling is found in *Performance Evaluations of the Modeling of Ambient CO Concentrations in Spokane* (Appendix E).

The areawide modeling resulted in two key findings. First, the modeling results indicate that elevated CO concentrations generally occur in the grids covering Spokane's central business district where major traffic intersections with significant congestion exist. CO levels appear to rise and fall with traffic activity. Consequently, it is appropriate to focus the attainment demonstration on intersections known or suspected to have elevated CO concentrations.

The second finding is that the relationship between CO emissions from the Kaiser aluminum smelter at Mead and areawide CO concentrations needs further analysis. From the areawide modeling, Kaiser appears at times to contribute significantly to widespread elevated CO concentrations. This needs to be verified using a point source model, which is more appropriate and realistic for the simulation of industrial stack emissions. Areawide gridded models, such as UAM, are not designed to handle point source emissions very well. EPA recommends the use of screening and refined techniques for point source analysis (40 CFR 51 Appendix W, 6.2.2.d.).

In response to a request from SCAPCA and Ecology, Kaiser had the consulting firm CH2MHill analyze the impact of its smelter on nearby ambient CO concentrations. Because of the nature of the terrain around the Kaiser smelter, the analysis addressed downwash, intermediate terrain approaching the stack top elevation and elevated terrain. The models ISC-PRIME, ISCST3 and AERMOD, respectively, were used to address the different terrain types as they were determined to be the most appropriate models for each situation. The analysis simulated meteorological and operational conditions from 1993-1995 to correspond to the period used for the SIP analysis.

Evaluation of concurrent monitoring from downtown Spokane and a monitor maintained by Kaiser Mead indicated that high concentrations in the downtown are not reflected in concentrations measured at the plant. Evidently, concentrations in the central business district are not to be transported north to the Kaiser Mead site. Therefore, to determine the total CO concentration during periods when CO impacts from the Kaiser smelter are at a peak, data from the Kaiser Mead monitoring station were evaluated to obtain a representative background concentration. Data from 2000 were examined when winds were from the northwest. When the winds were from this sector, the monitor, which is situated to the northeast, is not affected by emissions from the Kaiser smelter. Further, maximum modeled impacts occur to the southeast of the smelter. The highest monitored 1-hour CO concentration of 1.6 ppm was selected as the background concentration. The background concentration is added to the modeled concentration to arrive at the total CO concentration at any spot.

The analysis indicates a maximum total 8-hour modeled concentration of 8.6 ppm on the hilltop to the southeast of the smelter. The modeled results are overlain on the USGS quadrangle map in Figure 5-1. During a December 1995 episode of high CO concentrations in downtown Spokane, the Kaiser Mead monitor (which is not located in an area of maximal concentrations) measured a maximum concentration of 2 ppm. This corresponds to a highest modeled concentration of 5.6 ppm for the same December episode. While modeled and monitored concentrations cannot be compared directly because the model uses allowable emissions (or potential to emit) and the monitor reflects the effects of actual emissions, the significant difference between modeled and monitored concentrations leads to the conclusion that the modeled concentrations are conservatively high. The report prepared by CH2MHill on the Kaiser Mead smelter analysis is found in Appendix E.

Since the modeled concentration is close to the CO standard of 9 ppm, Kaiser will be required to verify that CO exceedances are not occurring on the hilltop to the southeast of the plant during smelter operations. Ecology's Industrial Section is developing an order to make the monitoring requirement enforceable. Ecology will submit the order to EPA for approval when it is finalized.

The order will be submitted by October 13,2001.

5.3 Evaluation of Worst-case Combined Areawide and Intersection Modeling Results

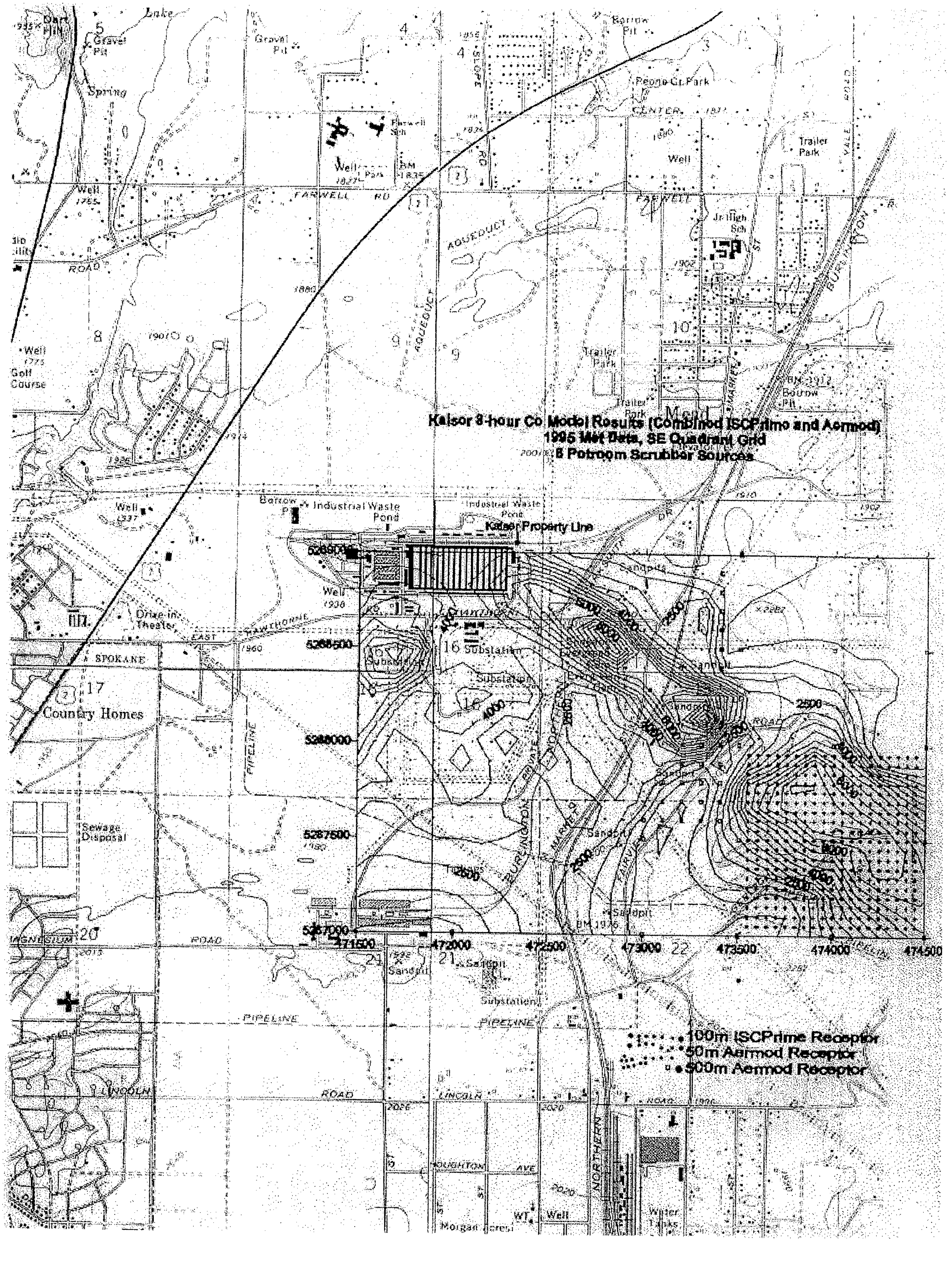
The next phase of modeling focused on model performance and validation of the combined modeling results. Worst-case —that is, modeled maximum—CO concentrations for three monitored intersections were simulated for ten episode days from 1993-95 as specified in the modeling protocol. The episode days were selected on the basis of elevated CO concentrations. The modeling protocol provides additional information on the selection of days. The three monitored intersections are Third & Washington, Hamilton & Sharp, and Main & Monroe.

The worst-case CO concentration for an intersection is the sum of the highest possible areawide concentration and the highest possible intersection concentration for an episode day. The areawide concentration is the UAM-V modeled maximum 8-hour concentration for the grid-square where the intersection is located. The 8-hour intersection concentration is based upon the highest of the maximum 5 p.m. l-hour concentrations modeled by CAL3QHC in the vicinity of the intersection. The 1-hour concentration is converted into an 8-hour concentration through the use of a persistence factor, which reflects the empirical ratio of 8-hour to 1-hour concentrations. This use of CAL3QHC "in the screening mode" provides worst case CO concentrations for an intersection. Use of CAL3QHC to model peak afternoon concentrations is the EPA-approved use of the CAL3QHC model (40 CFR 51 Subpart W).

Performance evaluation of the worst-case modeling lead to the following significant findings:

- Worst-case modeling of CO concentrations is a valid approach for the Third & Washington and Hamilton & Sharp intersections.
- Worst-case modeling does not meet criteria for model validation for the Main & Monroe intersection due to modeled gross overpredictions of CO concentrations. While the reason for such overpredictions is not known, it is hypothesized that poor model performance is attributable to the proximity of the intersection to the Spokane River canyon and the complex configuration of the group of intersections formed by Main Avenue, Monroe Street, Spokane Falls Boulevard, and Riverside Avenue.
- November 10-11, 1993 was selected as the worst case episode. This episode persists for two days and has the second and third highest CO concentrations of all ten episode days.

As a result of the performance evaluation, the intersection Main & Monroe was dropped from any further consideration in attainment demonstration. Only limited further modeling was performed on this intersection for purposes of model performance evaluation. Further information on the performance evaluation is found in *Performance Evaluations of the Modeling of Ambient CO Concentrations in Spokane* (Appendix *E).*


Kaiser 8-hour Co Model Results (Combined ISCPrime and Aermod)
1995 Met Data, SE Quadrant Grid
8 Potroom Scrubber Sources
Kaiser Property Line
5289000
5288500
5288000
5287500
5287000
471500
472000
472500
473000
473500
474000
474500
2500
4000
6000
100m ISCPrime Receptor
50m Aermod Receptor
500m Aermod Receptor
Industrial Waste Pond
Country Homes
Sewage Disposal
Farwell Sch
Trailer Park
Drive-in Theater

5.4 Comparison of Modeling Results from Different Approaches to Intersection Modeling

Further modeling of worst-case CO concentrations raised a number of questions about this approach. When episode days were projected to the year 2000, the resulting CO concentrations were much higher than the wintertime concentrations that have been observed during the past few years.

Further, EPA has developed a new mobile source emissions model MOBILE6 to replace MOBILE5b, which was used for this plan. Calculation of mobile source emissions using the Sierra Cold CO Model, which incorporates many new features of MOBILE6, shows that projected 2000 emissions are over 6 percent lower than those calculated by MOBILE5b (see Appendix E). Thus, the resulting CO concentrations in this plan are most likely overestimated as a consequence of using MOBILE5b emission factors rather than MOBILE6. These considerations raised the issue of whether the worst-case CO concentrations best represented the CO concentrations being monitored at the intersections.

EPA's *Guideline for Modeling Carbon Monoxide from Roadway Intersections* (November 1992) outlines an alternative approach to use of areawide and intersection modeling results in a demonstration of attainment. In this refined approach, the temperature, wind speed and wind direction used in UAM-V modeling is also used in CAL3QHC modeling. The CAL3QHC model is run using the hourly UAM-V temperature, wind speed and wind direction from the grid-square where the intersection is located. Then the hourly UAM-V concentrations for the grid square are summed with the CAL3QHC results for the same hour to determine the total intersection concentration for each hour. The results are averaged for 8-hour periods to determine the maximum 8-hour concentration.

When CAL3QHC is run using the UAM-V inputs, the model is called CAL3QHCR. EPA allows the use of CAL3QHCR on a case-by-case basis (40 CFR 51 Appendix W, 6.2.2.a.). To be acceptable CAL3QHCR predictions must be superior to CAL3QHC predictions. The analysis provided in *Performance Evaluations of the Modeling of Ambient CO Concentrations in Spokane* (Appendix E) showed that CAL3QHCR provided the best estimate of observed concentrations. The document also contains additional performance evaluation of the CAL3QHCR results. EPA Region 10 granted the state's request to use the model (Appendix E).

5.5 Attainment Demonstration

SRTC demonstrated attainment of the CO standard in 2000 at each of seven analyzed intersections. The seven intersections were selected for the attainment demonstration by ranking intersections on the basis of severity of level-of-service and/or traffic volume and the potential for violation or possible violation of the CO NAAQS.

Six of the seven intersections showed attainment of the CO standard (total impact below 9 ppm) without any additional control measures. The seventh intersection, 3rd Avenue & Washington Street, was initially projected to be over the standard (9.38 ppm) and required additional emission reduction. Through a series of workshops with local jurisdictions and citizen representatives, SRTC reviewed multiple transportation control measures (TCMs) based on their potential to reduce traffic and/or CO emissions from motor vehicles. One of these TCMs—a new eastbound on-ramp to Interstate 90 (I-90)—was selected to demonstrate attainment at 3rd Avenue & Washington Street. The selected TCM also affected projected CO concentrations at four nearby analyzed intersections. Table 5-1 summarizes the final results of the attainment demonstration. A detailed discussion is found in *Modeling Carbon Monoxide from Roadway Intersections in Spokane Using CAL3QHC* in Appendix *E*.

Table 5-1. Demonstration of Attainment for Selected Intersections on 11/09/00

INTERSECTION	CAL3QHC+UAM MAXIMUM 8-HOUR AVERAGE (ppm)
A. Intersections Not Affected by the TCM	
Hamilton St. & Sharp Ave	8.71
Northwest Blvd & Indiana St.	8.76
B. Intersections Affected by the TCM	
3rd Avenue & Washington St	8.64
2nd Avenue & Browne St.	8.45
3rd Avenue & Browne St.	8.85
2nd Avenue & Division St	8.63
3rd Avenue & Division St.	8.73

The intersections listed in Table 5-1 were selected on the basis of some of the same criteria used to identify intersections for hot-spot conformity analysis. At a minimum, any projects in or affecting one or more of these identified intersections must complete CO project-level (hot-spot) analysis. Additional requirements for project-level analysis are found in 40 CFR 93.123.

The projected mobile source emission inventories for the attainment demonstration were prepared in 1999. The inventories reflected the provision of WAC 173-422 that vehicles with a model year newer than four year old and older than 24 years old are not exempted from testing in the Emission Check Program, the state's motor vehicle inspection and maintenance (I/M) program. Accordingly, the inventories reflected biennial I/M testing of vehicles spanning model year (MY) 1976 through MY 1996.

In 2000, Ecology modified the I/M program to exempt four-year old vehicles as a result of a successful challenge to Ecology's interpretation of the statutory language exempting newer vehicles from the I/M program. RCW 46.16.015(2)(j) exempts cars newer than five years old, beginning January 1,2000. Since Ecology has a biennial testing program, the year 2000 started with the testing of even MY vehicles spanning MY 1976 (the oldest vehicles tested) to MY 1996 (the newest). As a result of the modification, the last MY 1996 vehicles were tested on May 25, 2000. After that date, Ecology ensured that vehicles newer than five years old were exempted from the program by testing no vehicle newer than MY 1994.

On October 31,2000, Ecology adopted revisions to the WAC 173-422 that specify the vehicles to be tested each calendar year (see Appendix E for testing schedule). Ecology is incorporating the revised rules, which are found in Appendix E, into the state's Motor Vehicle Inspection and Maintenance Program State Implementation Plan to meet EPA requirements.

Ecology and SRTC evaluated the impact of the modified new car exemption on the attainment demonstration. Ecology analyzed the impact of the change on the mobile source inventories used for the attainment demonstration. Since mobile source inventories are based upon emission factors from EPA's MOBILE5b emissions model, Ecology focused on how the modification to the program affected emission factors.

While the attainment demonstration is based on projecting the November 10-11, 1993, CO episode to November 9,2000, MOBILE5b allows for calculation of emission factors only for January 1 and July 1 of each year. Projected 2000 mobile source inventories are based on July 1, 2000, emission factors since they are more conservative than January 1,2001 emission factors, which reflect a slightly newer fleet of on-road vehicles. Since mobile source CO emissions are highly dependent on temperature, November episode temperatures were used to calculate the 2000 emission factors.

When the newest model year tested in the I/M program is MY 1996, the emission factor for a speed of 24 mph is 23.83 grams of CO per mile (gpm). When MY 1996 is exempted from the program and the newest model year tested becomes MY 1994, the emission factor changes to 24.08 gpm. This is an increase of only 1 percent. Ecology forecast that such an insignificant increase in the emission factor would not have any significant effects on modeled CO concentrations that demonstrated attainment of the CO standard.

EPA recommended that the remodeling of the intersection with the highest projected CO concentration to confirm that the modification in the I/M program would have minimal impact on the attainment demonstration. Table 5-1 above shows that the highest projected CO concentration is 8.85 ppm at 3rd & Browne. In the attainment demonstration, background and intersection concentrations are summed and compared to the standard. The background concentration is derived from the UAM-V modeling of point, area and mobile sources. The same background concentrations that were used in the attainment demonstration were used in the remodeling since a slight change to the mobile source emission factor will have no significant impact on the background concentration. SRTC reran the intersection modeling with revised mobile source emission factors. The result was a projected CO concentration at 3rd & Browne of 8.87 ppm. The difference between the previously modeled concentration of 8.85 ppm and the remodeled concentration of 8.87 pprn is an increase of only 0.02 ppm. Since the projected CO concentration at the intersection with the highest modeled concentration remains below the CO standard, the remodeling confirms the demonstration of attainment.

5.6 Transportation Control Measure Used to Demonstrate Attainment

The TCM that is used to demonstrate attainment in 2000 is a new on-ramp from northbound Division Street to eastbound Interstate 90. This TCM focuses on reducing congestion in the central-business district at the 3rd Avenue & Washington Street intersection by allowing direct eastbound freeway access rather than requiring circuitous trips through downtown.

As part of the implementation of this TCM, the City of Spokane will maintain and optimize signal coordination along the Second and Third Avenue corridors in order to minimize delay at intersections. SRTC followed standard practice in optimizing signal timing for the analysis of a TCM (Transportation Research Board, 1994). Due to variations in driver behavior and land use changes, operational characteristics used for the analysis may differ from operational modifications implemented with the TCM. Nonetheless, operational characteristics (i.e., signal phasing) at the critical intersections will be implemented to maintain or improve the forecast emission reductions for the 70-second signal cycle used in the analysis.

The SRTC Board of Directors approved the incorporation of the TCM into the Transportation Improvement Program (TIP) on February 10,2000. The funding package was outlined, and the TIP revision to reflect the construction of the TCM was forwarded to the State Department of Transportation on March 9,2000. Copies of the SRTC Board approval and the revised TIP are included in Appendix E.

SRTC's incorporation of the TCM into the TIP is just the first major step of numerous planning, design, engineering and construction steps that will need to be completed before there is a new eastbound on-ramp to 1-90. SRTC, the Washington State Department of Transportation (WSDOT) and the Federal Highway Administration (FHWA) play significant roles in carrying out these steps. Table 5-2 provides an overview of the major steps, the agency responsible for the completion of these steps and the target date for completion.

Table 5-2. Major Steps Leading to the Implementation of the TCM

MAJOR STEP	RESPONSIBLE AGENCY	TARGET DATE
Project incorporation into the TIP	SRTC	March 9,2000 (completed)
Planning level analysis	SRTC	September 2000 (completed)
Preliminary design completion	WSDOT	June 2001 (completed)
Access revision report approval	FHWA	September 2001
Project out for bid	WSDOT	February 2002
Project open to public	WSDOT	October 2002

Funding for the TCM comes from Congestion Mitigation/Air Quality accounts and a local match. The cost of the TCM is estimated at 5.2 million dollars.

5.7 Motor Vehicle Emissions Budget

Under EPA's transportation conformity regulations (40 CFR Part 93), transportation plans and improvement programs must be consistent with the motor vehicle emissions budget (MVEB) defined in the SIP. The State of Washington explicitly defined a MVEB for the Spokane CO nonattainment area in the moderate attainment plan submitted to EPA on April 30, 1996. In a Federal Register notice published on September 22, 1997 (62 FR 49442), EPA deferred approval of the MVEB until EPA had approved the demonstration of attainment. EPA approval of the demonstration of attainment was deferred until EPA had determined whether to reclassify Spokane to serious. In a May 14, 1999, letter to the Department of Ecology, EPA found the emission budget inadequate for use in conformity determinations because Spokane had not attained the CO standard by the required attainment date and was subsequently reclassified to serious. The June 10, 1999, Federal Register notice of adequacy status (64 FR 3217) listed the Spokane CO MVEB as inadequate. The May 1999 letter and June 1999 Federal Register notice are found in Appendix E.

The MVEB is the on-road mobile source portion of the total allowable emissions defined in the SIP for the purpose of demonstrating attainment. In this serious CO attainment plan, the on-road mobile source emissions used to demonstrate attainment in 2000 are 268,871 pounds per winter day. This amount—268,871 pounds per winter day—is the MVEB. The budget is seasonally adjusted to reflect peak CO season weekday emissions. It represents 40 percent of the CO emissions from all sources. The MVEB applies to 2001 and future years unless changed by an EPA-approved SIP. Once a MVEB is found to be adequate by EPA or this SIP is approved, for future Spokane Transportation Plans and Transportation Improvement Programs to conform, the emissions must be less than or equal to the MVEB. SRTC's description of how the emissions budget was developed is found in Appendix E.

EPA's transportation conformity regulations also require the following:

- consultation among federal, state and local agencies before the plan is submitted to EPA;
- submission of full implementation plan documentation to EPA; and
- addressing any stated concerns of EPA.

A consultation on the MVEB was held on October 25,2000. The minutes are found in Appendix E. This plan has been revised to address EPA's concerns; the plan includes the full documentation.

5.8 References

Systems Applications International, Inc., *Regional Carbon Monoxide Dispersion Modeling for the Spokane Serious Nonattainment Area Plan,* Final Report, San Rafael, CA (October 1999).

Transportation Research Board, *Highway Capacity Manual,* Third Edition, Special Report 209, Washington, D.C. (1994).

U. S. Environmental Protection Agency, *Technical Support Document to Aid States with the Development of Carbon Monoxide State Implementation Plans* (July 1992).

U. S. Environmental Protection Agency, *Guideline for Modeling Carbon Monoxide from Roadway Intersections* (November 1992).

Chapter 6. Contingency Measures

The Clean Air Act requires that a plan for meeting the carbon monoxide (CO) standard include contingency measures. For a serious CO nonattainment area, the measures are implemented if the area fails to meet and maintain the standard by the attainment date established by the Act, December 31,2000. Contingency measures provide emission reductions that can occur quickly while further plan revisions to reduce CO emissions are being considered.

This chapter describes the contingency measures that will be implemented if Spokane fails to meet the standard and estimates the air quality benefit of implementation.

6.1 Description of the Contingency Measures

Contingency measures must be implemented to further reduce CO emissions if the CO standard is violated. The Spokane Regional Transportation Council (SRTG) organized workshops with technicians and citizen representatives to identify measures that would decrease CO emissions and congestion in downtown Spokane. The contingency measures adopted as a result of the SRTC Transportation Control Measure (TCM) workshop process are channelization on Browne Street and signage improvements on Division Street. These measures can be implemented quickly if the CO standard were violated. Other contingency measures suggested in the TCM workshop process were eliminated since implementation would take longer or funding could not be found.

The contingency measures will improve traffic flow by minimizing or eliminating weaving movements on Browne and Division Streets between 2nd and 3rd Avenues. Currently, weaving slows or stops traffic progression on both streets. The placement of jersey barriers on Browne will force vehicles to queue in the appropriate lanes between the critical intersections of 2nd and 3rd Avenues. While traffic proceeding on Division to the intersections with 3rd and 2nd Avenues is channelized already, improvements to the existing signage help drivers determine the appropriate lane and minimize or eliminate lane changes between 3rd and 2nd Avenues.

CO levels at the intersection of 3rd & Browne are expected to improve as a result of channelization. CAL3QHC analyses were modified to quantify the expected benefits. Analytical modifications include a geometric change to account for the barriers channelizing Browne and a change in queue dynamics on Browne that result from the new channels. Quantification using CAL3QHC in the refined mode indicates the maximum running 8-hour average concentration of CO at the intersection of 3rd & Browne improves by 0.23 parts per million (ppm) (Table 6-1). Detailed Urban Airshed Model V (UAM-V) and CAL3QHC results for 3rd & Browne that provide the basis for this analysis are found in Appendix F.

CO concentrations at other intersections on Browne and Division Streets that were analyzed for the demonstration of attainment in the previous chapter remain unchanged. Since the channelization occurs on Browne between 2nd and 3rd Avenues, traffic volumes on Browne approaching 2nd Avenue are not affected and the projected attainment demonstration CO concentration of 8.45 ppm at 2nd & Browne remains the same.

The signage improvements on Division are expected to reduce CO concentrations by improving traffic flow. Current models however are not able to predict the effect of signage on traffic volumes. Since the traffic volumes are not changed, the projected concentrations at 2nd & Division and 3rd & Division remain those projected for the attainment demonstration.

The projected CO concentrations at these three intersections are included in Table 6-1 to provide a more complete picture of the projected impacts of contingency measure implementation.

Table 6-1. Estimated November 9,2000, Benefits of Channelization of Browne Street between 2nd and 3rd Avenues

INTERSECTION	CAL3QHC+UAM MAXIMUM 8-HOUR AVERAGE (ppm)	
	Before Channelization	After Channelization
3rd Avenue & Browne St.	8.85	8.62
2nd Avenue & Browne St.	8.45	8.45
2nd Avenue & Division St.	8.63	8.63
3rd Avenue & Division St.	8.73	8.73

Another benefit that may be realized from implementation of the contingency measures is an improvement in travel speeds that will result in lower CO emission rates. This potential benefit was not modeled.

6.2 Implementation of the Contingency Measures

The SRTC Board of Directors approved potential contingency measures for inclusion in the serious attainment plan on February 10,2000. Minutes of the SRTC Board approval are included in Appendix E.

Chapter 7. Commitments for Further SIP Actions

This chapter reviews commitments made in this plan for future actions, as well as, sets forth plans for future State Implementation Plan (SIP) development.

7.1 Plan Commitments

This plan established commitments for submission of a periodic inventory for 1999, for tracking and reporting vehicle miles traveled (VMT), for requiring Kaiser to monitor carbon monoxide (CO) in the vicinity of Mead plant, and for completing a transportation control measure (TCM) to fully implement of the control strategy used to demonstrate attainment. The Clean Air Act requires the submission of an updated emission inventory every three years until an area is redesignated to attainment. The state has already submitted VMT reports for the years 1993 to 1999 to the U.S. Environmental Protection Agency (EPA). Submission of the report for 2000 will satisfy Clean Air Act VMT requirements. Ecology is issuing an administrative order to require CO monitoring in the vicinity of the Kaiser plant because modeled concentrations are so near the CO standard. The completion of the eastbound on-ramp to Interstate 90 will fully implement the set of control measures used by the plan to attain the CO standard. Plan commitments are summarized in Table 7-1 below.

Table 7-1. Serious CO Attainment Plan Commitments

PLAN COMMITMENT	PLAN SECTION	CLEAN AIR ACT REQUIREMENT?	TARGET DATE
1999 Periodic Emission Inventory	3.3	Yes	September 30,2001
VMT Tracking Report for 2000	4.4	Yes	September 30,2001
Administrative order for CO monitoring	5.2	Yes	October 13,2001
TCM, Eastbound On-Ramp to 1-90	5.6	Yes	October 2002

7.2 The Next Step

Monitoring shows that the Spokane nonattainment area is meeting the CO standard. Formal recognition that Spokane now meets the standard would be provided by EPA's redesignation of Spokane from Nonattainrnent to Attainment. For that reason, the Spokane County Air Pollution

Control Authority (SCAPCA), the Spokane Regional Transportation Council (SRTC) and the Washington State Department of Ecology have started working on the development of a CO maintenance plan and redesignation request.

Two of the Clean Air Act's requirements for redesignation to Attainment are monitored attainment and fulfilling the nonattainment requirements of the Act. EPA has recently recognized that Spokane is meeting the CO standard. When EPA reclassified the Spokane nonattainment area to Serious, that attainment date was amended to December 31,2000. In a recent Federal Register notice (66 FR 44060, August 22, 2001), EPA made a formal determination that Spokane had met the standard by the December 2000 attainment date. To be redesignated to Attainment, Spokane must continue to meet the standard at all CO monitoring sites.

As detailed in Chapter 2, EPA has already approved elements of the moderate attainment plan for Spokane. EPA approval of this serious attainment plan will complete the redesignation requirement that the nonattainment area meet the nonattainment provisions of the Act. The work of the three agencies on the maintenance plan.and redesignation request will fulfill the remaining requirements for redesignation.

Appendix A. Technical Analysis Protocol

- Technical Analysis Protocol for the Spokane Carbon Monoxide Serious Area Attainment Plan

Technical Analysis Protocol for the Spokane Carbon Monoxide Serious Area Attainment Plan

An agreement between Spokane County Air Pollution Control Authority, Spokane Regional Transpiration Council, Washington State Department of Ecology, and United States Environmental Protection Agency, Region 10 for the development of an attainment plan for the Spokane serious carbon monoxide nonattainment area.

1.0 Background

This Technical Analysis Protocol (TAP) is a "plan for a plan" for developing carbon monoxide (CO) plans for the Spokane CO nonattainment area. The TAP and the plans based on it are joint products of the Spokane County Air Pollution Control Authority (SCAPCA), the Spokane Regional Transportation Council (SRTC), and the Washington State Department of Ecology. The three agencies are developing a serious area attainment plan and a redesignation request and maintenance plan. In order to expedite attainment plan submittal, the redesignation request and maintenance plan will be submitted at a later date.

This TAP for the attainment plan contains a description of the technical approach, a brief review of the status of the area in meeting Clean Air Act requirements, and a general schedule for the plan development process. SIP requirements for the Spokane serious CO nonattainment area are based on a letter from Anita Frankel, Director, Office of Air Quality, EPA Region 10 to SCAPCA dated June 11, 1996 (Attachment A). The TAP addresses all issues raised in Region 10's letter and EPA Headquarters guidance.

Air Quality Status – Based on past violations of the federal ambient air quality standards for CO, the Spokane urban area (as described by the WSDOT urban area maps) is classified as of April 13,1998, as a serious CO nonattainment area. Until that date Spokane was a "moderate-plus" nonattainment area for CO with a design value of 13.8 ppm based on 1988-1989 monitoring data.

An attainment plan meeting most of the requirements of the 1990 Amendments to the federal Clean Air was submitted by Ecology to EPA as a revision to the State Implementation Plan (SIP) on January 22, 1993. Partly to meet remaining Clean Air Act requirements and partly to deal with EPA's replacement of MOBILE4.1 with MOBILE5a as EPA's officially recognized mobile model, Ecology submitted an additional SIP revision to EPA on April 30, 1996. The revision revised the base year and forecast emission inventory, VMT forecasts, the oxygenated fuel control measure, and the attainment demonstration. It also added a contingency measure for implementation if the standard was not met by December 31, 1995. EPA approved the base year emission inventory, provisions for forecasting and tracking VMT, VMT contingency measures and the contingency measure for failure to attain the standard through a final rule published in the September 22, 1997, Federal Register.

Effective April 13, 1998, the Spokane area was reclassified as a serious nonattainment area for not meeting the moderate area attainment date of December 31, 1995. EPA found that the standard was exceeded four times at one monitoring site in 1995. In 1996 the CO standard was exceeded once each at two different monitoring sites. 1997 and 1998 were monitored as attainment years.

Existing Control Measures – State and local control measures have been implemented since 1992 in the Spokane area specifically to attain the CO standard. These measures include the following:

- Revisions to the Washington State vehicle emission Inspection and Maintenance (I/M) program, including expansion of the testing area and more stringent testing procedures

- Wintertime oxygenated fuel program

These measures have been shown to work in concert with the Federal Motor Vehicle Control Program (FMVCP) and fleet turnover, to reduce motor vehicle CO emissions in the Spokane nonattainment area despite growth in Vehicle Miles Traveled (VMT). The serious area SIP analysis projects CO emissions for the year 2000 and models the resulting air quality levels.

2.0 Serious Area CO Attainment Plan

2.1 Emission Inventory Preparation

The moderate area attainment plan used a base year 1990 inventory. A new base year inventory for a more recent year—1996—has been developed for the serious area plan. Preparation of the emission inventory was done in conjunction with the required periodic inventory for 1996 due in September of 1998. An inventory preparation plan (IPP) incorporating a quality assurance plan was developed to guide inventory preparation and assure quality data. The IPP has been submitted to EPA.

2.1.1 Base Year 1996 Emission inventory totals are reported by EPA's prescribed source categories for the nonattainment area.

2.1.2 Attainment Year 2000 - The attainment year inventory is based on projections of the base year 1996 inventory. Source categories are projected based on appropriate factors such as increases in population, VMT, or households.

2.1.3 Base Year and Projected Gridded Inventories –SRTC's geographic information system (GIS) is used to overlay the 1 km x 1 km grid developed for Spokane's PM_{10} nonattainment area on the CO nonattainment area and SRTC's street network. Emissions are then allocated among the grids for the regional dispersion modeling and development of subarea emissions budgets. Further information about gridding various source categories is found in Attachment B "Attainment and Maintenance Demonstrations for Spokane's Carbon Monoxide State Implementation Plans."

2.2 Attainment Demonstration

The attainment demonstration modeling includes regional dispersion modeling using Urban Airshed Model-V in combination with intersection modeling using CAL3QCH. Area and intersection hotspots are modeled for compliance with the CO standard following EPA recommended procedures. The procedure for demonstrating attainment in the year 2000 is outlined in Attachment B "Attainment Demonstration for Spokane's Carbon Monoxide State Implementation Plan." Any additional control measures required to demonstrate attainment will be formally adopted and submitted with the serious area attainment plan.

2.3 Vehicle Miles Traveled Forecast/Tracking

The established VMT tracking process already approved by EPA is continued for annual tracking of actual VMT estimates through the year 2000. VMT was forecast and tracked through the 1995 under the moderate area attainment plan. The process was continued for 1996, 1997 and 1998. The serious area attainment plan for Spokane will summarize reported VMT forecasts and estimates of actual VMT for 1996-98 and provide VMT forecast for 1999 and 2000. The VMT contingency measure is being replaced with a similar but locally directed measure.

2.4 Contingency Measures

Contingency measures are addressed in the serious area attainment plan to meet Clean Air Act requirements and related EPA guidance. A Spokane technical advisory group developed a list of possible transportation control measures (TCMs) for use as contingency measures. The expectation is that one or more of these measures will be selected as contingency measures for the serious area attainment plan. Air quality benefits are estimated.

2.5 Transportation Emission Budget

An emission budget for the nonattainment area is included in the serious area attainment plan to meet EPA requirements. Selected subarea budgets may be developed if analysis indicates that this approach has value for maintaining air quality.

3.0 Timeline

See Table 1.

4.0 Proposal and Concurrence

PROPOSED FOR SIP DEVELOPMENT BY:

Spokane County Air Pollution Control Authority — Date: 4/24/00

Spokane Regional Transportation Council — Date: April 17, 2000

for Mary Burg
Washington State Department of Ecology — Date: 5/10/00

CONCURRENCE WITH PROPOSED APPROACH:

United States Environmental Protection Agency, Region 10 — Date: 5-31-00

Table 1. Proposed Timeline for the Spokane Serious CO Attainment Plan

ACTION	TARGET DATE	NOTES
TAP/Modeling Protocol Development/Resolution of Issues	March 1,1998 – October 21,1999	EPA's assistance with the TAP and included modeling protocol is appreciated
Identification of Funding for Regional Modeling Contract	April 15, 1999	Reprogrammed from existing Section 105 funds
Execution of Modeling Contract	June 3, 1999	Based on qualifications and proposal, Systems Application International (SAI) was selected as the contractor for regional dispersion modeling
Regional Dispersion Modeling	June 3 – September 29, 1999	Performed by contractor
Attainment Demonstration/Control Measures/Contingency Measures	September 30, 1999 – March 15,2000	Joint effort of SCAPCA, SRTC and Ecology
Peer Review Draft Preparation	February 11 – April 14,2000	Joint effort of SCAPCA, SRTC and Ecology
Revised TAP Submittal to EPA	April 14,2000	Minor revisions and revised timeline
Peer Review Draft Completion	April 28,2000	Draft ready for copying and distribution to SCAPCA, SRTC, Ecology and EPA
Peer Review - SCAPCA, SRTC, Ecology and EPA	May 1 – June 9,2000	Coordinate arrangements with EPA on expectations and process.
Public Review Draft Completion	June 30,2000	Draft ready for copying and distribution to repositories
Public Hearing Notice	July 10, 2000	Published in Spokane Spokesman Review
Public Review Period	July 10 – August 8,2000	30-day public review period required by 40 CFR 51.102
SIP Hearing	August 9,2000	Hold in Spokane
Ecology submittal to EPA	September 15,2000	Adopted SIP revision and supporting documentation

Attachment A

Letter from Anita Frankel, EPA Region 10 to Eric Skelton, SCAPCA, June 11,1996

(The following letter is an OCR reproduction for electronic delivery and not a photocopy. Location of graphics may not be exact to original. Text was proofed and should match original. You may request photocopies of the original from SCAPCA)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

JUN 11 1996

Reply To
Attn of: OAQ-107

Eric P. Skelton, Director Spokane County Air Pollution
Control Authority
West 1101 College, Suite 403
Spokane, WA 99201

Dear Mr. Skelton:

Your letter dated April 2, 1996, requested EPA's concurrence or correction regarding your understanding of the implications and timelines relative to the Spokane carbon monoxide (CO) nonattainment area's reclassification to serious. As you are aware, EPA is in the process of determining whether the Spokane Co nonattainment area currently, classified as "moderate", will be reclassified to "serious" pursuant to Section 186(b) (2) of the Clean Air Act (CAA). EPA intends to publish a proposed Federal Register Notice by the end of June which will contain our preliminary determination. A 30 day public comment period will follow which will allow interested parties the opportunity to comment and submit additional information to EPA which will be taken into consideration prior to a final determination being made.

The CO serious area planning requirements are set forth in section 187(b) of the CAA. EPA has issued two general guidance documents related to the planning requirements for CO SIPs. The first is the "General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990" that sets forth EPA's preliminary views on how the Agency intends to act on SIPs submitted under Title I of the Act. The second general guidance document for CO SIPs issued by EPA is the "Technical Support Document to Aid the States with the Development of Carbon Monoxide State Implementation Plans," July 1992. In addition to the serious area requirements, the State would still be responsible for submitting any applicable moderate area requirements under section 187(a) of the CAA.

The assessment of the CO serious area requirements contained in your letter was essentially accurate. If the 1995 exceedances recorded at the Third Avenue and Washington Street monitor are verified and Spokane were to be reclassified to serious, the State would be required to submit a SIP revision to EPA that would include the following elements:

1. Attainment Demonstration: A Demonstration of attainment of the CO National Ambient Air Quality Standard as expeditiously as practicable but no later than December 31, 2000.

2. Vehicle Miles Traveled (VMT) Forecast: A forecast of VMT for each year before the attainment year and provisions for annual updates of these forecasts.

3. Contingency Measures: Adequate contingency measures to replace those being implemented due to a finding of failure to attain.

4. Transportation Control Measures (TCMs): Adopted transportation control measures and strategies to offset any growth in CO emissions from growth in VMT or number of vehicle trips.

5. Periodic Emission Inventories: Periodic emission inventories for every 3 years (1996 and 1999) to be submitted to EPA the following year.

6. Conformity: The mobile source emissions assumptions included in the serious area SIP will form an emissions budget with which transportation plans, programs, and projects must conform.

The "other strategies" you mention that may be useful in moving areas toward attainment have all been determined not to be required elements of a serious area CO SIP for Spokane. Thus, the following measures are not required.

1. Major Stationary Source Definition: A revision of the major stationary source definition under the State NSR rules to 50 tons per year is not required, since Spokane has no sources large enough to contribute significantly to the CO nonattainment problem. This is consistent with William Laxton's May 13, 1991 memorandum, "Guidance for Determining Significant Stationary Sources of Carbon Monoxide."

2. Employee Commute Option (ECO): The trip reduction program requirement is now a voluntary option for areas classified as serious for carbon monoxide. (See enclosed letter dated April 23, 1996, from Margo Oge, Director of the Office of Mobile Sources to all Regional Air Division Directors).

3. 3% Annual Reduction: The CO serious area requirements cross

reference a section in the CAA pertaining to severe ozone nonattainment areas that requires a 3% average annual reduction in baseline emissions from a 1990 baseline through a combination of TCMs and other measures. The applicability of this requirement has been discussed with the Office of General Council and EPA's reading of the Clean Air Act is that this cross reference is not an applicable requirement for CO serious nonattainment areas.

CO nonattainment areas reclassified to serious must submit planning requirements as stated in section 187(b) of the CAA within 18 months of the area's reclassification. (See enclosed memo dated October 23, 1995, from Sally Shaver, Director of the Air Quality Strategies and Standards Division).

I look forward to our continued cooperative efforts in resolving the reclassification issue and in working towards attainment of the carbon monoxide standard in your community. Please call me at (206)553-2963 or Bonnie Thie at (206) 553-1189.

Sincerely,

n
its Frankel, Director
Office of Air Quality

Enclosure

cc: Joe Williams, Ecology
Ron Edgar, SCAPCA
Glenn Miles, SRTC
Dale Arnold, City of Spokane

Attachment B

Attainment and Maintenance Demonstrations for Spokane's Carbon Monoxide State Implementation Plans

Attainment and Maintenance Demonstrations for Spokane's Carbon Monoxide State Implementation Plans

Revised October 15, 1999

I. Gridded Inventory Preparation

A. Modeling Inventories for Episodes or Days of Interest

Gridded inventories of carbon monoxide (CO) emissions for the Spokane CO nonattainment area have been prepared for 10 episodes of interest during the period 1993-96 and for 5 selected days from the winter of 1998-99 when a background CO monitor was operating for use in dispersion modeling.

The grid density and structure were established by using Spokane Regional Transportation Council's (SRTC's) geographic information system (GIS) system to overlay the 1 kilometer by 1 kilometer (1 km x 1 km) grid developed previously for the PM_{10} nonattainment area on the Spokane CO nonattainment area. The GIS system was also used to determine the street segments on SRTC's street network in its TMODEL2 travel demand model within each grid cell.

B. 1996 Base Year Emission Inventory

1. General

Since 1989, CO exceedances have been observed only during winter time conditions in Spokane. The Washington State Department of Ecology, the Spokane County Air Pollution Control Authority (SCAPCA), and SRTC cooperated in the development of an emissions inventory based on typical daily winter-time emissions for all CO sources for the year 1996. The three agencies decided to use the winter-time temperatures determined for the Spokane CO nonattainment area's 1990 base year inventory. The 1990 inventory was required for CO nonattainment areas by the 1990 Amendments to the Clean Air Act. The temperatures were 38 degrees Fahrenheit maximum, 24 degrees minimum, and 33 degrees ambient. While recent years have been a little warmer, mobile source inventories especially are affected by temperature. The agencies decided that it was important not to underestimate the mobile source emissions.

2. Mobile Source Inventory

SRTC's TMODEL2 travel demand model and EPA's MOBILE5b mobile source emissions model were used to develop CO emissions for each link of SRTC's street network. The emissions for each link were then distributed among the gridded street segments reflecting the link. For dispersion modeling, all CO emissions by link within 1 km x 1 km grid are summed to represent total mobile source emissions within a grid square.

Mobile source emissions may be recalculated with the COLDCOMS mobile source emissions model. COLDCOM5 has been recently developed by Sierra Research with assistance from the U.S. Environmental Protection Agency's (EPA's) Office of Mobile Sources to provide an interim model that will reflect current technical understanding of CO emissions more accurately than MOBILES. Both emissions models will be replaced by the MOBILE6 model being developed by EPA.

3. Point Source Inventory

Data gathered from SCAPCA and Ecology were used to calculate typical winter daily emissions for point sources. The daily emissions were entered into the grid square representing the Universal Transverse Mercator (UTM) location of the point source. Large sources and the central business district may require special analysis.

4. Area Source Inventory

a. Woodstoves

The average number of pounds of CO emissions per day from woodstoves for a household (lbs./day/household) in the Spokane CO nonattainment area was calculated with the methodology previously used for revising the woodstove inventory in the January 1996 attainment plan revision for Spokane. Since SRTC's GIS system locates households based on 1990 census data and 1990-1996 building permits, the GIS system was used to determine the number of households in each grid square. Then the woodstove CO emissions in each grid were calculated by multiplying the lbs./day/household by the number of households in each grid.

b. Other Area Sources

Residential yard waste burning contributed about 2 percent of typical day peak season CO emissions. SCAPCA only allows burning during short intervals. Since SCAPCA did not allow open burning within the nonattainment area on any of the selected modeling days, yard burning emissions were not included in the gridded inventory. Other area sources categories totaled less than 1 percent of the emission inventory. These were considered insignificant and not included in the gridded inventory. These sources included residential non-wood, commercial, and industrial fuel use, commercial/industrial incineration, trash burning, prescribed fires, wildfires, and structure fires.

5. Nonroad Mobile Source Inventory

a. Aircraft

CO emissions were developed according to EPA guidance using engine and takeoff-and-landing information from the Federal Aviation Authority and Spokane airports (Geiger Field and Felts Field). Since Felts Field aircraft represented only 0.1 percent of the total daily inventory, these emissions were considered insignificant and not gridded. Geiger Field emissions, on the other hand, were entered into the grid squares covering the airport.

b. Other Nonroad Mobile Sources

Other nonroad mobile source emissions were based upon EPA's 1990 nonroad study. Emissions in each category of nonroad sources were increased or decreased depending on ratio of 1996-to-1990 emission surrogates. These surrogates include population and employment in specific industries. Emissions were distributed among grid squares either by use of surrogates such as households per grid or by the relationship between the generation of emissions and the location of the activity. Several nonroad mobile source categories totaled less than 1 percent of the emission inventory. These were considered insignificant and not included in the gridded inventory. These sources included locomotives, agricultural equipment, airport service equipment, logging equipment, and recreational vehicles.

C. Episode Inventories

Hourly emissions for episode days in 1993-96 and for areawide model validation days in 1998-99 have been developed to reflect actual emissions under ambient conditions. Each modeling run begins during the episode or validation day of interest and includes part of the following day to ensure capture of late evening or early morning peaks. Rather than develop a separate inventory for the second day, the model uses cyclic emissions whereby the hourly emissions developed for the episode or validation day are also used for the second day. Mobile source emissions are based on vehicle miles traveled (VMT) estimates for the appropriate year, month and day of evaluation and emission factors based on daily temperatures. Woodstove emissions are projected or reduced from the 1996 base year inventory based on households and adjusted for heating degree days. Except for aircraft, nonroad mobile source emissions reflect expected activity on the specific day and the population as of April 1 following the CO season.

D. Projected Inventories

The 1996 base year inventory was projected to 2000,2005, and 2012. For most categories, projections were based upon population. Point source projections reflect allowable CO emissions. Episode day inventories based on the projected inventories use the ambient temperatures of the original 1993-96 episode days and retain the original day of week because of relationship of the day to traffic.

II. Modeling Protocol

A. Introduction

Urban areawide grid modeling together with refined meteorological data and detailed emissions inventory can provide information that increases the certainty that the national ambient air quality standard (NAAQS) for CO will be met and maintained. An in-depth modeling analysis also provides valuable planning information that is of assistance in devising effective control strategies. Spokane's reclassification from "moderate" to "serious" warrants a rigorous, urban areawide technical analysis to demonstrate attainment. Such an approach has been taken in such other serious carbon monoxide areas across the nation as Las Vegas, Phoenix, and Denver.

The approach for CO SIP modeling is codified in ***40 CFR Part 51 Appendix W: Guideline on Air Quality Models.*** The guideline ***(Section 6.2.2, Models for Carbon Monoxide)*** states that, "the recommended model for urban area-wide analysis is RAM or Urban Airshed Model (UAM)." The recommended approach for microscale (hot spot) modeling is documented in ***The Guideline for Modeling Carbon Monoxide from Roadway Intersections (EPA-450/R-92-005).*** The ***Guideline on Air Quality Models*** also provides provision for alternative models. ***Section*** 3.2 ***Use of Alternative Models*** states that alternative models can be accepted when a preferred air quality model is not appropriate for the particular application or a more appropriate model or analytical procedure is available and is applicable.

For the Spokane SIP analysis, SCAPCA contracted with a private firm for areawide modeling. SRTC performed the hotspot modeling and demonstrations of attainment and maintenance of the CO NAAQS. This protocol references the general direction that the cooperating agencies (SCAPCA, SRTC and Ecology) provided to all potential contractors for areawide modeling. As such, it was subject to change as the agencies consulted with the selected contractor on specifics of the modeling. Deviations from the general direction given to the contractor or from other parts of this protocol are discussed with EPA Region 10 technical staff as part of the process of ongoing consultation on planning and performing modeling analysis.

B. . Model Selection

EPA guidance for CO SIP modeling and previous modeling studies in other serious CO nonattainment areas (Phoenix, Las Vegas, Denver) included an approach where neighborhood scale and microscale processes are modeled separately and then the results of each are merged to estimate the total concentration. This approach allows the application of a three-dimensional eulerian grid model (e.g., Urban Airshed Model (UAM), CALGRID, CAMX) to describe the accumulation of emissions over several hours, as well as the separate estimation of roadway impacts at hot spot intersections using CAL3QHC, an updated version of CALINE3. CAL3QHC is used in a screening mode to estimate microscale impacts. Hourly microscale concentration predictions from CAL3QHC are converted to 8-hour concentrations using the appropriate persistence factor and then added to the 8-hour neighborhood-scale "background" concentrations from UAM or CALGRID to estimate total 8-hour concentrations at an intersection. The total UAM or CALGRID plus CAL3QHC simulated concentrations are compared with the NAAQS.

It should be noted that the addition of microscale impacts to areawide background concentrations results in double-counting of the mobile source inventory affecting the hotspot. The impact though on the calculated concentration is usually minimal. In microscale modeling,, modeled emissions are typically distributed among 4-to-5,000 square meters of road surface. In areawide modeling, on the other hand, the impact of modeled mobile source emissions are diluted by being distributed throughout the entire 1 million square meters of a 1 km grid square. As a result, the overestimation is typically less than one percent.

A new hotspot model (called HYROAD) is currently being developed by the National Cooperative Highway Research Program. Since a goal of this new model is improved CO dispersion estimates under stagnant conditions, the expectation is that it would provide more realistic estimates of CO concentrations than CAL3QHC for the stagnant conditions that normally accompany elevated CO concentrations in Spokane. Unfortunately, it will not be completed for a year or more. The timeframe for development of HYROAD however precludes its use in Spokane SIP analysis.

C. Modeling Domain and Receptor Grid Selection

The 1 krn x 1 km grid developed for the Spokane PM_{10} nonattainment area was overlaid on the Spokane CO nonattainment area by means of SRTC's GIS system. The resulting grid structure was used to grid the emission inventory and define the modeling domain. The area within the modeling domain includes all current and future (known to date) area and major point source emissions, all current air quality monitors, and the hot spot locations for application of the CAL3QHC microscale intersection model. The boundaries are sufficiently distant from the area of primary interest to minimize the effect of boundary condition uncertainty on calculated concentrations. The receptor grid for areawide modeling uses the same grid structure and density as the emission inventory grid.

D. Meteorological Database

Available meteorological data are employed in a diagnostic/prognostic wind model to produce gridded wind fields. There are number of sources available for routine observation data in the Spokane area. The National Weather Service at Spokane International Airport collects hourly surface and twice-daily rawinsonde observation data. Hourly surface observations are also available from Felts Field in Spokane and sixty-minute averaged wind speed, direction, standard deviation of the horizontal wind direction, and temperature from three Ecology sites.

A commonly accepted meteorological model (e.g., Mesoscale Model 5 (MM5), CALMET, Diagnostic Wind Model (DWM)) or any combination thereof is used to produce a realistic wind field for the domain of interest. It is expected that local topography and other distinct features such as water bodies are resolved in the meteorological model. The contractor selected to perform areawide modeling for the Spokane SIP analysis also had the option of using other sources of meteorological data to improve the computed wind fields.

The general direction provided to potential contractors was first to compute wind fields for the domain for five days from 1998-99 when the background CO monitoring site was in operation. The contractor then compared the wind fields to input data and demonstrated that the wind fields are consistent with the input data and other information.

Next the contractor computed wind fields for the domain for 10 episodes from 1993-96 for use in attainment and maintenance demonstrations. Again, the contractor checked the computed wind fields for consistency and realistic patterns.

E. Areawide Modeling Validation

The areawide modeling needs to be validated against monitored concentrations to provide some confidence in the use of modeled concentrations at selected hotspot sites in demonstrations of attainment and maintenance. A background site began operation on the campus of Gonzaga University on December 21,1998. The monitor at Gonzaga is close to Spokane's central business district (and potentially the highest background CO concentrations) but removed from direct sources of CO. As part of the validation, CO concentrations throughout the domain were examined to see if they appeared realistic and modeled concentrations were compared with monitored concentrations at the background site and at the monitored intersections. While area-wide modeled concentrations should not match monitored concentrations at intersections, modeled concentrations should be sufficiently low to allow addition of CAL3QHC results so that the total modeled concentrations show a good match with the monitored concentrations.

The cooperating agencies working on SIP development chose dates for validation of background concentrations in consultation with EPA. As expected for a La Nina winter, monitored concentrations from Spokane's CO monitoring network are not especially high for the period when data are available from the Gonzaga background monitor. While it would be desirable to be able to model cases where the NAAQS was exceeded, the network has not recorded NAAQS exceedances since the winter of 1995-96. Validation modeling can still be performed but cannot conclusively confirm model performance at higher concentrations.

At the time when days were selected for model validation, data from the monitor had been validated only through January 31, 1999. Elevated CO concentrations are not likely after January anyway. Later examination of validated February 1999 data revealed that monitored CO concentrations were much lower.

In the 1990s the two stations monitoring the highest CO concentrations have been 3rd &Washington (southside) and Hamilton & Sharp. Between these two stations, 5 candidate days were identified between December 21, 1998, and January 31, 1999, when 1-hour readings are moderately high (6.4 to 12.3 ppm). The corresponding 8-hour averages range from 4.5 to 7.7 ppm. The reading of 4.5 ppm is proposed for inclusion because of interesting correspondences between the monitors. The cases are summarized in the following table.

	MONITORED CO CONCENTRATION (ppm)				
DATE	3rd & Wash. (1-hour average)	3rd & Wash. (8-hour average)	Hamilton (1-hour average)	Gonzaga (1-hour average)	Gonzaga (8-hour average)
30-Dec-98	11.9	7.7	8.7	4.0	2.2
05-Jan-99	8.2	5.4	6.8	3.4	2.5
06-Jan-99	7.8	5.6	9.4	5.1	2.7
10-Jan-99	6.4	4.5	6.6	4.3	2.7
11-Jan-99	12.3	7.3	9.3	5.5	3.7

The general direction provided to the potential contractor was to use computed wind fields and hourly carbon monoxide emission data for each of the selected 5 days to compute CO concentrations for the grid over the domain. Hourly emission data are derived from the emission inventory. Mobile source emissions are based on VMT estimates for the appropriate year of evaluation and emission factors based on daily temperatures. Woodstove emissions are projected based on households and adjusted for heating degree days. For all other sources, since there is only a small percentage difference between the 1996 base year inventory and the 1998 or 1999 projected inventory, the 1996 base year inventory is used as a surrogate for projections. The contractor was expected to compare computed CO concentrations with the background monitor values recorded for each hour and perform appropriate performance evaluation.

F. Attainment and Maintenance Episode/Event Selection

High ambient CO concentrations in urban areas result from periods of high emissions—more specifically, high mobile source emissions from afternoon and evening traffic peaks--coinciding with the adverse meteorological conditions of low wind speeds and poor vertical dispersion. Under such conditions, microscale processes (i.e., emissions and dispersion parameters at a spatial resolution of tens of meters) contribute to early evening peak concentrations with the result that concentrations can increase rapidly near heavy traffic areas. At the same time, radiational cooling causes CO emissions to become trapped in a shallow, stable surface layer. The resultant neighborhood scale buildup of high concentrations often persists for 18-to-24 hours. The combined effect of microscale and neighborhood scale processes results in maximum &hour average concentrations.

A single worst-case episode simulation was found to be adequate for attainment demonstrations in previously completed CO areawide modeling studies for Las Vegas, Phoenix, and Denver serious area SIPs. In order to model a single episode, the selected episode needs to have adequate, concurrent detailed meteorological and air quality data available for conducting the modeling analysis. When the characteristics of episodes of high CO concentrations cannot be adequately represented in a single episode, then more than one episode should be considered for modeling.

Meteorological conditions associated with high CO concentrations from 1993-96 have been reviewed to determine the regimes under which elevated CO concentrations are found in Spokane. Overall, the period 1993-96 had the highest concentrations observed during the 1990s. The 50 cases of 8-hour CO concentrations over 7.2 ppm should furnish a sufficient number of cases to select a subset that provides representative coverage of conditions under which high CO occurs in Spokane.

The review of the 1993-96 cases reveals that elevated levels of ambient CO concentrations generally occur in the afternoon and evening hours under dry and clear sky conditions, when wind speeds are low (<5 mph), ambient temperatures are between 30-45 degrees Fahrenheit.

Because the purpose of the modeling analysis is to show compliance with the NAAQS, the data for days when the 8-hour CO NAAQS (9 ppm) were exceeded at any monitoring station were analyzed. There were twelve such cases found from the 50 days selected from 1993-96. There are 10 days with exceedances at the 3rd and Washington site and 5 days at the Hamilton site. Division and Riverside monitors showed no exceedances during the period.

Since both time and resources are limited, the cooperating agencies working on SIP development in consultation with EPA decided to model six episodes or events showing monitored concentrations above 9.5 ppm and four other events based upon interesting meteorological characteristics (i.e., atypical temperature or wind speed). During the model performance evaluation process, it will be clear as to which episodes are dominating or controlling. At that time, the cooperating agencies and EPA with the contractor's advice will select the episodes to be considered for attainment and maintenance demonstrations. The days selected for modeling, monitored concentrations at 3rd & Washington and Hamilton, and ambient wind speed and temperature conditions are listed below:

DATE	MAXIMUM 8-HOUR CO CONCENTRATION (ppm)		WIND SPEED (mph)	TEMPER-ATURE (°F)
	3rd & Wash.	Hamilton		
11-Dec-95	13.1	7.7	4.3	43.31
11-Nov-93	12.7	9.8	1.26	35.18
10-Nov-93	11.8	10.1	1.72	40.49
12-Dec-95	11.2	5.3	7.19	46.6
09-Jan-95	10.4	7.5	4.36	37.48
22-Mar-93	8.5	6.3	3.91	50.4
01-Apr-93	7.9	3.8	5.76	49.01
01-Feb-96	7.9	8.2	1.93	9.95
02-Mar-94	7.3	3.8	6.76	53.62
30-Dec-96	NA	10.0	3.15	33.64

A cursory examination of the data for the selected days shows that most of the days exceeding the NAAQS occur at low wind speeds (<4 mph) and at a narrow band of temperature ranges (35-45°F). Furthermore, November 10-11, 1993, exhibits characteristics of a stagnant episode. On both days, wind speeds were consistently low (near calm conditions) and temperatures were between 35 and 40 degrees. Also, there may be a buildup of pollution at monitoring locations. These two days need to be further investigated based on hourly data (wind speed, temperature, concentration, mixing height, inversion characteristics, etc.). Likewise, December 11-12, 1995, shows some characteristics of a multi-day episode.

The general direction being provided to potential contractors was to use computed wind fields and hourly carbon monoxide emission data for each of the 10 episodes from 1993-96 to compute CO concentrations for the grid over the domain. Hourly emission data are derived from the emission inventory. Mobile source emissions are based on VMT estimates for the appropriate year of evaluation and emission factors based on daily temperatures. Woodstove emissions are reduced from 1996 levels based on households and adjusted for heating degree days. For all other sources, since there is only be a small percentage difference between the 1996 base year inventory and 1993-96 episode inventories, the 1996 base year inventory is used as a surrogate.

G. Hot Spot/Intersection Selection

Microscale modeling using CAL3QHC is being performed for a selected number of intersections for each of the 10 episode days for model performance evaluation and the days selected for attainment and maintenance demonstrations. The intersections include the three intersections in Spokane with CO monitors and seven additional, non-monitored intersections. The non-monitored intersections were selected based on highest modeled background CO concentrations and traffic counts. The intersections selected for microscale modeling are the following:

- monitored intersections
  - 9 3rd & Washington
  - ➢ Hamilton & Sharp
  - ➢ Main & Monroe

- non-monitored intersections
  - 9 Browne & 2nd
  - 9 Browne & 3rd
  - 9 Division & 2nd
  - 9 Division & 3rd
  - 9 Northwest Blvd & Indiana
  - 9 Park & Sprague
  - 9 Sprague & Fancher

CAL3QHC uses traffic flow and signalization information to calculate queue length. SRTC inputs specific intersection geometric data and signalization information from the local traffic engineering department responsible for the operation and maintenance of the intersection being modeled. Traffic flow information is derived from actual field counts. When field data are not available, SRTC relies on its travel demand model, TMODEL2, for traffic volume and turning movement data sets. The travel demand model SRTC uses must meet stringent statistical requirements and is certified by the Federal Highway Administration.

The selected receptor locations in CAL3QHC modeling include locations where maximum concentrations are likely to occur and where the general public has access. Essentially, this means that receptors are sited in the vicinity of those portions of the intersection where traffic is likely to be the greatest and the most congested, e.g., along queues. Receptors are not located on the roadways or within three meters of the traveled roadways which comprise the intersection. Vehicle turbulence does not allow current models to make valid concentration estimates in these locations. Receptors are placed on both sides of the road for each approach to an intersection where queues develop.

For each of the ten selected 1993-96 episode days, CO concentrations are modeled at all monitored intersections with CAL3QHC. The CAL3QHC results, which represent peak traffic conditions, are based on 5 p.m. emission factors for the specific day's ambient conditions and traffic matched to the year and the day of the week. The intersection modeling results are converted to 8-hour concentrations through the use of a persistence factor of 0.7. The 8-hour concentrations are summed with 8-hour CO concentrations from the areawide modeling to determine total CO concentrations. Total CO concentrations at monitored intersections are compared with monitored levels and statistical and graphical performance measures are evaluated.

H. Model Performance Evaluation

Areawide and intersection modeling results must be evaluated at several points during the development ofattainment and maintenance demonstrations. Only then can there can confidence that the models provide reliable estimates of CO concentrations for projected emission scenarios under specified meteorological conditions. The *Guideline on Air Quality Models* recommends certain data quality assurance and model diagnostic analyses that should be conducted as part of the performance evaluation. The cooperating agencies intend to follow these performance evaluation and quality assurance procedures. Any deviations from the established guidelines are discussed with the EPA Region 10 modeling staff before and during the analysis.

Model performance evaluation can be broken down into three components: wind field evaluation, areawide model evaluation, and overall model performance evaluation that addresses the combined results of areawide and intersection modeling.

1. Wind Field Evaluation

The guidance document for areawide CO modeling, *Guideline for Regulatory Application of the Urban Airshed Model for Areawide Carbon Monoxide (EPA 450/4-92-011a and 011b)* recommends mapping of gridded wind fields. Realistic windfields are critical to the whole modeling effort. The general direction from the cooperating agencies to potential contractors is to compare windfields with observed data for each of the five days in 1998-99 used for areawide model validation and to demonstrate that computed windfields are consistent with observed data and other information. The contractor was also asked to evaluate computed windfields for each of the 10 selected episode days for consistency and unrealistic patterns.

2. Areawide Model Performance Evaluation

As part of areawide model validation, modeling results are compared with data measured from 5 days in 1998-99 when the background monitor at Gonzaga University was in operation. The cooperating agencies developed the following general guidance for evaluation of model performance:

> The contractor will compute statistics showing the model performance as a function of temperature, wind speed, and observed concentration using predicted concentrations over the 3 by 3 patch of grid squares centered on the background monitoring site. The contractor will demonstrate that the predicted concentrations estimate the observed concentrations with acceptably high confidence.

Similar to the approach used for regional modeling of ozone, analysis of the 3 by 3 square of grids centered on the grid containing the background monitoring site focuses on grid-to-grid consistency of results within this modeling subdomain. The 95 percent confidence criteria is general guidance and not acceptance/rejectance criteria.

The contractor will also evaluate whether the model predicts realistic concentrations everywhere in the modeling domain as well as specifically in grid squares containing monitored intersections. Modeled background concentrations for grids containing monitors cannot be compared directly with monitored values that reflect both motor vehicle emissions at the monitored intersection and the background concentration. Still, modeled background concentrations need to be below monitored concentrations to allow for traffic emissions and still reflect monitored values.

3. Overall Model Performance Evaluation

As part of the attainment and maintenance demonstration process, total CO concentrations from areawide and intersection modeling are compared with data measured from historical CO episodes. Once the models have satisfactorily simulated both spatial and temporal CO distributions, greater confidence can be placed in their ability to provide reliable estimates of concentrations under the same meteorological conditions for a variety of future emission scenarios.

Rigid rejection and acceptance criteria for model evaluation or validation have not been supported by model developers or by decision makers participating in previous modeling efforts. The *Guideline for Regulatory Application of the Urban Airshed Model for Areawide Carbon Monoxide* provides both graphical and statistical performance measures. The statistical measures include unpaired highest-prediction accuracy, normalized bias test, gross error of all pairs above 5.0 ppm, average station peak prediction frequency, bias of all station peaks, fractional bias of peak concentration, etc. The graphical performance measures include time-series plots, ground-level isopleths, quantile-quantile plots, and scatter plots. In the guidance document, the following statistical performance values are recommended:

- Unpaired (time and space) highest 8-hour prediction accuracy: 30-35 percent (plus/minus)
- Average absolute error in 8-hour peak prediction accuracy paired (time and space) values greater than 5.0 ppm: 20-35 percent
- Average absolute error in the predicted time of the 8-hour peak concentration, paired by station greater than 5.0 ppm: 2.0 hours.

The ranges above were derived from past model performance evaluations with varying densities of air quality and meteorological monitoring networks and corresponding variations in the quality and quantity of aerometric model input data. Since CO episodes correlate with meteorological parameters, there is also the possibility of examining model performance as functions of wind speed and temperature.

If, for any of the 10 episode days, statistical results are worse than the above ranges and graphical analyses also indicate poor model performance, then further analysis will be done to determine the reason for poor performance. Should further analysis be unable to improve model performance, the cooperating agencies in consultation with EPA may choose to discard the episode day.

I. Attainment and Maintenance Demonstrations

Once model performance is deemed to be satisfactory, the areawide model is run for each of 1993-96 episode days with adequate model performance. ***CO*** concentrations are also modeled at all selected intersections for each of thses episode days with CAL3QHC. Areawide and intersection modeling results are summed for each grid square containing an analyzed intersection.

Similar areawide modeling for the episode days is performed with projected emissions inventories. The modeling uses the inventory for 2000 to demonstrate attainment and inventories for 2005 and 2012 to demonstrate maintenance.

A 1998 base year inventory was developed for the intersections being analyzed. This inventory, which used traffic volumes and emissions factors for an average winter day, serves as the basis for traffic projections for attainment and maintenance years. Traffic projections are adjusted for day of the week and week of the month for each projected case. The traffic volumes are used in conjunction with the 5 p.m. episode day MOBILE5b emissions factors developed for the areawide modeling to calculate CO concentrations at the analyzed intersections.

Again, areawide and intersection modeling results are summed for each grid square containing an analyzed intersection. The resulting total CO concentration is compared with the NAAQS.

EPA guidance requires compliance with the CO NAAQS of 9 ppm in all grids of the modeling domain to demonstrate attainment and maintenance. The modeling demonstrates attainment and maintenance if the projected total CO concentration at all selected intersections does not exceed the NAAQS. Simulations with different control technologies may become necessary to show attainment and maintenance over the entire domain.

Appendix B. Monitoring

- Special Air Quality Studies

  The studies referenced in "Special Air Quality Studies" are available in repositories and upon request. For more information, please contact Judy Beitel at (360) 407-6878.

Special Air Quality Studies

Spokane has a long history of special studies. The following discussion provides an overview of the major studies. A listing of these and other studies is found at the end of this section.

Air Quality Saturation Studies. The Spokane County Air Pollution Control Authority (SCAPCA) finalized parts of the Dames & Moore Study from the 95-96 CO season. Data from this work and others was submitted to Ecology and the U.S. Environmental Protection Agency (EPA) for review. SCAPCA completed a study to determine if any other street canyons in the central business district (CBD) had the potential to show carbon monoxide (CO) levels as high as the intersection of Third Avenue & Washington Street. Ecology also ran a short study of the Third Avenue corridor using their mobile monitoring van. All of this data was given to the University of Washington National Research Center for Statistics and the Environment for analysis.

The general conclusion from the statistical analysis of all the saturation studies is that the Empire Ford site (Third & Washington) is a well-chosen monitoring site. It consistently has the largest measurements in the network. The Empire Ford site shows a similar pattern to the Hamilton Street site. Hence, the high concentrations at the Empire Ford site are not due to an inappropriate point source. The study also indicates that the highest downtown concentrations tend to be at the Empire Ford site. The site is not representative of downtown concentrations in general, but is convincingly representative of high downtown concentrations. There is no indication that any other downtown site has potential for higher values than the Empire Ford site at high CO days.

Micro-inventory. For the micro-inventory SCAPCA, with the cooperation of Washington Water Power and at least 60 percent of the businesses in the study area, obtained the highest natural gas usage by the businesses in a ten block area around the Third & Washington site. From this we calculated the CO emissions of stationary sources in the immediate area of the monitor. The only significant sources of CO in the area besides cars are heating systems, most of which are natural gas. The largest is the boilers at the Deaconess Steam Plant. A very conservative estimate of the total emissions from stationary sources in the area of the Third & Washington site is 26 pounds per day. This is only a fraction of the emission from cars.

To address concerns about the individual impacts of sources, two sources were modeled. First was the Deaconess Steam Plant, the largest in the area. It is estimated to have a maximum one-hour impact of 0.0046 parts per million (pprn) and a 24-hour average impact of 0.0019 ppm under worst case conditions. The next source modeled was the boiler at Empire Ford, which would be the closest to the monitor. It is estimated to have a one-hour impact of 0.009 ppm and a 24-hour average impact of 0.004 ppm. Neither of these concentrations would have much effect on the 9 ppm standard. The conclusion of the micro-inventory is that stationary sources have very little impact on the monitored results at Third & Washington.

Tracer gas study. Washington State University (WSU) conducted an SF_6 Tracer Gas Study in the area of Third & Washington. SF_6 is a gas not normally found in the air. It can be released at a known rate and measured very accurately. A total of 37 release experiments were done with different release points and weather conditions in an attempt to get a better understanding of what happens around the site.

Again, the conclusions were that local traffic generally has the greatest effect on concentrations. The local street-level source influence is at least 2.5 times greater than the freeway sources under most conditions. There is the potential for pollutant trapping in an area of restricted circulation. There is some type of flow effect when winds are out of the South. North and northeast wind give higher results on the north side of the street. The study was never able to sample under the exact conditions that lead to the exceedances at Third & Washington.

Traffic origin and destination study. The Spokane Regional Transportation Council (SRTC) issued a Summary of Findings to the 1996 External Origin and Destination Study on December 12, 1996. Of more interest is the "Evaluation of the Spokane County Emissions Testing Area" report revised on March 25, 1997, which used the data from the origin and destination study. It concluded that the current testing boundary captures 94 percent of the trips originating from the nonattainrnent area.

Model traffic patterns and emissions in the CBD. SRTC completed "Evaluation of Mobile Source Emissions in the Second and Third Avenue Corridor" on April 25, 1997. It recommended shorter signal cycles and signal optimization along the corridors and close monitoring of any changes to see that they did not cause problems elsewhere in the system.

Below is a list of documents that contain most of the studies and analysis used to define Spokane's air quality:

1. Carbon Monoxide Study, Spokane, Washington, Executive Summary, November 21 - December 19, 1980, U.S. Environmental Protection Agency (EPA) 91019-81-083, Jon W. Schweiss.

2. Carbon Monoxide Study, Spokane, Washington, January 9 – March 1, 1984, Executive Summary, Eastern Washington University, Malcolm Droege.

3. Spokane Carbon Monoxide Study, December 5, 1988 to February 24, 1989, Air Monitoring and Analysis Section, EPA, Region 10, John C. Palmer and Jon W, Schwiess (June 1990).

4. Spokane Metropolitan Area Carbon Monoxide Saturation Study, December 7, 1995 to March 8, 1996, Dames & Moore.

5. CO Saturation Study of Spokane CBD, February 5,1997 to March 19,1997, SCAPCA, Ronald J. Edgar.

6. Spokane Carbon Monoxide Study (Mobile Monitoring), February 6, 1997, Ecology, Bob Miller.

7. Carbon Monoxide Saturation Study in the Spokane Area, November 24, 1997 to January 15, 1998, SCAPCA, Ronald J Edgar.

8. Analysis of Spokane CO Data, July 1, 1997, National Research Center for Statistics and the Environment, Peter Guttorp.

9. 1994-97 Carbon Monoxide Monitor Correlation Analysis, February 26, 1998, SRTC, Pam Tsuchida.

10. 1996 External Origin and Destination Study, Summary of Findings, SRTC, December 12, 1996.

11. Carbon Monoxide Meteorological Analysis for the Spokane Area, September 1998, SRTC.

12. Evaluation of Mobile Source Emissions in the Second and Third Avenue Corridor, April 25, 1997, SRTC.

13. SF6 Tracer Gas Study of the Empire Ford Carbon Monoxide Site in Spokane, Dr. Dennis Finn, December, 1997, WSU.

14. Survey and Analysis of Natural Gas Heating and Its Impacts in the Area of the Empire Ford Monitoring Site, June 1997, SCAPCA, April Westby.

15. Exceptional Event Request for November 1993 Carbon Monoxide Exceedances Spokane, Washington, August 1994, Ecology, Gary Idleburg.

Appendix C. Emission Inventories

- August 13, 1999, letter from Ecology to EPA transmitting *Inventory Preparation Plan, Spokane Carbon Monoxide Nonattainment Area* and *Quality Assurance Plan, Spokane Carbon Monoxide Nonattainment Area*

- *Inventory Preparation Plan, Spokane Carbon Monoxide Nonattainment Area* and *Quality Assurance Plan, Spokane Carbon Monoxide Nonattainment Area*

- January 12,2000, response fi-om EPA to Ecology on *Inventory Preparation Plan* and *Quality Assurance Plan*

- March 12,2000, response from Ecology to EPA including *Addendum to the Inventory Preparation Plan* and *the Quality Assurance Plan*

- April 27,2000, EPA approval of *Inventory Preparation Plan* and *Quality Assurance Plan*

- *Spokane Carbon Monoxide Nonattainment Area Emission Inventories* (March 2000)

Sally

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

P.O. Box 47600 • Olympia, Washington 98504-7600
(360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

August 13,1999

Joan Cabreza (OAQ-107)
U.S. Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Dear M U ~

This letter transmits both the ***Inventory Preparation Plan, Spokane Carbon Monoxide Nonattainment Area*** and the ***Quality Assurance Plan, Spokane Carbon Monoxide Nonattainment Area.*** These plans cover the inventories that Washington State Department of Ecology, Spokane County Air Pollution Control Authority, and Spokane Regional Transportation Council are using for Spokane's serious attainment plan and maintenance plan. The previously submitted 1996 periodic emission inventory will serve as the base-year inventory.

It is our understanding that EPA requires inventory preparation and quality assurance plans for approval of SIP inventories. Should you have any questions about the enclosed plans or the 1996 periodic emission inventory, please contact Sally Otterson at (360) 407-6806. Feel free to contact me at (360) 407-6874 if you have questions about Spokane SIP planning.

Sincerely,

Doug Schneider

Douglas L. Schneider
Senior SIP Planner

DLS:cp
Enclosures

cc: Dan Johnson, Ecology
Eric Skelton, SCAPCA
Glenn Miles, SRTC

Inventory Preparation Plan
Spokane Carbon Monoxide Nonattainrnent Area

Purpose of Plan

This plan outlines the procedures and data sources that will be used to develop emissions inventories for the 1) attainment plan and 2) maintenance plan for Spokane's carbon monoxide (CO) nonattainment area.

Background

Spokane's CO nonattainment area was declared "serious" on March 12,1998. Prior to this the area had been classified "moderate" with a design value greater than 12.7 parts per million (ppm). A base year 1990 inventory and 1995 attainment projection were submitted to EPA in 1992. Periodic update inventories representing base years 1993 and 1996 were submitted in 1995 and 1998, respectively.

Although declared serious due to the failure to meet the 1995 attainment date, Spokane currently meets the air quality requirements to request redesignation to attainment. The state of Washington plans to request redesignation to attainment and submit the required maintenance plan shortly after the serious area attainment plan.

Plan Information Sources

This inventory preparation plan (IPP) draws upon example plans in <u>Emission Inventory Requirements for Carbon Monoxide State Implementation Plans</u>, EPA-45014-91-011, March 1991, topics from the Inventory Preparation Process outlined in the June 4-6,1991 EPA manual <u>Workshop for Implementation of Clean Air Act Provisions Relating to Ozone and Carbon Monoxide Emission Inventories</u>, and past experiences with 1990 base year, 1995 projection, and 1993 and 1996 periodic update inventories.

Inventories to be Developed

Inventories that will be developed are listed in the table below. Plans are designated as either "A" for attainment plan or " M for maintenance plan.

Plan	Inventory Type	Year	Point Srce Emissions	Spatial	Temporal
A	base yr	1996	actual	NAA	typical CO day and annual
A	base yr modeling	1993-99	actual	1-km grids	hourly for episode days
A	Projection	2000	allowable	NAA	typical CO day and annual
A	proj. modeling	2000	allowable	1-km grids	hourly for episode days
M	Attainment	1997	actual	NAA	typical CO day and annual
M	Projection	2005,2012	allowable	NAA	typical CO day and annual

M	proj. modeling	2005,2012	allowable	1-km grids	hourly for episode days

Base Year Inventory

The inventory effort will build upon inventories developed for the 1990 base year, and 1993 and 1996 periodic update inventories. Source categories required for consideration in preparing CO inventories per Emission Inventory Requirements for Carbon Monoxide State Implementation Plans (EPA-45014-91-011) are addressed in the appendix. Inventory methods and sources of information for each major source category are presented below.

Point Sources

For serious areas, point sources are defined as any stationary source having the potential to emit 50 tons per year, unless it has been determined that the NAA does not have significant stationary sources of CO. If it is determined that there are no significant stationary sources, then the cutoff level is 100 tons per year. A determination was made that there were no significant stationary sources of CO in the NAA;[1] therefore, the minimum cutoff level for point sources will be 100 tons per year. Point source emissions will be obtained from sources via the regular annual point source update.

Area Sources

Area sources include all stationary sources too small to be counted as point sources (< 100 tons potential to emit), and sources that individually are of short duration, but cover larger geographic areas. Emissions are typically estimated by multiplying the activity level by an emission factor in mass per activity. Information sources for individual categories are shown in the table below.

Category	Activity Level	Emission Factors
prescribed burning	DNR permit records	USFS consumption and emissions models developed for the PNW
agric. Burning	SCAPCA permit records	AP42
other open burning	Outdoor burning survey by the Puget Sound Air Pollution Control Agency, population	AP42
wildfires and structure fires	SCAPCA fire dept. survey, 1991	AP42
non-wood fuel use	state energy use (from Energy Info. Admin), WA Water Power natural gas usage records, population, employment	AP42
Woodstoves	1990 Bonneville Power Admin woodstove	AP42

[1] Letter to Eric P. Skelton, Director of the Spokane County Air Pollution Control Authority from Anita Frankel, Director, Office of Air Quality, EPA Region 10, dated June 11, 1996.

	survey (statewide and Spokane County), Dept. of Revenue new sales records, population	

Nonroad Mobile Sources

EPA compiled an emissions inventory of some types of nonroad mobile sources for the 1990 base year. Spokane was one of the areas specifically inventoried. The EPA inventory will be adjusted to 1996 based on appropriate surrogates for each source category (see table below).

Two additional categories will be inventoried: aircraft and locomotives. Aircraft emissions will be estimated using airport landing and takeoff data for individual aircraft types and engine-specific emission factors available in Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources (EPA-45014181-026d revised 1992). Locomotive emissions were estimated in the 1990 base year inventory using recommended EPA methods. Because the methods were somewhat involved and resulting emissions were less than lpercent of the total inventory, 1996 emissions will be estimated by adjusting the 1990 emissions based on 1996 statewide railroad diesel use available from the Energy Information Administration.

Nonroad Mobile Sources

Equipment	Surrogate Activity Indi at
agricultural	minimal presence in area
airport service	air carrier landing/takeoff oyerations
construction	employment in SIC 16
commercial	Population
industrial	employment in SICs 10-14, 20-39, 50-51
logging	not present in area
lawn and garden	Poyulation
recreational	Population
boats	boat registrations

Onroad Mobile Sources

The Spokane Regional Transportation Council (SRTC) maintains detailed traffic volume information over Spokane's roadway network. Link-specific volumes and speeds will be combined with emission factors calculated using an approved EPA model. There is a small chance that COLDCOM5 would be available to generate emission factors. COLDCOM5 incorporates the new deterioration rates that will be used in the next version of the MOBILE model and also updates the credit assigned to oxygenated fuel. It is more likely that one of the current EPA models, MOBILE5b or MOBILE5ah, will be used to generate emission factors (for CO, both versions 5b and 5ah should yield the same results). Input parameters including temperatures, inspection and maintenance programs, vehicle operating modes, and fleet registration distribution will be tailored for the Spokane area.

Application of Rule Effectiveness/Rule Penetration

Rule effectiveness reflects the ability of a control device or regulation to achieve all the emissions reductions that could be achieved by fill compliance at all times. Where there is no control device or regulation, rule effectiveness does not apply. Rule penetration is a measure of the extent to which a regulation may cover emissions from a source category.

None of the point sources are controlled for CO; therefore, rule effectiveness does not apply. There are no regulations for CO emissions fiom area sources. The concept of rule effectiveness and penetration will be used to estimate illegal residential outdoor burning emissions, but per David Misenheimer (EPA 1992), rule effectiveness did not really apply to this source. Woodstove activity is regulated, but typical daily emissions will be calculated for a day when woodstove use is not prohibited.

Discussions of rule effectiveness and penetration are not normally considered for mobile sources, but the concept is used to evaluate the Inspection and Maintenance program for onroad mobile sources. The waiver rate and compliance rate inputs to the MOBILE model and survey information on vehicles registered outside of the testing area are used to discount the fill credit that is potentially available.

Base Year Modeling Inventory

Emissions estimates calculated for the base year inventory will be adjusted to reflect the expected hourly emissions on the individual modeling days. Hourly adjustment factors available in EPA modeling guidance, local transportation traffic count data, and other local data will be used to make the hourly allocations. The mobile source emission factors will be adjusted to account for temperature, year, and vehicle miles traveled for the individual modeling days. Woodstove emissions will be adjusted to account for annual population estimates and the number of heating degree days recorded for each modeling day. Point source estimates will be obtained fiom annual point source inventories. The importance of smaller sources of CO will be determined and modeled as appropriate.

Maintenance Plan Attainment Year Inventory

Attainment with the CO standard was achieved in 1997; therefore, 1997 will be inventoried as the attainment year in the maintenance plan. Emissions for 1997 will be based a combination of actual 1997 emissions and projected emissions fiom 1996. It is anticipated that point source emissions will be actual 1997 emissions and area/mobile source emissions will be projections fiom 1996.

Attainment and Maintenance Plan Projected Inventories

Emissions will be projected to 2000,2005, and 2012. Point source projections for 2000,2005, and 2012 will be based upon allowable emissions. Allowable emissions will be estimated based on permit limits or maximum production estimates.

Projections for all other sources will be based on expected actual emissions. Area and nonroad source projections will be made by projecting the appropriate surrogate values, such as population and employment, to the evaluation years. Any controls expected to be in place in future years will be evaluated and applied as appropriate. Onroad mobile sources will be projected into the future using a combination of expected growth in miles traveled and MOBILE (or COLDCOMS) model emission rates calculated using parameter settings that reflect conditions expected in the projection years.

Attainment and Maintenance Plan Projected Modeling Inventories

Emissions will be projected to 2000,2005, and 2012 for each episode day's meteorological conditions. Point source projections for the attainment year will be based upon allowable emissions. Allowable emissions will be estimated based on permit limits or maximum production estimates.

Projections for all other sources will be based on expected actual emissions under the episode days' hourly temperature profiles. Projections will be made according to the procedure detailed above under the projection inventory. Adjustments for temperature will be made as outlined above under the base year modeling inventory.

Responsibility

The inventory process will be a joint effort between the Spokane Air Pollution Control Authority (SCAPCA), Spokane Regional Transportation Council (SRTC), and the Washington State Department of Ecology (Ecology). A brief list of inventory responsibilities follows:

SCAPCA will inventory some of the open burning sources, accidental fires, and will compile point source allowable emissions for the attainment demonstration. SCAPCA will provide written and electronic documentation to Ecology in preparation for submission to EPA.

SRTC will inventory onroad mobile sources using a link-based transportation model (TMODEL2) for Spokane and emission rates generated with MOBILE or COLDCOMS. SRTC will provide nonattainment area estimates of population, employment, and housing to assist in inventory development and spatial allocation. SRTC will compile all inventory data into one-kilometer grids for the attainment demonstration using information from their GIS system and fi-om specific spatial information supplied by Ecology and SCAPCA. SRTC will provide written and electronic documentation to Ecology in preparation for submission to EPA.

Ecology will inventory area source fuel use, some open burning sources, all nonroad mobile sources, and will compile point source emissions from information supplied by SCAPCA and Ecology's Industrial Section. Ecology will supply input parameters to SRTC for the MOBILE or COLDCOMS model for mobile source emissions modeling. Ecology will examine the temperature profile and three-month season derived in the original 1990 base year inventory to see if any changes are appropriate. Ecology will be responsible for compilation and submission of final inventory documentation.

All three agencies will participate in inventory review and quality assurance activities. More specific information on quality assurance may be found in the quality assurance plan.

Documentation

Written

Written documentation specifying inventory methodology and information sources will be provided. Emissions summaries will be presented in tabular and graphical forms.

Electronic

EPA's preferred emissions inventory database is the National Trends Emissions (NET) database. Any required data will be provided in Excel using the NET format.

Emission Inventory Requirements for Carbon Monoxide State Implementation Plans (EPA-450/4-91-011) lists source categories that must be considered when preparing CO inventories. Each category must be inventoried or include a justification as to why it was not included. The source categories and required information are listed below. Sources marked with an 'X' will be included in the inventory. Sources marked with 'NA' are not present in the nonattainment area. Sources marked with an 'I' emit at very insignificant levels and were not inventoried. Several sources inventoried do not appear on the EPA list; they are noted in the appropriate sections.

Point Source Categories (> 100 tons)

External Fuel Combustion
- Utility boilers _NA_
- Industrial boilers _X_
- Commercial/institutional boilers _NA_
- Other external fuel combustion _NA_

Stationary Internal Combustion
- Reciprocating engines _NA_
- Gas turbines _NA_

Waste Disposal
- Municipal Waste _X_
- Combustion _NA_
- Refuse-derived fuel _X_
- Mass burn _NA_
- Co-fired _NA_
- Other _NA_

Industrial Processes
- Iron and Steel Manufacture
  - all processes _NA_
- Petroleum Refineries _NA_
- Mineral Products
  - all processes _NA_

Sources Not on EPA List
- Primary Aluminum Production _X_
- Secondary Aluminum Production _X

Area Source Categories

Stationary Source Fuel Combustion
- Electric utility _NA_
- Industrial _X_
- Commercial/institutional _X_
- Residential _X_

Waste Disposal, Treatment and Recovery
- On-Site Incineration
  - Industrial on-site _X_
  - Comml/Instit On-site _X_
  - Residential on-site _X_
- Open Burning
  - Industrial _I_
  - Commercial/Institutional _I_
  - Residential _X_

Miscellaneous Area Sources
- Other Combustion
  - Forest wildfires _X_
  - Managed burning _X_
  - Charcoal grilling _I_
  - Structure fires _X_
  - Firefighting training _I_
  - Aircraft/rocket/testing _I_

Sources Not on EPA List
- Commercial Equipment _X_
- Airport Service Equipment _X_

Mobile Source Categories

On-Road Vehicles
- Light duty gasoline vehicles _X_
- Light duty gasoline trucks 1 _X
- Light duty gasoline trucks 2 _X_
- Heavy duty gasoline vehicles _X_
- Motorcycles _X_
- Light duty diesel vehicles _X_
- Light duty diesel trucks _X_
- Heavy duty diesel vehicles _X_

Non-Road Vehicle Gasoline
- Recreational vehicles _X_
- Construction equipment _X_
- Industrial/commercial eq. _X_

Lawn and garden equipment _X_
Farm equipment _NA_

Non-Road Vehicle Diesel

Construction equipment _X_
Industrial / commercial equipment _X_
Farm equipment _NA_

Aircraft

Military aircraft _I_
Commercial aircraft _X_
Civil aircraft _X_
Unpaved airstrips _NA_

Marine Vessels

Coal _NA_
Diesel fuel _X_
Residual oil _NA_
Gasoline _X_

Railroads

Coal _NA_
Diesel _X_

Sources Not on EPA List

Commercial Equipment _X_
Airport Service Equipment _X_

Quality Assurance Plan
Spokane CO Nonattainrnent Area

Policy Statement / Purpose of Quality Assurance Plan

It is not possible to characterize pollutant emissions from all sources at all times. Differences in a source's day-to-day operation and effects of meteorology may impact the amount of pollution generated by an individual activity. Emission inventories are, therefore, *estimates* of pollutant discharges made using available tools and technology for emissions assessment within resource constraints. It is important that the limitations of emissions estimates be understood in order to avoid misuse of data. It is the purpose of this plan to identify quality assurance activities that will 1) ensure a comprehensive, good-quality emission inventory, and 2) qualify the resulting estimates. To this end, resources have been allocated both to write and to carry out the requirements of this plan.

Information Sources

A major source of information for this plan was the Emission Inventory Improvement Program (EIIP). The EIIP is sponsored by State and Territorial Air Pollution Program Administrators (STAPPA)/Association of Local Air Pollution Control Officials (ALAPCO) and EPA. It was formed to enhance the quality of emission inventories. Another source of information was inventory preparation/quality assurance plans prepared for carbon monoxide and ozone nonattainment areas in Washington, including the 1990 base year, and 1993 and 1996 periodic Spokane CO inventory efforts.

Responsibilities

Ron Edgar (SCAPCA)
- inventory some outdoor burning sources, accidental fires, and point sources
- review final inventory

SRTC staff
- inventory onroad mobile sources
- provide population and employment for the NAA and county
- gridding of inventory data
- review final inventory

Sally Otterson (Ecology)
- Overall Quality Assurance Coordinator
- inventory some outdoor burning sources, area sources, and nonroad mobile sources, develop MOBILES parameters
- review final inventdry, perform and document quality assurance checks for onroad
- write final inventory and quality assurance reports

Bernard Brady (Ecology)

- perform and document quality assurance checks

Data Quality Objectives

Data quality objectives ensure that inventory quality is suitable for a State Implementation Plan (SIP) inventory. The EIIP classifies SIP inventories as "level 11" as they provide supportive data for decision making. The objectives address accuracy (uncertainty), completeness, and comparability of data. The goal of the inventory process is to provide the best possible inventory under the given time and resource constraints. A brief discussion of the data quality objectives is given below.

Accuracy: All estimates must be calculated and documented using accepted methods. Individual source requirements and availability of data and resources will affect estimation method selection.

Completeness: Completeness is addressed by ensuring that all source categories are included in the inventory, and that all information required to estimate emissions is present.

Comparability: Data will be compared to the 1993 periodic update inventory and the 1990 base year inventory.

Quality Assurance Checks

Several quality assurance checks will be employed to address the data quality objectives: reality/peer review checks, sample calculations, sensitivity analyses, and standard range checks. For each type of check, a definition, objective, data quality objective addressed, check procedure, assessment of limitations, and person(s) doing the check will be given. The product of the quality checking process will be a completed summary of items checked, summary of results, and recommended follow-up action.

Reality Check/Peer Review Check

Definition: Independent review by a knowledgeable expert.
Benefit: Ensure data, assumptions, and procedures are reasonable.
Objective(s) Addressed: accuracy, completeness, comparability.
Check(s): Reasonableness of methods, assumptions, and emissions estimates will be assessed. This will be accomplished by 1) comparing data sources used in the final inventory to those specified in the Inventory Preparation Plan, 2) reliance on reviewer expertise, and 3) comparison of emissions estimates to other approved inventory efforts, particularly the 1993 periodic update.
Limitations: None
Who: Bernard Brady - lead (Sally Otterson, Ron Edgar, Eve Nelson and other SRTC staff).

Sample Calculations

Definition: Verification of values by replicating calculations.
Benefit: Ensure calculations are done correctly.
Objective(s) Addressed: accuracy

Check(s): Emissions calculations will be duplicated to check the accuracy of the arithmetic and, therefore, the resulting emissions estimate. Priority will be given to those categories identified as the largest CO contributors.
Limitations: Estimates calculated using computer models such as MOBILE will be checked using simplified assumptions to arrive at a "ballpark" value to use as a comparison to the actual calculated value.
Who: Bernard Brady – lead (Sally Otterson, Ron Edgar, Eve Nelson and other SRTC staff).

Sensitivity Analysis

Definition: Systematic study of how changes in parameters affect data.
Benefit: Identify the parameters that have the greatest effect on data.
Objective(s) Addressed: generally addresses all objectives.
Check(s): A sensitivity analyses in the form of a source category CO emissions ranking will be performed. The ranking will help determine where efforts should (or should not) be concentrated.
Limitations: None
Who: Sally Otterson

Standard Range Checks

Standard range checks address the data quality objective of comparability. Data will be compared to the 1993 periodic update inventory source by source. Any discrepancies (data outliers) greater than 10 percent involving sources that made up greater than 2 percent of either the 1993 or the 1996 daily inventories will be investigated and either corrected (see Corrective Acion Plan below) or justified. General source category percent contributions will be compared to the approved 1990 base year inventory, and any large discrepancies will be investigated and explained.

Corrective Action Plan

Corrective and follow-up actions identified during the quality checking process will be noted and referred to the appropriate staff. Both the corrective actions identified and results of actions taken in response will be documented and kept on file.

Quality Assurance Final Report

The final report will include discussions on inventory quality considerations for each major source category. It will summarize the results of the quality checking procedures. The report will include an assessment of the limitations of the inventory data.

External Audits

The state is willing to be audited by EPA, and make changes to this quality assurance plan if warranted.

Data Management

Written documentation specifying inventory methodology and information sources will be provided to EPA. Emissions summaries will be presented in tabular and graphical forms. Any required electronic information will be provided to EPA in Excel format consistent with the National Trends Emissions (NET) database. Any paper or computer files used to assist in emissions calculations and quality checking will be kept on file.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

January 12,2000

Reply To
Attn Of: OAQ-107

Douglas Schneider
Senior SIP Planner
Washington Department of Ecology
Box 47600
Olympia, WA 98504-7600

Dear Mr. Schneider:

I am sorry to have been somewhat slow in responding to your submission of the revised Inventory Preparation Plan (IPP) and Quality Assurance Plan (QAP) for the Spokane carbon monoxide nonattainment area. I have reviewed the IPP and QAP, and they appear to have addressed most of our previous comments. If you can provide us some additional information as an addendum (a letter is fine, there is no need to re-do the plans), we should be able to approve them quickly.

Please provide the following. additional information:

- The IPP does not indicate data will be calculated for average CO-season days. Please co m that temporal coverage will include annual and average CO-season days.

- Please describe extent of the modeling area. Does it coincide with the nonattainment area boundaries, or is it only a portion of the area?

- There seems to be a conflict between the cover letter and the IPP: the cover letter states the 1996 PEI will be used as the base year inventory, while the plan states the inventory will "build upon" efforts of the 1996 PEI. Which is correct? (We understood at the time of PEI submittal, that the latter was the case. If so, please specify what additional information will be included.)

- The QA plan does not include a fourth Data Quality Objective that is normally considered in an inventory (representativeness). Was this omission intentional (and if so, why?), or was it just an oversight?

- What procedures will be used to identify and deal with any missing data?

I also have a couple of comments and suggestions for future IPP/QAP submissions:

Timing. Luckily, there do not seem to be any major issues with the IPP or QA plan. But ideally, an IPP/QAP should be prepared and approved prior to inventory development, so that if a problem is found in the inventory procedure or quality assurance checks, there is an opportunity to make appropriate changes before the inventory is developed and/or before modeling is done, to avoid need for re-work.

Detail. The QAP appears to touch on all of the major areas, but it is a little sketchy on actual details such as defining actual points in the process where QA checks will occur. Defining the procedures in greater detail up-front for future inventories would be helpful to both Ecology staff (particularly if new staff become involved) and EPA. I am aware that a QA plan is currently nearing completion (at least point sources), which addresses QA in greater detail, and perhaps this can be referenced in future documents.

Forms. Some other states also have developed a set of forms to use in QA work. If you have such forms, it would be useful to append them to the QA plan. If you do not have any, developing some would probably be very helpful to QA staff. If you are interested in seeing what other states have developed, let me know and I can send you some examples of what is being used elsewhere.

QA Coordinator. It is usually preferable (but not required) that the Quality Assurance' Coordinator be an outside person not associated with inventory preparation, although quality control should be done by someone preparing the inventory.

Confidence evaluation. Use of the Data Attribute rating system (DARS; discussed in the **EIIP** Volume **6,** appendix F) or some other system to evaluate quality and arrive at an overall confidence rating for an inventory is a good idea (although not required). You might want to consider trying this to get an idea of where inventory data is the most questionable, and where you may want to augment/complement the existing inventory at a future time. (There is also free software available on the internet for this.)

We look forward to receiving your addendum, and we promise to process it expeditiously! If you have any questions, please feel free to give me a call at (206) 553-8505.

Sincerely,

for Renly Ramos

Joan Cabreza
Environmental Scientist

g\oaq\spokane final ipp-qa.wpd

Bob S
Doug

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

P.O. Box 47600 • Olympia, Washington 98504-7600
(360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

March 21,2000

Joan Cabreza (OAQ-107)
U.S. EPA, Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Dear ~~Ms. Cabreza~~ Joan:

Your January 12,2000, letter specified information that EPA needed to approve the Inventory Preparation Plan (IPP) and the Quality Assurance (QA) Plan for the Spokane carbon monoxide nonattainment area. The enclosed Addendum to the IPP and the QA Plan is our response.

Thank you for the comments and suggestions in your letter on future submittals. We agree with your statement that all elements of the IPP and the QA Plan should be worked out in the earliest stages of SIP development. We look forward to putting this into practice during future SIP efforts.

Because of the observations in your letter on QA plans, it seems appropriate to provide our view of SIP QA Plan Guidance and its relation to recent inventories. We submitted the first CO State Implementation Plan (SIP) inventories for Spokane to EPA in 1992. The first periodic update inventory came in 1995. QA plans for those inventories followed the most current EPA guidance (dating from the late 1980s). In the late 1990s, the Emissions Inventory Improvement Program (a joint program of STAPPA, ALAPCO and EPA) issued additional QA guidance. We attempted to incorporate the new QA guidance into the plans for the 1996 periodic emission inventory and the new attainment plan inventories. The lack of specificity about which elements of old and new guidance needed to be addressed in the inventories provided the opportunity for both flexibility and confusion. In the'end, more items were addressed during the QA process than were specified in the plan. We agree the SIP inventory QA plan could be improved.

Ms. Joan Cabreza
March 21,2000
Page two

We look forward to quick approval of the IPP and the QA Plan. Should you have any additional questions, please contact Sally Otterson at (360) 407-6806.

Sincerely,

Doug Schneider

Douglas L. Schneider
Senior SIP Planner

DLS:cp
Enclosure

cc: Roger Dovel, Ecology
Eric Skelton, Spokane County Air Pollution Control Authority
Glenn Miles, Spokane Regional Transportation Council

Addendum to the Inventory Preparation Plan and the Quality Assurance Plan

Spokane Carbon Monoxide (CO) Nonattainment Area

March 17,2000

Response to Environmental Protection Agency's (EPA) Comments on the Inventory Preparation Plan and the Quality Assurance Plan

In response to the January 12,2000, request from Joan Cabreza of EPA Region 10 to Doug Schneider of the Department of Ecology (Ecology), an addendum to the inventory preparation and quality assurance plans for the Spokane carbon monoxide nonattainment area has been developed. The information is provided by pairing the EPA comment *(in Italics)* with Ecology's response.

The Inventory Preparation Plan (IPP) does not indicate data will be calculated for average CO-season days. Please confirm that temporal coverage will include annual and average CO-season days.

Emissions for average CO-season days will be calculated. This was referred to as "typical day" in the column titled "Temporal" of the table on page 2 of the inventory preparation plan.

Please describe extent of the modeling area. Does it coincide with the nonattainment area boundaries, or is it only a portion of the area?

The modeling domain encompasses the entire nonattainment area. **A** map of the modeling domain may be found in the Systems Applications International (SAI) Urban Airshed Modeling (UAM) report.

There seems to be a conflict between the cover letter and the IPP: the cover letter states the 1996 Periodic Emission Inventory (PEI) will be used as the base year inventory, while the plan states the inventorywill "build upon" efforts of the 1996 PEI. Which is correct? (We understood at the time of PEI submittal, that the latter was the case. If so, please specify what additional information will be included.)

The 1996 base year inventory will be nearly identical to the 1996 periodic inventory. Minor changes will be made to the on-road mobile source emissions estimates, and changes will be made to the presentation format of the documentation.

The QA plan does not include a fourth Data Quality Objective that is normally considered in an inventory (representativeness). Was this omission intentional (and if so, why?), or was it just an oversight?

Representativeness was not specifically addressed in the plan, more by oversight than by design. Representativeness as a data quality objective came from new QA guidance issued by the Emissions Inventory Improvement Program (please see comments under "State Implementation Plan (SIP) QA Plan Guidance Comments" below). Very briefly, point sources are representative of the area since they are located in the area and most of the emissions were estimated through material balance. On-road mobile sources are representative since an area-specific Geographic Information System (GIs)-based traffic model will be used to derive vehicle miles traveled (VMT), and the MOBILE model will be tailored as much as possible to reflect local conditions. Woodstoves are fairly representative since activity levels will be based on information collected from a survey of Spokane households; however, the emission factors will be national factors. Non-road sources will be based on an EPA study done specifically for Spokane.

What procedures will be used to identify and deal with any missing data?

Missing data are identified by the inability to calculate emissions and supply data necessary for modeling and clear documentation. For point sources, further review of the source files, and if necessary, contact with facility personnel are procedures used to obtain missing data elements. For area, non-road and on-road sources, a reasonable effort will be made to acquire any missing data. If this is unsuccessful, estimates will be made based on past years' data or default information contained in EPA documents and models. Sources of all data will be documented.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

APR 27 2000

Reply To
Attn Of: OAQ-107

Mr. Douglas L. Schneider
Senior SIP Planner
Washington Department of Ecology
Post Office Box 47600
Olympia, Washington 98504-7600

Dear Mr. Schneider:

We have received your letter dated March 21, 2000, providing clarification for Spokane's Carbon Monoxide Nonattainment Area Inventory Preparation Plan (IPP). Your response addresses the concerns raised in EPA's letter dated January 12, 2000, therefore, the IPP and Quality Assurance Plan's are approved.

After reviewing your IPP again, the EPA's Regional mobile modeler suggests you consider using MOBILE 5b or MOBILECO for the Onroad Mobile Sources.

Thank you for your timely response and should you have any questions, please contact me at (206) 553-8505.

Sincerely,

Katherine M. Holt

Katherine M. Holt
Environmental Protection Specialist

KMH:cb

g\oaq\spokane.wpd

Spokane Carbon Monoxide Nonattainment Area
Attainment Plan Emission Inventories

Prepared by
Spokane County Air Pollution Control Authority
Spokane Regional Transportation Council
Washington State Department of Ecology Air Quality Program

March 2000

Table of Contents

Figures

Tables

Tables (continued)

Introduction

Background

The Spokane carbon monoxide nonattainment area has a design value of 13.8 parts per million (ppm), and was originally classified as Moderate+ (>12.7 ppm). A base year 1990 inventory and 1995 attainment projection were submitted to EPA in 1992. Periodic update inventories representing base years 1993 and 1996 were submitted in 1995 and 1998, respectively. In spite of ongoing efforts, Spokane failed to meet the CO standards by 1995. Failure to attain the standard resulted in reclassification to Serious in April 1998. Serious areas must attain the standard by Dec. 31,2000.

Inventories Prepared

Four types of inventories are required for the Spokane Serious area: base year, periodic, modeling, and onroad mobile source projection. The base year and periodic inventories are estimates of actual emissions representative of a typical CO season day. A new base year inventory was constructed using 1996 as the base year, replacing the original 1990 inventory. As stated above, the 1996 periodic inventory was completed and submitted to EPA in September of 1998.

Modeling inventories are estimates of episode-specific emissions. They consist of actual emissions on selected base case days; and projections to the attainment year based on allowable emissions where they exist, and expected emissions projections where allowable emissions have not been established. Modeling inventories for ten base case days during 1993-96 were developed and projected to the year 2000.

The onroad mobile source projection is an inventory of expected emissions on a typical CO season day in the atttainment year 2000. The inventory will be used to set the emissions budget for conformity. For comparative purposes, typical daily emissions from other sources were also compiled. They were based on allowable emissions where they exist, and expected emissions projections where allowable emissions have not been established.

Inventory Planning

An Inventory Preparation Plan and Quality Assurance Plan were submitted to EPA in September 1999. Both plans were utilized during preparation and finalization of the inventories.

A complete list of source categories required for a CO inventory was included as an appendix to the Inventory Preparation Plan (Sept. 1999). Many sources on the list either did not exist in the nonattainment area, or were only present at very insignificant levels. These sources were not included in the inventory.

Report Contents

This report presents emissions summaries and the methods and information sources used to develop the required inventories. Appendices include information on population, employment and vehicle miles traveled, and a report on quality assurance activities.

Major Contributors

This report resulted from a cooperative effort among the Spokane County Air Pollution Control Authority, Spokane Regional Transportation Council, and Department of Ecology. Many people and agencies contributed information essential to the completion of this report. Special thanks goes to staff at Kaiser Aluminum and Chemical, Kaiser Trentwood, and Waste to Energy for quickly providing specific information required for modeling.

General Information

Abbreviations Used Throughout the Inventory

NAA	nonattainment area
EPA	Environmental Protection Agency
Ecology	Washington State Department of Ecology
SCAPCA	Spokane County Air Pollution Control Authority. This is the local air authority having jurisdiction over all sources except pulp mills and aluminum smelters in Spokane County.
DOE-IS	Department of Ecology's Industrial Section. This section has jurisdiction over all pulp mills and aluminum smelters in Washington.
SRTC	Spokane Regional Transportation Council. This is the local planning agency for Spokane County.
CO	Carbon monoxide
tpy	tons per year
ppd	seasonal pounds per day
g/sec	grams per second

References

References are listed at the end of the document with two exceptions: the 1990 Base Year Carbon Monoxide Emissions Inventory and the 1993 Periodic Update Inventory. These inventories were used as the basis for many of the source categories, and are referenced within the text of all applicable source categories.

Electronic Data Availability

All emissions information will be provided to EPA in an electronic format on request. Base year point source emissions were entered into the Aerometric Information Retrieval Systems (AIRS).

Contact Person

Any questions about the information contained in this report may be directed to Sally Otterson, Air Quality Program, Department of Ecology (360)-407-6806 (e-mail sott461@ecy.wa.gov).

Temperature/Season Determination

The 1990 base year inventory included documentation on determination of the three-month carbon monoxide season, and maximum and minimum daily temperatures to be used in mobile source modeling. The EPA procedure for making the determination was followed and consisted of two steps: 1) determine the three consecutive months with the greatest frequency of exceedances using the past three years of air monitoring data (1988-90), and 2) choose the ten highest exceedances from the months selected in step 1, and calculate average maximum and minimum temperatures from the ten days' individual maximum and minimum temperatures.

The procedure resulted in carbon monoxide season being defined as October through December, with maximum temperature 38 °F and minimum 24 °F. The temperatures were nearly identical to the long-term average winter (defined as coldest three months – Dec, Jan, Feb) temperatures for Spokane, 25-36 °F. With this latest inventory effort, the season-temperature determination was revisited. The past three years of data (1994-1996) yielded a different three-month season, and a somewhat warmer temperature profile (November to January with maximum temperature 43 °F and minimum 24 °F).

It was decided to take a more comprehensive look at the season-temperature determination. Carbon monoxide levels rise during periods of air stagnation. Table 1 gives an indication of the frequency of 8-hr exceedances* from 1988-1996. It is clear that exceedances are most likely to occur from October to February, and that carbon monoxide season cannot be limited to a three-month period.

Table 1: Carbon Monoxide Exceedances. 1988-1996

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
15	23	4	1	1	1	0	0	7	16	20	28

* not counted here according to normal guidance: only one exceedance counted per day, even if more than one occurred; if 8-hr exceedance crossed a day boundary and hourly values greater than-or equal to 9.5 occurred on both days, both days were counted.

In compiling the inventory, this broader view of carbon monoxide season was considered by expanding the CO season to October through February. Practically, this resulted in little change from the 1990 and 1993 inventories since the season was still basically "winter." Sources that are strictly controlled to a small temporal window, such as residential open burning, were given special consideration and may be found in the detailed inventory text.

No changes were made to the mobile source temperature profile. The new, warmer temperatures calculated from the 1994-1996 data resulted in mobile source emissions about 4% lower than the 1990 inventory temperatures. Because of 1) the sensitivity of the MOBILE model to temperature, 2) the large portion of the inventory that mobile sources occupy, and 3) the similarity of the original profile with Spokane long-term average winter temperatures, it was judged prudent to retain the original temperature profile.

Emissions Summaries and Charts

Table 2: Base Year 1996 Emissions Summary

Category	tpy	ppd	%ppd
POINT SOURCES			
Point Sources	28,982	159,648	23
NONROAD MOBILE SOURCES			
Aircraft	904	4,451	1
Locomotives	151	826	0
Agricultural Equipment	0	0	0
Airport Service Equipment	294	1,609	0
Recreational Boats	1,798	287	0
Commercial Equipment	3,432	21,949	3
Construction Equipment	1,044	4,115	1
Industrial Equipment	991	6,336	1
Lawn and Garden Equip	8,497	21,030	3
Logging Equipment	0	0	0
Recreational Vehicles	460	2,148	0
STATIONARY AREA SOURCES			
Woodstoves & Fireplaces	13,490	120,704	17
Residential Non-wood Fuel	142	1,109	0
Commercial Fuel	66	522	0
small point	12	64	0
Industrial Fuel	62	397	0
small point	3	15	0
Commercial/Industrial Incineration	1	9	0
Trash Burning	146	798	0
Yard Waste Burning	108	15,482	2
Prescribed Burning	182	0	0
Wildfires	184	1,008	0
Structure Fires	125	685	0
ONROAD MOBILE SOURCES			
Onroad Mobile	*61,032	334,423	48
TOTAL ALL SOURCES	122,106	697,615	

* tons per year calculated as 365 days x CO ppd

Table 3: Projection Year 2000 Emissions Summary

Category	tpy	ppd	%ppd
POINT SOURCES			
Point Sources	34,365	188,301	28
NONROAD MOBILE SOURCES			
Aircraft	961	4,731	1
Locomotives	160	878	0
Agricultural Equipment	0	0	0
Airport Service Equipment	312	1,710	0
Recreational Boats	1,911	305	0
Commercial Equipment	3,648	23,328	3
Construction Equipment	1,055	4,160	1
Industrial Equipment	1,017	6,502	1
Lawn and Garden Equip	9,031	22,351	3
Recreational Vehicles	489	2,283	0
STATIONARY AREA SOURCES			
Woodstoves & Fireplaces	14,338	128,288	19
Residential Non-wood Fuel	151	1,179	0
Commercial Fuel	70	555	0
small point	13	68	0
Industrial Fuel	64	407	0
small point	3	15	0
Commercial/Industrial Incineration	1	9	0
Trash Burning	155	848	0
Yard Waste Burning	115	16,455	2
Prescribed Burning	0	0	0
Wildfires	196	1,071	0
Structure Fires	133	728	0
			0
ONROAD MOBILE SOURCES			
Onroad Mobile	*49,076	268,908	40
TOTAL ALL SOURCES	117,264	673,080	100

* tons per year calculated as 365 days x CO ppd

Figure 1: Base Year 1996 Daily Emissions

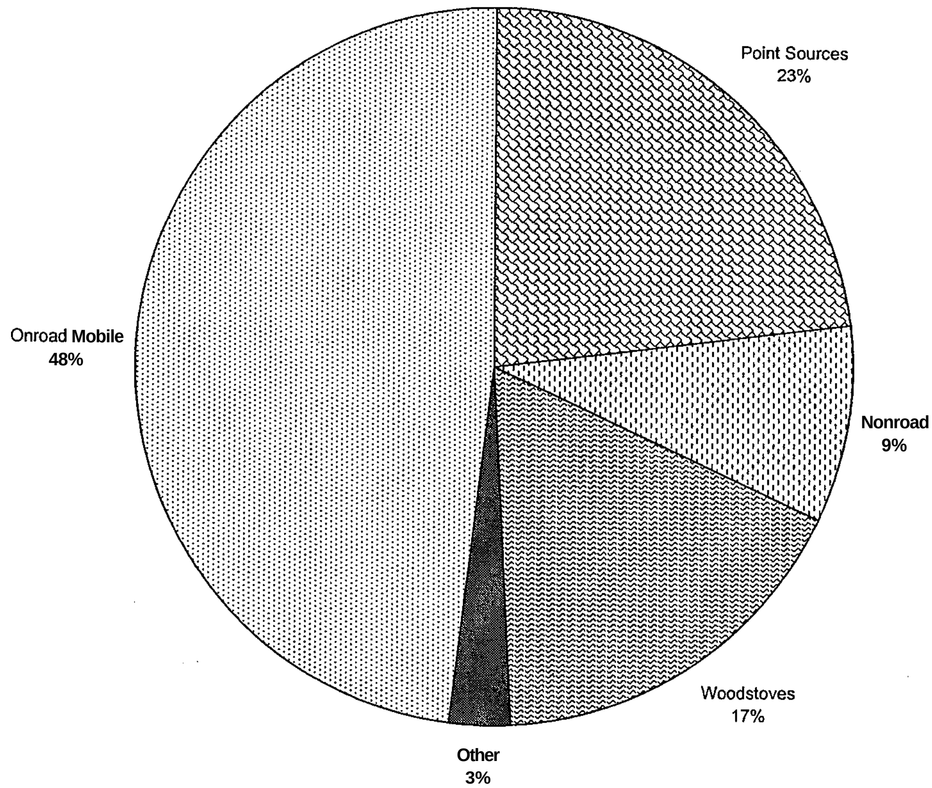
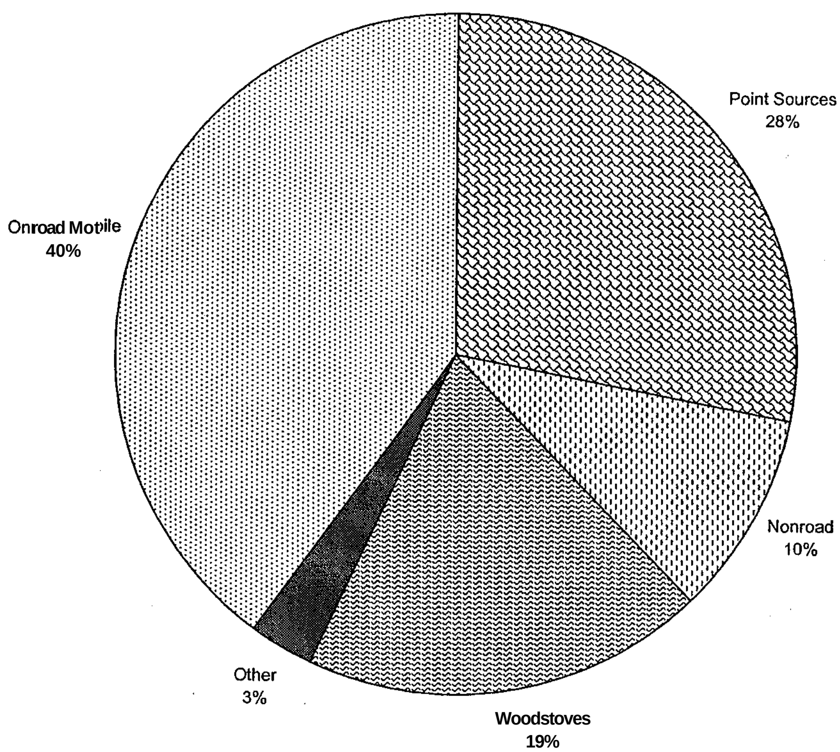


Figure 2: Projection Year 2000 Daily Emissions



Base Year 1996 Inventory

The base year inventory is an estimate of actual 1996 emissions representative of a typical CO season day. Per EPA guidance, annual emissions are also calculated. The base year 1996 inventory is very similar to the 1996 periodic update inventory report submitted to EPA in September 1998. A few changes were made. Among the changes were switching to version 5b of the MOBILE model for onroad mobile source emissions calculations, and incorporating updates to the quality assurance plan.

To estimate emissions, four basic tasks were completed for each source category. The four tasks were: 1) estimate the activity level, 2) adjust/allocate the activity level (or emissions) temporally, 3) determine emission rates per the activity, and 4) estimate emissions. The tasks are described below for each source category.

Point Sources

Point sources are stationary sources that have the potential to emit CO in quantities greater than or equal to a specified cutoff point. For Serious NAA areas, the cutoff level is 50 tons per year, unless it is determined that stationary sources do not significantly contribute to carbon monoxide levels. If such a determination is made, the cutoff level is 100 tons per year. A determination was made that stationary sources do not significantly contribute to CO levels in the NAA; therefore, the minimum required cutoff level for point sources was 100 tons per year.[1] It is optional to lower the cutoff level for inventory purposes. For this inventory, the cutoff level was lowered to the potential to emit 50 tons per year.

Activity Level and Emission Rate Determination

All point sources are inventoried annually for actual emissions.[2] SCAPCA identified six sources in the NAA that met the 50 ton potential to emit criteria.[3] Activity is measured by process throughput as defined by source classification category (SCC) code. Examples of activity measures are amount of fuel burned, and ton of product produced. Emissions may be estimated using direct source measurement (stack testing, continuous emissions monitoring), material balance, published emission factors (emissions rates per activity), or professional judgment.

The majority of the emissions from Kaiser Mead were estimated by material balance. Most of the other sources' emissions were estimated through direct measurement.

Temporal Adjustments

All sources operated during at least part of the CO season. Daily emissions were calculated by dividing annual emissions by the total number of operating days.

Emissions Estimates

Table 4: Actual Point Source Emissions by Facility, 1996

Source ID#	Plant Name	tpy	ppd
S-063-0016	Kaiser Aluminum and Chemical, Mead	28,751	157,986
K-063-0023	Kaiser Trentwood	118	648
K-063-0097	Waste to Energy	45	311
K-063-0011	Shamrock Paving, Inc.	29	305
K-063-0066	Acme Material and Construction	26	325
K-063-0092	Inland Empire Paper	13	73
	total point sources	***28,982***	***159,648***

The emissions from the point sources may also be summarized by type of process as shown in Table 5.

Table 5: Point Source Emissions by Process, 1996

Process Name	tpy	ppd
Primary Aluminum Processes	28,751	157,986
Secondary Aluminum Processes	116	637
Asphalt Rotary Dryers	55	630
Municipal Incineration	45	311
External Combustion Boilers	15	84
total processes	***28,982***	***159,648***

Small Point Sources (Counted as Area Sources)

Several point sources inventoried in the annual update emit CO, but have less than 50 tons per year of potential emissions.[2,3] Those sources are presented here. The emissions come from external combustion processes.

Activity Level and Emission Rate Determination

Activity levels and emission rates were determined using the same methods as the major point sources. Most of the emissions estimates were made using emission factors. Emissions from the fuel combustion processes will be subtracted from area source totals (detailed later in this document) to avoid double-counting the emissions.

Temporal Adjustments

Daily emissions were calculated using the same method as the larger point sources.

Emissions Estimates

Table 6: Small Industrial Point Source Fuel Combustion Emissions, 1996

Source ID#	Plant Name	tpy	ppd
K-063-0095	The Boeing Company	1	5
K-063-0105	Columbia Lighting	1	5
K-063-0084	Koch Materials Co	1	5
	total	**3**	***15***

Table 7: Small Commercial Point Source Fuel Combustion Emissions, 1996

Source ID#	Plant Name	tpy	ppd
K-063-0110	Deaconess Medical Center	2	11
K-063-0111	Holy Family Hospital	1	5
K-063-0112	Sacred Heart Medical Center	4	22
K-063-0113	Dept Of Social & Health Services	3	16
K-063-0114	Saint Luke's Rehabilitation Institute	1	5
K-063-0120	Dept Of Veterans Affairs Medical Center	1	5
	total	***12***	***64***

Aircraft

There are two airports in the NAA, Spokane International (Geiger Field) and Felts Field. To calculate emissions, emission rates per landing-takeoff operation (LTO) are determined and multiplied by total LTOs. Emissions are calculated for three major aircraft types: carrier, air taxi and general aviation.

Activity Level

Activity level is defined as the number of LTOs. Both the Federal Aviation Administration (FAA) and the airports publish LTO information, but in differing formats. The differing fomats may account for the difference in number of LTOs reported in each category. For this inventory, airport data was supplemented by the FAA data to determine number of LTOs for the three major aircraft classifications.[4, 5]

Temporal Adjustments

The number of LTOs were available by month and were used to develop seasonal adjustments for general aviation and carrier/taxi operations. The season percent adjustment was calculated as the percent of annual activity occurring during October through February. Activity was assumed to take place 365 days per year.

Emission Rate Determination

EPA has provided guidance for determining emission rates.[6] For larger aircraft, engine data is generally available that can be used to calculate an airport-specific emission rate. For smaller aircraft, engine data may not exist or would require more effort to obtain than is warranted since the expected emissions are fairly insignificant. For these aircraft, default emission rates from the EPA guidance were used.

Felts Field

Only smaller aircraft use Felts Field. Default factors were used for air taxis and general aviation.

Spokane International

Default factors were used for general aviation aircraft. An airport-specific factor for combined carriers and taxis was calculated for Spokane International using FAA information as shown in the steps below.

I. Determine total LTOs for which engine emissions information is available. The FAA reported 36,505 total LTOs.[7] Some aircraft had no corresponding engine data (6,497 LTOs), and some of the engines used by the aircraft had no emission factors (3,343 LTOs). Total aircraft LTOs for the emission rate calculations were reduced to:

36,505 - (6,497 + 3,343) = 26,665 aircraft LTOs.

II. Because emission factors were given by engine rather than aircraft, the number of engine LTOs had to be determined first. This was accomplished in three steps:

a) total air carrier LTOs by aircraft were taken fiom step I above;
b) table 5-2 fi-om reference 6 was used to assign the number of engines, engine names, and percentage of each engine's usage to each aircraft;
c) the number of engines and the fraction of that engine's use by each aircraft were multiplied by the number of LTOs for each aircraft to determine number of LTOs per engine.

III. Emission factors were calculated for each engine using the default time-in-modes fiom Table 5-1 and the emission factors and fuel usage in Table 5-4 fiom reference 6. The individual modes (takeoff, climbout, approach and taxi/idle) were calculated and summed for overall lbs/Engine LTO factors.

IV. Total CO emissions were calculated by multiplying the number of engine LTOs calculated in step I by the CO emission factors calculated in step II for each engine, and summing. Total CO emissions were 766,924 lbs.

V. The airport emission factor in lbs/aircraft LTO was calculated:

$$\frac{766{,}924 \text{ lbs CO}}{26{,}665 \text{ LTOs}} = \frac{28.761 \text{ lbs CO}}{\text{LTO}}$$

Emissions Estimates

tpy = (LTOs/yr) x (CO lbs/LTO) x (T/2000 lbs)
ppd = (tpy) x (%year/season) x (season1152 days) x (2000 lbs/T)

Table 8: Aircraft Emissions, 1996

Airport	Aircraft	LTOs	CO lb/LTO	season %	tpy	ppd
Spk. Int.	Carrier/Taxi	*41,991	28.761	41	604	3,237
Spk. Int.	General Av.	13,980	12.014	29	84	318
Felts	Taxi	3,615	28.13	41	51	273
Felts	General Av	27,466	12.014	29	165	624
total		87,052			***904***	***4,451***

* from Spokane International Airport data

Railroad Locomotives

EPA guidance was used to estimate emissions in the original base year 1990 inventory.[8] The method consisted of multiplying the amount of diesel fuel used by a CO emissions rate in lbs/gallon. The method for determining fuel use was somewhat involved, and required obtaining confidential railroad information. The resulting emissions were less than 1% of the total inventory. Because this category was not significant in the base year inventory, and fuel use for locomotives only increased by 10% from 1990 to 1996 (70,082,000 gal. to 76,883,000 gal.),[9] the procedures followed to estimate 1990 emissions will not be repeated. The emissions estimates calculated for 1990 are repeated here and increased by 10% to reflect the higher fuel use.

Activity Level

Activity level is measured in gallons of fuel. Locomotive operations can be split into two types: switch yard service and line haul service. There are two switch yards in the NAA near Yardley. One is owned by Burlington Northern (BN), the other by Union Pacific (UP). The Mechanical section of UP and the Fuel Use section of BN provided estimates of switch yard fuel use.[10, 11]

Line haul fuel consumption was calculated by multiplying a railroad-specific fuel consumption rate in gallons per gross ton-mile by the number of gross ton-miles traveled in the NAA. This method required obtaining information from the Interstate Commerce Commission and individual railroads companies.[12, 13] Some of the information was considered confidential and will not be shown here.

Temporal Adjustments, Emission Rate Determination and Emissions Estimates

Operation was considered uniform, 365 days per year. Emission factors were from reference 6.

Emissions estimates for 1990 and 1996 are shown in Table 9. As stated above, 1996 emissions were estimated at 110% of the 1990 levels.

*Switch **Yard***
tpy = (#locom) x (galllocorn-day) x (365 dayslyr) x (CO lbslgal) x (T/2000 lbs)
ppd = (#locom) x (gal/locom-day) x (CO lbslgal)
Line Haul
tpy = (gross ton-mileslyr) x (gallgross ton-mile) x (CO lbslgal) x (T/2000 lbs)
ppd = (gross ton-mileslyr) x (gallgross ton-mile) x (365 dayslyr) x (CO lbslgal) x (T/2000 lbs)

Table 9: Locomotive Emissions, 1990 and 1996

RR	# Locom	gallloc-day	annual gals	CO lbslgal	tpy	ppd
BN yard, 1990	5	250	456,250	0.0894	20	112
UP yard, 1990	2	150	109,500	0.0894	5	27
All Line Haul, 1990				0.0626	112	611
total 1990					***137***	***750***
total 1996					***151***	***826***

Other Nonroad Mobile Sources

The 1990 Clean Air Act required EPA to study and inventory nonroad mobile sources in many of the nation's carbon monoxide and ozone nonattainment areas.[14,15] EPA in turn strongly recommended that these inventories be used in the State Implementation Plan emissions inventories.[6] For this inventory, the EPA Spokane County Nonroad inventory was used to estimate emissions. The study included emissions information for both the county and the NAA. The county emissions were used in order to take advantage of local spatial data in allocating emissions to the NAA. The study inventoried 79 different types of nonroad equipment/vehicles grouped into nine general categories.

Activity Level and Emission Rate Determination

Activity level is measured in horsepower hours (hp-hrs). The hp-hrs for each equipment/vehicle type were adjusted up or down for 1996 emissions according to activity level indicators appropriate for each category (see Table 10). Recreational vehicle activity was not included in the EPA report for Spokane. Because recreational vehicle activity could take place within the nonattainment area, activity levels (per person basis) from the Seattle-Tacoma nonroad report were used to supplement the Spokane data.

For all source categories, the adjusted hp-hrs were multiplied by the emission factors (in g/hp-hr) to estimate emissions.

The equation used to project the 1990 activity levels for each equipment type is shown below:

$$\frac{\text{1996 NAA indicator}}{\text{1990 county indicator}} \times \text{1990 County hp-hrs} = \text{1996 NAA hp-hrs}$$

The category indicators were taken from a variety of sources.'.[5,16,17,18,19,20] Table 10 shows the 1990 county-level indicator activity level, and the indicator activity level for 1996 in the NAA.

Table 10: Nonroad Mobile Source Activity Indicators and Levels, 1990 and 1996

Equipment	Indicator	Activity Level	
		90 County	96 NAA
Agricultural	minimal presence in area	0	0
Airport Service	air carrier/taxi LTOs	37,545	41,991
Boats	boat registrations	8,944	937
Commercial	population	361,364	315,673
Construction	employment, SIC 16	577	727
Industrial	employment, SICs 10-14, 20-39, 50-51	30,410	29,367
Lawn & Garden	population	361,364	315,673
Logging	not present in area	0	0
Recreational	population	361,364	315,673

Temporal Adjustments

The activity levels were seasonally adjusted to represent October through February according to the 1990 EPA inventory assumptions, with a few exceptions. Lawn and garden equipment and recreational boating were originally set at zero percent activity during the winter season. Because some activity may occur during winter, seasonal activity levels were set at the levels used in the Seattle-Tacoma report of 3% lawn/garden and 5% boating.

Emissions Estimates

Emissions calculations were made for the 79 individual equipment types. The results are presented in Table 11 for the major nonroad source categories by the engine-fuel type classifications used in the EPA Nonroad Engine report (2-stroke gasoline, 4-stroke gasoline, diesel). Since activity levels for agricultural and logging equipment are zero, they are not presented in Table 11.

tpy = (hp-hrs/yr) x (CO lbs/hp-hr) x (T/2000 lbs)
ppd = (tpy) x (%annual activity/season) x (season/days) x (2000 lbs/T)

Table 11: Nonroad Emissions Estimates, 1996

Equipment Type	Tons per Year				Pounds per Day			
	diesel	gas 2-strk	gas 4-strk	*total*	diesel	gas 2-strk	gas 4-strk	*total*
Airport Service	84	1	208	***294***	463	7	1,140	***1,609***
Boats	1	91	68	***160***	1	164	122	***287***
Commercial	14	166	3,251	***3,432***	92	1,063	20,794	***21,949***
Construction	612	31	402	***1,044***	2,411	122	1,582	***4,115***
Industrial	38	223	730	***991***	245	1,424	4,667	***6,336***
Lawn/Garden	4	1,289	7,205	***8,497***	9	3,206	17,815	***21,030***
Recreational	0	148	311	***460***	0	1,151	996	***2,148***
total	***753***	***1,949***	***12,174***	***14,876***	***3,221***	***7,137***	***47,116***	***57,474***

Residential Wood Combustion

Residential wood combustion consists mainly of home heating and recreational use of woodstoves, fireplaces and fireplace inserts. To estimate emissions, an activity level in amount of wood burned is multiplied by an emission rate in pounds of CO per ton of wood burned.

Activity Level

Number of Wood Burning Devices

In 1990, the Bonneville Power Administration (BPA) conducted a telephone survey of wood heating habits during the 89-90 winter season.[21] They surveyed 2078 households. The BPA survey was used to develop number of households using each type of device (Central Furnace, Certified (Phase I) and Non-certified Inserts and Woodstoves, and Fireplaces) and how much wood they burned. Areas specifically over-sampled by the survey were Puget Sound, Olympic, Spokane and Yakima. BPA provided the survey and database of responses to Ecology for use in residential wood combustion calculations.

Since the 1990 BPA survey, the Department of Revenue (DOR) has tracked the number of sales of new stoves and inserts.[22] The BPA survey information was combined with the DOR sales data to determine 1996 wood burning activity.

It was assumed that some of the sales since 1990 were for new installations, while others were for device replacement. To determine the percentages of each, expected wood burning device usage for 1991 was calculated assuming that wood burning device usage rates found in the 1990 BPA survey would be the same for 1991. (It could not be assumed that the wood burning device usage rate in 1996 was the same as in 1990 since the new sales data showed that wood burning device sales were decreasing.) Households for 1990 and 1991 were calculated by dividing county population by the 1990 Census persons per household for each county.[23] All of the increase due to growth was assumed to be due to new installations. The number of new installations was subtracted from the total number of new sales. The remaining new sales were assumed to be replacements. The rates calculated were 67% new installations and 33% replacements.

Calculation of Final Wood Burning Device Activity

The new installation and replacement percentages were used with the total new sales fiom 1990 to 1996 to calculate total numbers of new installations and replacements of woodstoves and inserts. Replacement devices were subtracted fiom the 1990 numbers of uncertified devices. All new sales were assumed to have met Phase II certification. Expected new growth or replacements of central furnaces was accounted for under the woodstove category; 1990 central furnace levels were kept for 1996 calculations. 1996 county allocations of new sales were based on county population growth (and corresponding growth in households assuming 2.47 persons per household)[24] and 1991 expected usage rates calculated above. The results for Spokane are shown in Table 12.

Table 12: Spokane Wood Burning Device Usage, 1996

Equipment Type	% of Households
Central Furnace	1.1
Fireplaces	15.1
Non-certified Insert	8.6
Certified Insert, Phase I	1.6
Certified Insert, Phase II	1.0
Non-certified Woodstove	8.6
Certified Woodstove, Phase I	1.6
Certified Woodstove, Phase II	1.1
total equipment	***38.6***

Amount of Wood Burned

The BPA survey gathered information on pellets, presto logs and cords of wood burned. The weight of a cord of wood varies with species type and moisture content; therefore, both need to be defined. It is illegal to burn wood that is not seasoned (defined as a moisture content of 20%), so wood was considered to contain 20% moisture.[25]

Allocations of wood species burned was based on recommendations from Ecology, the Department of Natural Resources (DNR), and the US Forest Service (USFS).[26] Results are shown in Table 13 with estimated weight of a cord of wood in pounds based on 20% moisture.[27]

Table 13: Wood Species Weight and Percent Use

Species	lbs/cord	% Use
Douglas fir	2970	25
Larch	3330	25
Lodge ole ine		25
Ponderosa ine		25
average	***2788***	

The BPA survey provided information on the number of cords burned per device. Because of the low number of Central Furnaces, cords burned shown are the statewide average. Similarly, the average of all stoves and inserts was used for both certified and non-certified devices due to the lower number of certified stoves and inserts used.

Pellets used were given in number of 40 lb bags used, and presto logs as number of logs burned. A presto log manufacturer in Spokane estimated the weight of a log as 8 lbs.

The total number of pounds burned by device type are shown in Table 14.

Table 14: Pounds Burned per Wood Burning Device

Equipment Type	lbs Cord Wood	lbs Pellets & Presto Logs	Total lbs
Central Furnace	6329	9	6338
All Fireplaces	1338	111	1449
Non-certified Insert	4461	100	4561
Certified Insert	4461	635	5096
Non-certified Woodstove	7555	88	7643
Certified Woodstove	7555	344	7900

Determination of Emission Rates

Emission Factors

Emission factors in pounds of CO per ton burned were taken from AP42.[28] Certified stoves and inserts were assumed to be 50% catalytic and 50% non-catalytic.

Table 15: Wood Burning Device CO Emission Factors

Equipment Type	CO lbs/T
Central Furnace	230.8
Fireplaces	252.6
Non-certified Insert	230.8
Certified Insert, Phase I	122.6
Certified Insert, Phase II	123.9
Non-certified Woodstove	230.8
Certified Woodstove, Phase I	122.6
Certified Woodstove, Phase II	123.9

Temporal Adjustments and Emissions Estimates

Annual emissions for each wood burning device were calculated according to the following equation:

tpy = (persons) x (household/persons) x (fraction device usage) x (tons burned/device)
x (CO lbs IT) x (T/2000 lbs)

where the NAA population was 315,673, and there were 2.47 persons per household.[23]

Because the bum rates were characteristic of the BPA survey period (July 1989-June 1990), an adjustment was made account for differences in temperature, and therefore expected burn rates, in 1996. Monthly heating degree days from Spokane International Airport were obtained for 1996, and for the BPA survey period.[29, 30] The annual emissions calculated using the equation above were adjusted by multiplying by the ratio of 1996 heating degree days (7470) to1990 heating degree days (6421):

$$tpy_{adjusted} = (tpy) \times (7470/6421)$$

Seasonal (Oct – Feb) heating degree days were used to calculate average daily emissions according to the following equation:

$$ppd = (tpy_{adjusted}) \times (\text{seasonal HDD/annual HDD}) \times (\text{season/152days}) \times (2000 \text{ lbs/T})$$

Table 16: Spokane Heating Degree Days by Month, 1996

month	HDD		month	HDD
Jan	1217		Jul	35
Feb	1045		Aug	49
Mar	880		Sep	281
Apr	556		Oct	603
May	471		Nov	949
Jun	143		Dec	1241
			total	***7470***

Table 17: Residential Wood Burning Device CO Emissions, 1996

Equipment Type	tpy	ppd
Central Furnace	624	5,585
Fireplaces	2,105	18,834
Non-certified Insert	3,434	30,728
Certified Insert, Phase I	372	3,334
Certified Insert, Phase II	238	2,127
Non-certified Woodstove	5,731	51,281
Certified Woodstove, Phase I	577	5,165
Certified Woodstove, Phase II	408	3,651
total emissions	***13,490***	***120,704***

Residential, Commercial, and Small Industrial Fuel Use (excluding wood)

CO emissions from area source use of coal, residual oil, distillate oil, liquefied petroleum gas, and natural gas were calculated for the base year 1990 and periodic 1993 inventories. Emissions from residual and distillate oil, and liquefied petroleum gas accounted for about 0.06% of the total daily CO inventory. Because of their insignificance to the inventory and inherent difficulties in the estimation methodology, emissions from oil and liquefied petroleum gas will not be calculated. The rest of this section addresses emissions from coal and natural gas combustion.

Coal Combustion

Activity Level

The method for determining the amount of coal burned consists of three steps: 1) obtain statewide coal consumption by sector (commercial, industrial, residential), 2) subtract coal consumed by point sources to obtain area source total by sector, and 3) allocate area source coal consumption to the nonattainment area using appropriate surrogates.[31]

Statewide coal consumption was available through the Energy Information Administration's Internet homepage by sector.[32] Point source consumption was available from the statewide annual point source inventory.' Point source Standard Industrial Classification (SIC) codes were used to allocate point source consumption to the industrial (codes 20-39) and commercial (codes 50-99) sectors.

Employment in SIC codes 20-39[19] was used as a surrogate to allocate industrial consumption to the nonattainment area. After subtracting point source totals, area source totals calculated for commercial and residential consumption were less than zero; therefore, no further calculations were performed for these sectors. Table 18 shows coal consumption in the nonattainrnent area.

NAA Tons = (Total State Tons – Point Source Tons) x (NAA Employ./State Employ.)

Table 18: Coal Use by Sector, 1996

Sector	Washington State Tons Consumed			SIC 20-39 Employment		NAA Tons Consumed
	Total	Point	Area	State	NAA	
Industrial	152,000	107,000	45,000	339,290	17,880	2,371
Comm/Res	23,000	45,000	-22,000	n/a	n/a	n/a

Temporal Adjustments and Emission Rate Determination and Emissions Estimates

Emissions were calculated using emission factors from AP42.[28] As recommended in EPA guidance, the factor was a weighted factor of 80% underfeed stoker (11 lbs/T) and 20% overfeed stoker (6 lbs/T).[28, 31] The resulting factor was 10 lbs/T. Industrial coal combustion was considered to be uniform year-round, operating six days per week.[33]

Emissions Estimates

tpy = (Tons coal/yr) x (CO lbs/T) x (T/2000 lbs)
ppd = (tpy) x (yr/52 wks) x (wk/6 days) x (2000 lbs/T)

Table 19: Coal Combustion Emissions, 1996

Sector	CO lbs/T	tpy	ppd
Industrial	10	12	76

Natural Gas

Activity Level

The method for estimating natural gas consumption is similar to that used for coal, except that gas use is available for the nonattainment area and thus does not have to be scaled down from the state level. Washington Water Power is the only natural gas supplier in Spokane, and they provided gas usage in therms for residential, commercial, and industrial customers.[34] Therms were converted to million cubic feet using a heating value of 1,018 BTUs/cu.ft.[34]

Point source consumption for the nonattainment area was available from the annual point source inventory.[2] Point source Standard Industrial Classification (SIC) codes were used to allocate point source consumption to the industrial (codes 20-39) and commercial (codes 50-99) sectors, Point source totals were subtracted from Washington Water Power's totals to obtain area source totals.

Table 20: Natural Gas Use in Nonattainment Area, 1996

Sector	1000 Therms	MMcuft @ 1018 BTU/ft^3		
		Total	Point Sources	Area Sources
Residential	82,412,097	8,095	0	8,095
Commercial	71,328,455	7,007	733	6,274
Industrial	57,816,618	5,679	3,169	2,510

Temporal Adjustments and Emission Rate Determination

Emissions were calculated using emission factors from AP42.[28] Seasonal adjustments were made using seasonal allocations (October through February) and operation days per week recommended in EPA guidance.[33]

Emissions Estimates

tpy = ($MMft^3$ gas/yr) x (CO lbs/$MMft^3$) x (T/2000 lbs)
ppd = (tpy) x (% year's activity/season) x (0.01) x (2000 lbs/ton) x (season/total operation days)
where total operation days were calculated:
(152 days) x (operating days/week) x (week/7 days) [152 days during Oct-Feb)

Table 21: Natural Gas Emissions and Calculation Parameters, 1996

Sector	$MMft^3$	CO lbs/$MMft^3$	Season % Activity	days/wk	CO tpy	CO ppd
Residential	8,095	35	60	7	142	1,109
Commercial	6,274	21	52	6	66	522
Industial	2,510	40	42	6	50	321

<u>Total Emissions from Area Source Non-Wood Fuel Combustion</u>

Table 22: Area Source Non-wood Fuel Combustion Emissions, 1996

Sector	Coal		Natural Gas		***Total***	
	tpy	ppd	tpy	ppd	***tpy***	***ppd***
Residential	0	0	142	1,109	***142***	***1,109***
Commercial	0	0	66	522	***66***	***522***
Industrial	12	76	50	321	***62***	***397***

Onroad Mobile Sources

Onroad mobile sources are vehicles operated on public roadways.

Activity Level

The activity level for onroad mobile sources is measured in average daily vehicle miles traveled (ADVMT). Information on the derivation of ADVMT may be found in Appendix C-1. SRTC tracks VMT in somewhat different classes than those used by the federal tracking system called Highway Performance Monitoring System (HPMS). In order to report estimates in units consistent with HPMS, SRTC categorized their ADVMT according to the HPMS classification system. NAA ADVMT for 1996 is shown in Table 23.

Table 23: Average Daily Vehicle Miles Traveled by Functional Classification, 1996

Rural	ADVMT		Urban	ADVMT
Interstate	0		Interstate	1,539,630
Other Principal Arterial	0		Other Freeways and Expressways	3,455,729
Minor Arterial	2,191		Other Principal Arterial	942,020
Major Collector	19,131		Minor Arterial	577,741
Minor Collector	0		Collector	28,817
Local	0		Local	48,560
Total Rural	21,322		Total Urban	6,592,497
			total all ADVMT .	*6,613,819*

Emission Rate Determination

EPA's MOBILE model, version 5b, was used to calculate emission rates in grams per mile.[35] EPA used data collected from different categories of vehicles under different operating conditions to develop the model. The model is continuously updated as new information is gathered. The latest version, 5b, was released in 1996. The model may be tailored to account for local conditions. Local parameters were used for speed, inspection and maintenance (I/M) programs, Reid vapor pressure (RVP), oxygenated fuel programs, temperatures, operating mode fractions, and the vehicle fleet age distribution.

The model consists of three sections of input: control section, one-time data section, and the scenario section. All inputs are detailed below. A sample input file is shown in Figure **3.**

Control Section

The control section consists primarily of a series of flag settings. The flags control the format and content of the remaining inputs, influence the execution of the program, and determine the content and format of the data output. The flags were set so as require the input of Inspection and Maintenance (I/M) program parameters, and the Washington-specific model year registration distribution.

One-time Data Section

The one-time data section contains information which is input only once in a given MOBILE input file. The information is used to alter MOBILE internal data to reflect alternate (i.e. locally derived) data, rather than model defaults. Local data was used to replace the national vehicle model year registration distribution. The I/M program parameters were included in the one-time section, and also the input record known as the Local Area Parameter (LAP) record.

A July 1, 1996 registration distribution was compiled using information fiom the Department of Licensing (DOL).[36] The distribution shows that Washington has an older fleet than the national average, resulting in higher CO emissions.

The local area parameter record contains information on the minimum and maximum daily temperature, fuel Reid vapor pressure (RVP) and the presence of an oxygenated fuel program. The temperatures were those used in the 1990 base year inventory. The RVP value of 12.8 psi was taken fiom a fuel survey done by the Washington State Department of Agriculture.[37] The oxgenated fuel program parameters used were those in place during the winter of 1995-96. The oxygenated fuel was an alcohol blend, with 3.2% oxygen content. No waivers to the oxygenated fuel program were granted.[38]

I/M program parameters were compiled using actual program data collected fiom 6/93 to 12/94.[39] This data was used for the 1993 periodic update inventory. In detail the inputs were:

Program Start Year: July 1,1985

Stringency Level: The actual 6/93 - 12/94 failure rate among all light duty pre-1981 vehicles tested was used to determine the stringency level, since there are no testing or data reporting errors. Using this methodology, the stringency rate was 29%.

Table 24: I/M Program Stringency Level

Model Years	Initial Tests	Initial Failures	Percent
1968-1980	34,834	10,167	29%

Model Years Subject to the Requirements of the Program: 1968 through 2020

Waiver Rates: Waiver rates were calculated fiom Jun. 1, 1993 - Dec. 31, 1994, with retests counted through June 30, 1991

Table 25: I/M Program Waiver Rates

Model Years	Initial Failures	Retest Waived	Percent
1968-1980	10,167	574	6%
1981-1991	10,510	1,423	14%

Compliance Rate: The compliance rate calculated for the1990 base year inventory was 96%. A recent update showed that the compliance rate was also 96% for the year 1998; therefore the compliance rate was assumed to be 96%.

Program Type: Centralized

Frequency of Inspection: Biennial

Vehicle Types Covered by Program: All gasoline vehicles except motorcycles

Test Type: 2500/idle. While the test is actually a loaded-idle test, differences in the data sets used to derive emissions credits in the MOBILE model prompted EPA to advise using the 2500/idle test for modeling purposes.[40]

Use of Alternate I/M Credits: No

Scenario Section

The scenario records contains specific information for each emissions scenario to be evaluated. Among the parameters set in the scenario section are date of evaluation (January 1, 1996), speeds and operating mode fractions. Scenarios were run for all speeds between 3 and 65 mph using 1 mph increments. The default operating mode fractions in the MOBILE model were replaced with local values. Sierra Research, Inc. calculated Spokane-specific operating mode fractions with data fkom the SRTC.[41]

Emissions Estimates and Temporal Adjustments

Determine Appropriate Application of Emission Factors

An I/M program covering almost all of the NAA is operated in Spokane. Emission factors were calculated both with and without the I/M program. There are vehicles operating in the I/M test area which have entered from outside the area. **A** 1987 compliance survey found 77.5% of the vehicles in the Spokane area came within the area.[42] In order to account for this, the emission factors used for VMT inside of the I/M testing area were weighted using the formula: (survey rate = 0.775) x (factors calculated with I/M) + (1 - survey rate = 0.225) x (factors calculated without I/M).

Emissions Calculations

ADVMT data by individual roadway link was used to compute emissions. The emission factors generated above were used to calculate emissions based on link speed and ADVMT. The system was set up to calculate emissions based on the "all vehicle" factor, rather than each vehicle type. Emissions were allocated to individual vehicle types using the default VMT mix fractions and emissions rates for each vehicle type output by the MOBILE model. Because of rounding errors, emissions estimates by vehicle type will vary slightly fi-om the totals presented in the emissions summary in Table 2: Base Year 1996 Emissions Summary.

Seasonal Adjustment

The VMT and emissions data calculated represent average weekday traffic. The Department of Transportation provided monthly adjustment factors for interstate and non-interstate volume based on traffic counts.[43] The average of the factors for Oct. - Feb. was used to adjust emissions. The interstate factor (0.946) was applied to interstates and freeways, and the non-interstate factor (0.948) was used for all the other roadways.

Emissions estimates were made in pounds per day and tons per year. It is noted here that the tons per year figure is simply based on winter pounds per day multiplied by 365 days/year, and is therefore not truly representative of annual average emissions.

ppd = (ADVMT) x (CO g/mi) x (lb/453.59 g)
tpy = (ppd) x (365 days/yr) x (T/2000 lbs)

Table 26: Onroad Mobile Source Emissions in Pounds Per Day, 1996

HPMS class	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	*total*
Rural									
Interstate	0	0	0	0	0	0	0	0	***0***
Principal Arterial	0	0	0	0	0	0	0	0	***0***
Minor Arterial	57	20	12	9	0	0	2	0	***101***
Major Collector	428	153	92	66	0	0	16	3	***758***
Minor Collector	0	0	0	0	0	0	0	0	***0***
Local	0	0	0	0	0	0	0	0	***0***
Urban									
Interstate	35,894	12,795	7,696	5,541	10	4	1,357	274	***63,572***
Freeways/Expressways	100,942	35,983	21,643	15,581	29	11	3,817	770	***178,777***
Other Principal Arterial	29,418	10,487	6,308	4,541	9	3	1,113	224	***52,102***
Minor Arterial	19,360	6,901	4,151	2,988	6	2	732	148	***34,288***
Collector	1,166	416	250	180	0	0	44	9	***2,065***
Local	1,786	637	383	276	1	0	68	14	***3,163***
total	***189,051***	***67,3921***	***40,5351***	***29,182***	***55***	***21***	***7,149***	***1,441***	***334,8261***

Light Duty Gasoline Vehicles (LDGV), Light Duty Gasoline Trucks < 6000 lbs gvw (LDGT1), Light Duty Gasoline Trucks 6000-8500 lbs gvw(L DGT2), Heavy Duty Gasoline Vehicles > 8500 lbs gvw (HDGV), Light Duty Diesel Vehicles (LDDV), Light Duty Diesel Trucks < 8500 lbs gvw (LDDT), Heavy Duty Diesel Vehicles > 8500 lbs gvw (HDDV), Motorcycles (MC).

Table 27: Onroad Mobile Source Emissions in Tons per Year, 1996

HPMS class	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	*total*
Rural									
Interstate	0	0	0	0	0	0	0	0	***0***
Principal Arterial	0	0	0	0	0	0	0	0	***0***
Minor Arterial	10	4	2	2	0	0	0	0	***18***
Major Collector	78	28	17	12	0	0	3	1	***138***
Minor Collector	0	0	0	0	0	0	0	0	***0***
Local	0	0	0	0	0	0	0	0	***0***
Urban									
Interstate	6,551	2,335	1,405	1,011	2	1	248	50	***11,602***
Freeways/Expressways	18,422	6,567	3,950	2,844	5	2	697	140	***32,627***
Other Principal Arterial	5,369	1,914	1,151	829	2	1	203	41	***9,509***
Minor Arterial	3,533	1,259	758	545	1	0	134	27	***6,258***
Collector	213	76	46	33	0	0	8	2	***377***
Local	326	116	70	50	0	0	12	2	***577***
total	***34,502***	***12,299***	***7,398***	***5,326***	***10***	***4***	***1,305***	***263***	***61,106***

Light Duty Gasoline Vehicles (LDGV), Light Duty Gasoline Trucks < 6000 lbs gvw (LDGT1), Light Duty Gasoline Trucks 6000-8500 lbs gvw (LDGT2), Heavy Duty Gasoline Vehicles > 8500 lbs gvw (HDGV), Light Duty Diesel Vehicles (LDDV), Light Duty Diesel Trucks < 8500 lbs gvw (LDDT), Heavy Duty Diesel Vehicles > 8500 lbs gvw (HDDV), Motorcycles (MC).

Figure 3: Sample Base Year 1996 MOBILE5b Input File (with I/M Program)

```
1          PROMPT  -  no prompting, vertical format
Spokane I/M Program, 1996
1          TAMFLG  -  M5.0b tampering rates
1          SPDFLG  -  one speed for all vehicle types
1          VMFLAG  -  M5.0b VMT mix
3          MYMRFG  -  WA 1996 registration dist., M5.0b mileage accum. rate
1          NEWFLG  -  M5.0b basic exhaust emission rates
6          IMFLAG  -  I/M program with tech training
1          ALHFLG  -  no additional correction factors
1          ATPFLG  -  no anti-tampering program
5          RLFLAG  -  zero out refueling emissions
1          LOCFLG  -  one local area parameter for each scenario
1          TEMFLG  -  use max and min temperatures
1          OUTFMT  -  220 column output
2          PRTFLG  -  CO factors only
1          IDLFLG  -  no idle emission factors
1          NMHFLG  -  CO factors only
1          HCFLAG  -  CO factors only
 .024 .055 .053 .059 .054 .064 .064 .065 .063 .063   LDGV, MY 1-10
 .059 .057 .049 .024 .021 .025 .026 .030 .028 .021   LDGV, MY 11-20
 .016 .010 .011 .010 .052                            LDGV, MY 21-25
 .022 .045 .059 .050 .045 .050 .052 .059 .050 .048   LDGT1, MY 1-10
 .058 .048 .046 .028 .021 .026 .026 .036 .032 .029   LDGT1, MY 11-20
 .023 .017 .017 .018 .096                            LDGT1, MY 21-25
 .022 .045 .059 .050 .045 .050 .052 .059 .050 .048   LDGT2, MY 1-10
 .058 .048 .046 .028 .021 .026 .026 .036 .032 .029   LDGT2, MY 11-20
 .023 .017 .017 .018 .096                            LDGT2, MY 21-25
 .009 .024 .021 .019 .017 .020 .024 .027 .025 .021   HDGT, MY 1-10
 .026 .026 .018 .013 .012 .015 .017 .057 .067 .078   HDGT, MY 11-20
 .064 .044 .041 .054 .260                            HDGT, MY 21-25
 .024 .055 .053 .059 .054 .064 .064 .065 .063 .063   LDDV, MY 1-10
 .059 .057 .049 .024 .021 .025 .026 .030 .028 .021   LDDV, MY 11-20
 .016 .010 .011 .010 .052                            LDDV, MY 21-25
 .022 .045 .059 .050 .045 .050 .052 .059 .050 .048   LDDT, MY 1-10
 .058 .048 .046 .028 .021 .026 .026 .036 .032 .029   LDDT, MY 11-20
 .023 .017 .017 .018 .096                            LDDT, MY 21-25
 .028 .056 .040 .038 .041 .046 .064 .056 .054 .048   HDDT, MY 1-10
 .052 .058 .048 .011 .014 .014 .016 .025 .016 .042   HDDT, MY 11-20
 .023 .030 .036 .032 .109                            HDDT, MY 21-25
 .023 .039 .038 .038 .027 .023 .025 .026 .029 .035   MC, MY 1-10
 .060 .638 .000 .000 .000 .000 .000 .000 .000 .000   MC, MY 11-20
 .000 .000 .000 .000 .000                            MC, MY 21-25
1 1 2 1                                                              I/M Ctrl
85 29 68 20 06 14 096 112 2222 2212 220. 1.20 999.                   I/M Curr
c:\mob5b\imdata4.d                                                   I/M Credit
1 96 32.0 33.0 30.6 30.2 30.6  1                                     Scenario
spkim             24.  38.  12.8 12.8  20 2 1 1 1                    LAP
.001 .999 .027 .032 1                                                Oxy
00000000000000000000000000000000000000000000000000000000000000000000000000000
```

Commercial/Small Industrial Incineration

In 1993, the majority of emissions from incineration were from the Spokane Waste to Energy facility. In this inventory, the Waste to Energy facility was counted as a point source and may be found in the point source section.

Other area sources inventoried in the 1993 periodic inventory update included crematories, burn-out ovens, waste incinerators, and wire burners. Together these sources emitted only 1.4 tons in 1993. Assuming uniform operation, 6 days per week, they emitted 9 pounds per day. Because the emissions were so low, an update was not done for 1996.

Residential Outdoor Burning

Residential outdoor burning is divided into two categories: trash burning and yard waste burning.

Trash Burning

Activity Level

Trash burning is not allowed in Spokane County. To estimate the volume of illegal burning several sources were used, and a rule effectiveness (RE) of 80% was applied. Per David Misenheimer, this 80% is only a guide to estimate illegal burning, and will not be formally tracked as RE.[44]

A study by the Puget Sound Air Pollution Control Agency (PSAPCA) found that approximately 37.8% of the rural population and 3.0% of the urban/suburban population burned trash in the Puget Sound area.[45] Using these percentages, potential trash burning may be estimated. The population in the NAA was 315,673 in 1996. The urban population was 193,030 in 1996 (sum of Spokane, Millwood and Airway Heights).[24] There is no estimate of suburban population. In order not to underestimate emissions, the remaining population, 122,643, was considered rural. The population burning trash was calculated taking into account the 80% RE as follows:

(1 - 0.8) x [(193,030 pop x 0.03) + (122,643 pop x 0.378)] = 10,430 pop

Temporal Adjustments, Emission Rate Determination, and Emissions Estimates

In a memo from Radian to SIP Inventory preparers, paper and paperboard generation was estimated at 1.8 lbslperson-day for 1995.[46] An emission factor of 85 lb/T for municipal refuse open burning was used.[28] Trash burning is assumed uniform, 365 days per year.

tpy = (persons) x (1.8 Ibs trashlperson-day) x (365 days/yr) x (T/2000 Ibs) x (CO lbs/T) x (T/2000 lbs)
ppd = (persons) x (1.8 Ibs trashlperson-day) x (T/2000 lbs)

Table 28: Trash Burning Emissions. 1996

Pop Doing Burning	Tons Burned	CO lbs/T	CO tpy	CO ppd
10,430	3,426	85	146	798

Open Burning of Yard and Garden Waste

Activity Level

SCAPCA allows yard and garden waste burning outside of the no-burn zone during designated periods in the spring and fall. In 1996, burning was allowed a total of 14 days. Fall burning was allowed during five days in October.[47] As with trash burning, yard and garden waste burning is not allowed in the no burn zone. All of the NAA is within the no-bum zone, so there is no legal burning. Similar to trash burning, rule effectiveness (RE) of 80% was applied to estimate the volume of illegal burning.

A study by PSAPCA found that approximately 30% of the rural households (HH) and 3% of the urban/suburban households burned yard and garden waste in the Puget Sound area.[45] Using these same percentages, yard and garden waste burning was estimated. The population figures used above in trash burning estimates, were also used to calculate yard waste burning. The number of households in the NAA was calculated by dividing NAA population by the 1990 Census persons per household for Spokane County (2.47 persons per household).[23] The households burning yard waste were calculated taking into account the 80% RE as follows:

Urban

$$(1 - 0.8) \times 193{,}030 \text{ pop} \times \frac{\text{household}}{2.47 \text{ pop}} \times 0.03 = \textbf{469 households}$$

Rural

$$(1 - 0.8) \times 122{,}643 \text{ pop} \times \frac{\text{household}}{2.47 \text{ pop}} \times 0.30 = \textbf{2,979 households}$$

Another PSAPCA study estimated that urban burners burn approximately 2 legal size piles (4') per year, and rural about 8 piles.[48] It was estimated that the weight of a legal size pile was approximately 125 lbs.[49]

Temporal Adjustments, Emission Rate Determination and Emissions Estimates

An emission factor of 140 lb/T for unspecified forest burning was used.[28] Daily emissions were calculated by assuming that the burning was equally distributed over the 14 burning days.

tpy = (households) x (piles/household) x (125 lbs/pile) x (T/2000 lbs) x (CO lbs/T) x (T/2000 lbs)
ppd = (tpy) x (yr/burning days) x (2000 lbs/T)

Yard and Garden Waste Emissions, 1996

Type	Households Burning	Tons Burned	CO lbs/T	CO tpy	CO ppd
Urban	469	59	140	4	586
Rural	2,979	1,490	140	104	14,896
total	***3,448***	***1,548***		***108***	***15,482***

Total Residential Outdoor Burning:

Table 29: Total Residential Outdoor Burning Emissions, 1996

tpy	ppd
254	16,280

Prescribed Burning

Activity Level

In 1996, the Department of Natural Resources (DNR) permitted 110 small pile burns in or near the NAA.[50] The largest burns permitted were near the border of the NAA. A total of 2,158 tons of material were burned, approximately half of which was burned in months where CO exceedances have typically occurred (October through February).

Emission Rate Determination and Emissions Estimates

The DNR uses a model developed by the Pacific Northwest US Forest Service Research Station to estimate fuel consumption and resulting air emissions.[51] The emission factor used for pile burns was 169 lbs/ton. Emissions were calculated as follows:

$$\frac{2158\ \text{T}}{\text{yr}} \times \frac{169\ \text{lbs CO}}{\text{T}} \times \frac{\text{T}}{2000\ \text{lbs}} = \frac{\mathbf{182\ Tons\ CO}}{\mathbf{yr}}$$

The emissions calculation for the largest burn, which was burned on a single day in January, is shown below:

$$\frac{80\ \text{T}}{1\ \text{day}} \times \frac{169\ \text{lbs CO}}{\text{T}} = \frac{\mathbf{13{,}520\ lbs\ CO}}{\mathbf{1\ day}}$$

Temporal Adjustments

Burns are permitted by the DNR in conjunction with Ecology. Burns are not permitted during stagnant conditions, or when the plume may impact populated areas (i.e., the NAA). It is also noted that the burn was located near the southern border of the NAA. To count the pounds emitted on one day as a source characteristically impacting the NAA during winter, stagnant conditions is not reasonable; therefore, the lbs/day will not be counted in the total, but is noted here for information only.

Wildfires

Wildfires are counted by the suppressing agency. The Department of Natural Resources (DNR) and local fire districts suppress fires in Spokane County. The information presented here represents 1996 wildfire activity for the most part. Wildfire activity is extremely variable. For example, in 1989 only 252 acres were burned, while 3,423 acres burned in 1996.

Activity Level

DNR Fires

DNR provides statistics by county on number of fires occurring on forested and non-forested land.[52] Wildfires burned 1808 acres of forest land and 1615 acres of non-forest land in Spokane County in 1996. Time did not allow pinpointing the fires. According to a land use map, approximately 0.46% of the forested land is in the NAA, and 8.42% of the non-forested steppe/grass/shrubs land.[53] As an estimate of wildfire activity in the NAA, total acres burned on forested and non-forested land were multiplied by the fraction of the given land type in the NAA:

1808 forest acres x 0.0046 = **8 acres**
1615 non-forest acres x 0.0842 = **136 acres**

Local Fire District Fires

The Spokane County Air Pollution Control Authority surveyed all fire districts in the county in August 1991.[54] Information was gathered on number of forest and non-forest fires and acres burned. Fires occurring in the City District, District 1, and half of District 9 were considered to be in the NAA.

In 1990, the number of acres burned were approximately 22 acres forest, 20 acres non-forest. These numbers were carried over to 1996 without updating for several reasons: 1) DNR will respond to larger fires, and therefore track them in their fire count which was updated to 1996 above. 2) While forest fires are extremely variable, wildfires occurring in the generally urban setting of the CO NAA are somewhat more constant. 3) The 1990 fires were reported as being fairly average.

One change was made to the 1990 data. District 1 acres burned were about 6 acres less than average on non-forested land, so 6 acres were added to the non-forested total. Local wildfires were then evaluated at 22 acres forest (159 fires), and 26 acres non-forest (261 fires).

Temporal Adjustments, Emission Rate Determination and Emissions Estimates

A loading estimate of 4.3 T/acre for autumn fires was used for non-forested land.[55] This was multiplied by the emission factor for sagebrush of 166.4 lb/T from USFS slash burning estimates for sagebrush, resulting in a factor of 715.5 lb/acre. The emission factor of 9420 kglha from AP42, was converted from kglha to lb/acre for forested land (8,307 lb/acre).[28] It was assumed that wildfire activity was uniform, 365 days per year.[56]

tpy = (acres/yr) x (CO lbs/acre) x (T/2000 lbs)
ppd = (tpy) x (yr/365 days) x (2000 lbs/T)

Table 30: Wildfire Activity and Emissions, 1996

Type	Acres Burned	CO lblacre	tpy	ppd
Forest	30	8301.0	126	690
Non-forest	162	715.5	58	318
total	***192***		***184***	***1008***

Structure Fires

SCAPCA surveyed all fire districts in the county in August 1991.[54] Information was gathered on the number of structure fires in 1990. Most of the fire districts estimated that 1990 was a fairly average year for structure fires. Because this is not a major source of CO emissions, the survey was not updated. The 1990 survey data was used with 1996 population data to estimate emissions.

Activity Level, Temporal Adjustments and Emission Rate Determination

Total fires reported in the NAA in 1990 were 572. Using the 1990 NAA population of 294,455, there were 1.94 fires per 1000 persons. 1996 fires were estimated as follows:

$$315{,}673 \text{ people} \times \frac{1.94 \text{ fires}}{1000 \text{ people}} = \mathbf{613\ fires}$$

Amount of material burned per fire, the emission rate in pounds per ton burned, and seasonal adjustment were taken from EPA guidance.[33] The guidance assumed that 6.8 tons of material were burned in each fire, and that the emission rate was 60 pounds of CO per ton. This figure has had some discussion in the Emission Inventory Improvement Program's Area Source Subcommittee and may see some adjustment in the future. Per the EPA guidance, fires were assumed to occur uniformly throughout the year, so no seasonal adjustment was made.

Emissions Estimates

tpy = (fires) x (6.8 T burned/fire) x (CO lbs/T) x (T/2000 lbs)
ppd = (tpy) x (yr/365 days) x (2000 lbs/T)

Table 31: Structure Fires Emissions, 1996

# fires	T burned/fire	Tons burned	CO lbs/T	tpy	ppd
613	6.8	4168	60	125	685

Projection Year 2000 Inventory

The projection year 2000 inventory is an inventory of expected emissions on a typical CO season day in the atttainment year 2000. The onroad mobile source portion of the inventory will be used to set the emissions budget for transportation conformity. Other sources were projected for comparative purposes, and to use as a basis for the year 2000 modeling inventory projections. The emissions are based on allowable emissions where they exist, and expected emissions where allowable emissions have not been established.

The emissions projection methods and resulting emissions estimates are presented for each major source category. Individual source categories inventoried in the base year 1996 inventory are counted under their major category heading: point, area, nonroad, or onroad.

Point Sources

While the base year emissions were estimates of actual emissions in 1996, projected estimates for the year 2000 are defined as the allowable emissions. Allowable emissions will always be higher than actual emissions unless a source is not operating in compliance with its allowed limits. Allowable emissions were calculated based on emissions limits and/or maximum production/activity for each emission point. Allowable emissions for each major source (potential to emit 100 tons or more of CO per year) are shown in Table 32.[57-63]

Table 32: Point Source Allowable Emissions

Plant name	point ID	Description	tpy	ppd
Kaiser Alumimun and Chemical	03	Coke Kiln	15	82
	04	Potlines 1-8 Thru Scrubbers	31,333	171,688
	05	Potlines 1-8 Thru Roof Vents	1,408	7,715
	28	Ancillary Ops Emiss Points < 25 Tpy	27.8	152
	30	New Carbon Bake Furnace	1,032	5,655
Kaiser Trentwood	01-1	#1 Melter	10.9	60
	01-2E	#2E Melter	10.9	60
	01-2W	#2W Melter	10.9	60
	01-3	#3 Melter	10.9	60
	01-4	#4 Melter	10.9	60
	01-5	#5 Melter	10.9	60
	01-6	#6 Melter	10.9	60
	01-7	#7 Melter	10.9	60
	01-8E	#8E Melter	12.7	70
	01-8W	#8W Melter	12.7	70
	01-H	Holder	72.5	397
	02	Two Induction Furnaces	17.3	95
	13	Pusher Furnace	3.7	20
	17	Coating Line	73.1	401
	FAX1	Boiler	59.4	325
	FAX2	Soaking Pits	35.4	194
	FAX3	Misc External Combustion	3.4	19
Waste To Energy	01	Incinerator - Unit 1, Geiger Blvd&Prk	86	471
	02	Incinerator - Unit 2, Geiger Blvd&Prk	86	471
total all sources			***34,365***	***188,305***

Area and Nonroad Mobile Sources

Emissions projections for area and nonroad mobile sources were made by applying a growth factor to the 1996 base year estimates. Growth factors were based on surrogate indicators for each source category. Surrogates chosen were either population or employment in specific business types. Information about population and employment may be found in Appendix C-2. The growth factors were calculated as the ratio of the year 2000 surrogate to the 1996 base year surrogate. The growth factors were multiplied by the 1996 base year emissions estimates to project year 2000 emissions:

$$\text{1996 base year emissions} \times \frac{\text{2000 surrogate}}{\text{1996 surrogate}} = \text{year 2000 projected emissions}$$

Table 33: Area/Nonroad Mobile Source Surrogate Growth Rates, 1996 to 2000

Surrogate Activity Indicator	1996	2000	growth rate
Population	315,673	335,506	1.06
Employment SIC 16	727	735	1.01
Employment SICs 10-14, 20-39, 50-51	29,367	30,101	1.02

Table 34: Nonroad Mobile Growth Surrogates and Emissions Projections, 1996 and 2000

Category	1996 tpy	1996 ppd	growth surrogate	2000 tpy	2000 ppd
Aircraft	904	4,451	population	961	4,731
Locomotives	151	826	population	160	878
Agric. Equipment	0	0	minimal presence in NAA	0	0
Airport Service Equip.	294	1,609	population	312	1,710
Recreational Boats	1,798	287	population	1,911	305
Commercial Equip.	3,432	21,949	population	3,648	23,328
Construction Equip.	1,044	4,115	SIC 16	1,055	4,160
Industrial Equipment	991	6,336	SIC 10-14, 20-39, 50-51	1,017	6,502
Lawn & Garden Equip	8,497	21,030	population	9,031	22,351
Recreational Vehicles	460	2,148	population	489	2,283
total all nonroad	***17,571***	***62,751***		***18,584***	***66,248***

Table 35: Area Source Growth Surrogates and Emissions Projections, 1996 and 2000

Category	1996 tpy	1996 ppd	growth surrogate	2000 tpy	2000 ppd
Woodstoves/Fireplaces	13,490	120,704	population	14,338	128,288
Res. Non-wood Fuel	142	1,109	population	151	1,179
Commercial Fuel	66	522	population	70	555
small point	12	64	population	13	68
Industrial Fuel	62	397	SIC 10-14, 20-39, 50-51	64	407
small point	3	15	SIC 10-14, 20-39, 50-51	3	15
Comm/Ind Incineration	1	9	SIC 10-14, 20-39, 50-51	1	9
Trash Burning	146	798	population	155	848
Yard Waste Burning	108	15,482	population	115	16,455
Prescribed Burning	182	0	minimal presence in NAA	0	0
Wildfires	184	1,008	will assume no change	196	1,071
Structure Fires	125	685	population	133	728
total all area sources	***14,521***	***140,793***		***15,239***	***149,623***

Onroad Mobile Sources

The method for estimating year 2000 emissions was essentially the same as that used for the base year 1996.

Activity Level

Detailed information on the derivation of ADVMT may be found in Appendix C-1.

Table 36: Average Daily Vehicle Miles Traveled by Functional Classification, 2000

Rural	ADVMT		Urban	ADVMT
Interstate	0		Interstate	1,609,690
Other Principal Arterial	0		Other Freeways and Expressways	3,561,623
Minor Arterial	2,329		Other Principal Arterial	1,017,471
Major Collector	18,978		Minor Arterial	610,858
Minor Collector	0		Collector	39,432
Local	0		Local	57,650
Total Rural	21,307		Total Urban	6,896,724
			total all ADVMT	***6,918,031***

Emission Rate Determination

EPA's MOBILE model, version 5b, was used to calculate emission rates in grams per mile.[35] Inputs to the model are the same as those described for the base year 1996 except as noted below. A sample input file follows the discussion.

Registration Distribution

The most recent local registration distribution (July 1, 1998) was compiled using information from the Department of Licensing (DOL).[36]

Oxygenated Fuel Program

The oxygenated fuel program parameters used were those expected to be in place during the winter of 1999-2000. The oxygenated fuel was an alcohol blend, with 3.5% oxygen content. No waivers to the oxygenated fuel program were granted.[38]

Inspection and Maintenance (I/M) Program

Two changes will affect the I/M program in the year 2000: 1) vehicles with model year newer than four years old or older than twenty-four years old will no longer be tested, and 2) acceleration simulation mode (ASM) testing began in 1997. The I/M program record was adjusted to reflect these changes. No changes were made to the stringency, waiver, or compliance rates.

Emissions Estimates and Temporal Adjustments

No changes were made to the procedure to estimate and seasonally adjust emissions.

Even though ADVMT increased from 1996 to 2000, emissions decreased 20%. The decrease can be attributed to the turnover of motor vehicles from older to newer models, enhancements to the vehicle inspection and maintenance program, and an increase in the oxygen content of gasoline.

Table 37: Onroad Mobile Source Emissions in Pounds Per Day, 2000

HPMS class	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	***total***
Rural									
Interstate	0	0	0	0	0	0	0	0	***0***
Principal Arterial	0	0	0	0	0	0	0	0	***0***
Minor Arterial	44	18	11	6	0	0	2	0	***81***
Major Collector	300	120	71	43	0	0	15	3	***552***
Minor Collector	0	0	0	0	0	0	0	0	***0***
Local	0	0	0	0	0	0	0	0	***0***
Urban									
Interstate	26,787	10,690	6,369	3,800	7	4	1,362	251	***49,268***
Freeways/Expressways	77,222	30,817	18,360	10,955	19	11	3,927	724	***142,033***
Other Principal Arterial	23,674	9,447	5,629	3,358	6	3	1,204	222	***43,542***
Minor Arterial	15,360	6,130	3,652	2,179	4	2	781	144	***28,252***
Collector	1,176	469	280	167	0	0	60	11	***2,163***
Local	1,619	646	385	230	0	0	82	15	***2,978***
total	***146,1821***	***58,3371***	***34,756***	***20,737***	***36***	***20***	***7,433***	***1,370***	***268,871***

Table 38: Onroad Mobile Source Emissions in Tons per Year, 2000

HPMS class	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	*total*
Rural									
Interstate	0	0	0	0	0	0	0	0	***0***
Principal Arterial	0	0	0	0	0	0	0	0	***0***
Minor Arterial	8	3	2	1	0	0	0	0	***15***
Major Collector	55	22	13	8	0	0	3	1	***101***
Minor Collector	0	0	0	0	0	0	0	0	***0***
Local	0	0	0	0	0	0	0	0	***0***
Urban									
Interstate	4,889	1,951	1,162	693	1	1	249	46	***8,992***
Freeways/Expressways	14,093	5,624	3,351	1,999	3	2	717	132	***25,921***
Other Principal Arterial	4,320	1,724	1,027	613	1	1	220	40	***7,947***
Minor Arterial	2,803	1,119	667	398	1	0	143	26	***5,156***
Collector	215	86	51	30	0	0	11	2	***395***
Local	295	118	70	42	0	0	15	3	***543***
total	26,678	10,647	6,343	3,785	7	4	1,357	***250***	***49,069***

Figure 4: Sample Year 2000 MOBILE5b Input File (with I/M Program)

```
1          PROMPT  -  no prompting, vertical format
Spokane I/M Program, 2000
1          TAMFLG  -  M5.0b tampering rates
1          SPDFLG  -  one speed for all vehicle types
1          VMFLAG  -  M5.0b VMT mix
3          MYMRFG  -  WA 1998 registration dist., M5.0b mileage accum. rate
1          NEWFLG  -  M5.0b basic exhaust emission rates
6          IMFLAG  -  I/M program with tech training
1          ALHFLG  -  no additional correction factors
1          ATPFLG  -  no anti-tampering program
5          RLFLAG  -  zero out refueling emissions
1          LOCFLG  -  one local area parameter for each scenario
1          TEMFLG  -  use max and min temperatures
1          OUTFMT  -  220 column output
2          PRTFLG  -  CO factors only
1          IDLFLG  -  no idle emission factors
1          NMHFLG  -  CO factors only
1          HCFLAG  -  CO factors only
 .028 .051 .049 .060 .055 .060 .054 .063 .061 .062    LDGV, MY 1-10
 .058 .057 .052 .030 .029 .020 .018 .021 .022 .025    LDGV, MY 11-20
 .024 .018 .013 .008 .061                             LDGV, MY 21-25
 .026 .049 .039 .045 .059 .049 .044 .049 .050 .056    LDGT1, MY 1-10
 .047 .044 .053 .034 .033 .024 .019 .023 .023 .032    LDGT1, MY 11-20
 .028 .025 .021 .015 .116                             LDGT1, MY 21-25
 .026 .049 .039 .045 .059 .049 .044 .049 .050 .056    LDGT2, MY 1-10
 .047 .044 .053 .034 .033 .024 .019 .023 .023 .032    LDGT2, MY 11-20
 .028 .025 .021 .015 .116                             LDGT2, MY 21-25
 .017 .027 .016 .022 .021 .018 .017 .020 .022 .026    HDGT, MY 1-10
 .024 .020 .024 .018 .018 .012 .011 .014 .016 .055    HDGT, MY 11-20
 .064 .075 .061 .042 .339                             HDGT, MY 21-25
 .028 .051 .049 .060 .055 .060 .054 .063 .061 .062    LDDV, MY 1-10
 .058 .057 .052 .030 .029 .020 .018 .021 .022 .025    LDDV, MY 11-20
 .024 .018 .013 .008 .061                             LDDV, MY 21-25
 .026 .049 .039 .045 .059 .049 .044 .049 .050 .056    LDDT, MY 1-10
 .047 .044 .053 .034 .033 .024 .019 .023 .023 .032    LDDT, MY 11-20
 .028 .025 .021 .015 .116                             LDDT, MY 21-25
 .046 .055 .036 .050 .040 .039 .039 .041 .055 .051    HDDT, MY 1-10
 .045 .040 .045 .020 .018 .011 .014 .015 .016 .025    HDDT, MY 11-20
 .017 .044 .024 .031 .183                             HDDT, MY 21-25
 .032 .044 .041 .038 .035 .036 .026 .022 .023 .025    MC, MY 1-10
 .028 .650 .000 .000 .000 .000 .000 .000 .000 .000    MC, MY 11-20
 .000 .000 .000 .000 .000                             MC, MY 21-25
2 1 2 1                                                            I/M Ctrl
85 29 76 96 06 14 096 112 2222 2212 220. 1.20 999.                 I/M Curr
97 29 76 96 06 14 096 112 2222 5212  25.  25.   2.                 I/M ASM
c:\mob5b\imdata4.d                                                 I/M Credit
1 00 32.0 33.0 30.6 30.2 30.6  1                                   Scenario
spkim          24.  38.  12.8 12.8  20 2 1 1 1                     LAP
.001 .999 .027 .035 1                                              Oxy
000000000000000000000000000000000000000000000000000000000000000000000000000000
```

Modeling Inventories for Base and Projection Years

Emission Inventories were prepared for the Urban Airshed Model – V. Five days were chosen from the winter of 1998-99 to validate UAM-V. Ten base case days were chosen from 1993-96. Emissions projections inventories were constructed for ten base case days representing the same meteorological and day of week conditions experienced during each of the base case days for the projection year 2000.

Modeling Day Selection

Fifteen modeling days were selected based upon air monitoring and meteorological data. Five base case days were selected during air stagnation when CO concentrations were high. Another five base case days were selected when concentrations were below exceedance levels, yet high enough to be of concern. These days occurred during different meteorological and regulatory conditions including high temperatures, high wind speeds, low temperatures, and/or outside of the oxygenated fuel season. Five additional days were selected for model validation. The validation days were selected from days when a background CO monitor was in operation.

Table 39: Modeling Days

Date	Day	Type	Reason for Selection
03-22-93	Mon	base, projection	high temperature
04-01-93	Thu	base, projection	high temperature
11-10-93	Wed	base, projection	high concentration
11-11-93	Thu	base, projection	high concentration
03-02-94	Wed	base, projection	high wind speed, high temperature
01-09-95	Mon	base, projection	high concentration
12-11-95	Mon	base, projection	high concentration
12-12-95	Tue	base, projection	high wind speed, high concentration
02-01-96	Thu	base, projection	low temperature
12-30-96	Mon	base, projection	high concentration
12-30-98	Wed	validation	background concentration available
01-05-99	Tue	validation	background concentration available
01-06-99	Wed	validation	background concentration available
01-10-99	Sun	validation	background concentration available
01-11-99	Mon	validation	background concentration available

Emission Sources

Emissions sources making up ninety-seven percent of the base year 1996 inventory were included in the modeling inventory. The sources included were: major point sources, aircraft, commercial equipment, construction equipment, industrial equipment, lawn/garden equipment, woodstoves and fireplaces, and onroad mobile sources.

Spatial Allocation

Emissions were allocated to one-kilometer grids over the nonattainment area. Generally, emissions were allocated to grids by 1) point coordinates, 2) the intersection of the transportation roadway network with the grids, or 3) population totals by grid. Emissions projections were assigned to grids in the same way. For some source categories, population had to be substituted for the more appropriate emissions projection surrogates used in the year 2000 Typical Day Projection Inventory. For example, construction equipment was projected based on employment in SIC 16, but it was based on population for the modeling files. Substitutions are noted in the text.

Temporal Resolution

Emissions estimates in grams per second were calculated for each hour of each modeling day. Estimates were made for several hours prior to each modeling day in order to allow "spin-up" time for the model. Since maximum CO concentrations frequently occurred near the end of the modeling days, emissions for the modeling day were duplicated and appended after the day to allow for possible offsets in timing the maximum CO concentration.

Emissions projections to the year 2000 for the ten base case days were prepared using the same meteorological and day of week conditions experienced during each of the ten base case days.

Point Sources

Only those point sources with the potential to emit CO in excess of 100 tons per year were modeled. Three sources of this size operate in the nonattainment area: Kaiser Aluminum and Chemical, Kaiser Trentwood, and Waste to Energy.

Validation and Base Case Days

Annual air emissions reports were used to determine emissions estimates and stack parameters for each modeling day. Annual emissions estimates for each individual emission point within each facility were divided by the annual hours of operation to develop hourly emissions estimates. Because all of the sources operated 24 hours per day, 7 days per week, emissions were considered uniform for each hour of the day. For some emission points, additional information was obtained from the facilities to develop the specific stack parameters required by UAM-V. Emissions in g/sec were calculated:

$$g/sec = (T/yr) * (2000\ lb/T) * (453.6\ g/lb) * (yr/wk) * (wk/day) * (day/hr) * (hr/3600\ sec)$$

Table 40: Point Source Emissions Estimates in Tons per Year, 1993-1998

Plant name	1993	1994	1995	1996	1998
Kaiser Aluminum and Chemical	19460	18753	21674	28751	23049
Kaiser Trentwood	227	123	123	122	123
Waste to Energy	59	52	46	45	55

Table 41: Point Source Emissions Estimates in Grams per Second, 1993-1998

Plant Name	1993	1994	1995	1996	1998
Kaiser Aluminum and Chemical	561	541	625	829	665
Kaiser Trentwood	7	4	4	4	4
Waste to Energy	2	2	1	2	2

Year 2000 Projection Days

Point source emissions projections are based on allowable emissions. Allowable emissions were calculated based on emissions limits and/or maximum production/activity for each emission point. The allowable emissions were combined with the most recent year's (1998 or 1999) stack parameters for use in UAM-V. Emissions in g/sec were calculated:

glsec = (T/yr) * (2000 lb/T) * (453.6 g/lb) * (yr/8760 hrs) * (hr/3600 sec)

Table 42: Point Source Allowable Emissions

Plant name	tpy	g/sec
Kaiser Aluminum and Chemical	33816	973
Kaiser Trentwood	377	11
Waste to Energy	172	5

Aircraft

Emissions from Spokane International (Geiger) Airport were included in the modeling inventories. Emissions from Felts Field were insignificant and were not included. Emissions calculated for the 1996 base year inventory were used for all modeling days. This was a simplification of emissions projections made in the year 2000 typical day projection inventory where emissions were projected using population as a surrogate. Emissions were considered uniform year-round.

g/sec = (tpy) * (2000 lb/T) * (453.6 g/lb) * (yr/8760 hrs) * (hr/3600 sec)

Table 43: Aircraft Emissions

tpy	g/sec
688	20

Nonroad Mobile Sources

Emissions from commercial, construction, industrial and lawn/garden equipment were included in the modeling inventories. CO emission factors in g/person-yr were derived from EPA's 1990 Nonroad Study for each equipment type using the following equation:[14,15]

g/person-yr = (1990 emissions in grams) / (1990 population)

Emissions were seasonally adjusted using the seasonal fractions in the Nonroad Study. EPA guidance for allocating emissions by hour and day of week was used to develop day-specific hourly emissions profiles.[56] The resulting seasonally and hourly adjusted emission factors were multiplied by population estimates to estimate emissions for each of the modeling days. The year 2000 population projection was used to calculate year 2000 emissions.

The method used to calculate emissions for modeling is a simplification of the year 2000 Typical Day Projection Inventory method. In the typical day inventory, emissions from construction and industrial equipment were made by projecting appropriate employment figures.

Table 44: Seasonal Fraction of Annual Nonroad Emissions

Category	Seasonal Adjustment		Category	Seasonal Adjustment	
	winter	spring,fall		winter	spring,fall
Construction			*Commercial*		
Asphalt Pavers	0.15	0.235	Generator Sets < 50 HP	0.25	0.25
Tampers/Rammers	0.15	0.235	Pumps < 50 HP	0.25	0.25
Plate Compactors	0.15	0.235	Air Compressors < 50 HP	0.25	0.25
Concrete Pavers	0.15	0.235	Gas Compressors < 50 HP	0.25	0.25
Rollers	0.15	0.235	Welders < 50 HP	0.25	0.25
Scrapers	0.15	0.235	Pressure Washers < 50 HP	0.25	0.25
Paving Equipment	0.15	0.235	*Industrial*		
Surfacing Equipment	0.15	0.235	Aerial Lifts	0.25	0.25
Signal Boards	0.15	0.235	Forklifts	0.25	0.25
Trenchers	0.15	0.235	Sweepers/Scrubbers	0.25	0.25
Bore/Drill Rigs	0.15	0.235	Other General Industrial Equip	0.25	0.25
Excavators	0.15	0.235	Other Material Handling Equip	0.25	0.25
Concrete/Industrial Saws	0.15	0.235	*Lawn & Garden*		
Cement and Mortar Mixers	0.15	0.235	Trimmer/Edger/Brush Cutters	0.03	0.285
Cranes	0.15	0.235	Lawn Mowers	0.03	0.285
Graders	0.15	0.235	Leaf Blowers/Vacuums	0.03	0.285
Off-Highway Trucks	0.15	0.235	Rear Engine Riding Mowers	0.03	0.285
Crushing/Proc. Equipment	0.15	0.235	Front Mowers	0.03	0.285
Rough Terrain Forklifts	0.15	0.235	Chainsaws <4 HP	0.25	0.175
Rubber Tired Loaders	0.15	0.235	Shredders <5 HP	0.03	0.285
Rubber Tired Dozers	0.15	0.235	Tillers <5 HP	0.03	0.285
Tractors/Loaders/Backhoes	0.15	0.235	Lawn/Garden Tractors	0.03	0.285
Crawler Tractors	0.15	0.235	Wood Splitters	0.03	0.285
Skid Steer Loaders	0.15	0.235	Snowblowers	1	0
Off-Highway Tractors	0.15	0.235	Chippers/Stump Grinders	0.03	0.285
Dumpers/Tenders	0.15	0.235	Commercial Turf Equipment	0.03	0.285
Other Construction Equipment	0.15	0.235	Other Lawn/Garden Equipment	0.03	0.285

Table 45: Hourly Fractions of Daily Nonroad Emissions

hour	Weekdays					Saturday					Sunday			
	cnstr	comm	indst	lawn		cnstr	comm	indst	lawn		cnstr	comm	indst	lawn
0	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00		0	0	0	0.00
1	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00		0	0	0	0.00
2	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00		0	0	0	0.00
3	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00		0	0	0	0.00
4	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00		0	0	0	0.00
5	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00		0	0	0	0.00
6	0.08	0.08	0.06	0.00		0.20	0.20	0.06	0.00		0	0	0	0.00
7	0.08	0.08	0.06	0.00		0.20	0.20	0.06	0.00		0	0	0	0.00
8	0.08	0.08	0.06	0.10		0.20	0.20	0.06	0.10		0	0	0	0.10
9	0.08	0.08	0.06	0.10		0.20	0.20	0.06	0.10		0	0	0	0.10
10	0.08	0.08	0.06	0.10		0.20	0.20	0.06	0.10		0	0	0	0.10
11	0.08	0.08	0.06	0.10		0.00	0.00	0.06	0.10		0	0	0	0.10
12	0.08	0.08	0.06	0.10		0.00	0.00	0.06	0.10		0	0	0	0.10
13	0.08	0.08	0.06	0.10		0.00	0.00	0.06	0.10		0	0	0	0.10
14	0.08	0.08	0.06	0.10		0.00	0.00	0.06	0.10		0	0	0	0.10
15	0.08	0.08	0.06	0.10		0.00	0.00	0.06	0.10		0	0	0	0.10
16	0.08	0.08	0.06	0.10		0.00	0.00	0.06	0.10		0	0	0	0.10
17	0.08	0.08	0.06	0.10		0.00	0.00	0.06	0.10		0	0	0	0.10
18	0.08	0.08	0.06	0.00		0.00	0.00	0.06	0.00		0	0	0	0.00
19	0.00	0.00	0.04	0.00		0.00	0.00	0.04	0.00		0	0	0	0.00
20	0.00	0.00	0.04	0.00		0.00	0.00	0.04	0.00		0	0	0	0.00
21	0.00	0.00	0.04	0.00		0.00	0.00	0.04	0.00		0	0	0	0.00
22	0.00	0.00	0.04	0.00		0.00	0.00	0.04	0.00		0	0	0	0.00
23	0.00	0.00	0.04	0.00		0.00	0.00	0.04	0.00		0	0	0	0.00

Emissions in g/sec for each equipment type and hour were calculated:

g/sec = (persons) x (CO g/person-yr) x (% yr/season) x (season/13 weeks) x
(week/equipment operating days) x (%day/hour) x (hr/3600 sec)

Table 46 shows total nonroad emissions estimates for modeling days in 1996. Total hourly emissions are the sum of each individual equipment type's hourly emissions.

Table 46: Example Nonroad Emissions in g/sec Using 1996 Population Estimates.

hour	Dec-Feb			Mar-May, Sep-Nov		
	Weekday	'Saturday	Sunday	Weekday	Saturday	Sunday
00	0	0	0	0	0	0
01	0	0	0	0	0	0
02	0	0	0	0	0	0
03	0	0	0	0	0	0
04	0	0	0	0	0	0
05	0	0	0	0	0	0
06	376	376	0	407	407	0
07	376	376	0	407	407	0
08	451	564	188	898	1636	1229
09	451	564	188	898	1636	1229
10	451	564	188	898	1636	1229
11	451	267	188	898	1308	1229
12	451	267	188	898	1308	1229
13	451	267	188	898	1308	1229
14	451	267	188	898	1308	1229
15	451	267	188	898	1308	1229
16	451	267	188	898	1308	1229
17	451	267	188	898	1308	1229
18	376	79	0	407	79	0
19	47	47	0	47	47	0
20	47	47	0	47	47	0
21	47	47	0	47	47	0
22	47	47	0	47	47	0
23	47	47	0	47	47	0

Residential Wood Combustion

Validation and Base Case Days

Four basic steps were followed to calculate emissions. Each step is detailed below

Step 1: Calculate Annual Emissions

Emissions for the base case years (1993-96) were calculated by linearly interpolating between the 1990 and 1996 emissions. Details on the 1990 and 1996 inventories may be found in the base year inventory. Emissions for the validation case years (1998-99) were calculated:

1998 emissions = (1996 emissions) + [2 x (1996 emissions – 1990 emissions)/6]
1999 emissions = (1996 emissions) + [3 x (1996 emissions – 1990 emissions)/6]

Step 2: Divide Annual Emissions by Population and Survey HDD

Annual emissions in g/HDD-person were calculated:

g/HDD-person = annual emissions in grams 1 (6271 x annual population)
where 6271 is the number of heating degree days in the BPA survey year 1990.

Table 47: CO Emission Rates in g/HDD-person

year	CO tpy	pop	g/HDD-person		year	CO tpy	pop	g/HDD-person
1990	14,139	361,364	5.66		1996	14,569	406,500	5.18
1993	14,354	383,600	5.41		1998	14,712	410,900	5.18
1994	14,426	392,000	5.32		1999	14,784	417,124	5.13
1995	14,497	401,200	5.23					

Step 3: Calculate Individual Modeling Days' Emissions

The emission factors in g/HDD-person calculated in Step 2 were multiplied by the number of HDDs in each modeling day and by the modeling year's population to calculate emissions.[64, 24]

Table 48: Heating Degree Days (HDD) and CO Emissions grams

Day	HDD	CO grams/day		Day	HDD	CO grams/day
Mar. 22, 1993	20	4.15E+07		Feb. 1, 1996	64	1.35E+08
Apr. 1, 1993	18	3.74E+07		Dec. 30, 1996	33	6.95E+07
Nov. 10, 1993	28	5.81E+07		Dec. 30, 1998	27	5.75E+07
Nov. 11, 1993	34	7.06E+07		Jan. 5, 1999	33	7.05E+07
Mar. 2, 1994	13	2.71E+07		Jan. 6, 1999	33	7.05E+07
Jan. 9, 1995	28	5.88E+07		Jan. 10, 1999	28	5.98E+07
Dec. 11, 1995	24	5.04E+07		Jan. 11, 1999	24	5.13E+07
Dec. 12, 1995	19	3.99E+07				

Step 4: Allocate Modeling Day Emissions to Each Hour of the Day

The BPA survey gave estimates of daily and hourly burning activity for weekdays and weekends. The daily adjustment factor for weekdays was 0.949 and 1.13 for weekends. Hourly adjustments and example emissions for one of the modeling days are shown in the next two tables.

Table 49: Woodstove Hourly Adjustment Factors

hour	Weekday	Weekend		hour	Weekday	Weekend
00	0.030	0.029		12	0.034	0.042
01	0.030	0.029		13	0.034	0.042
02	0.030	0.029		14	0.034	0.042
03	0.030	0.029		15	0.034	0.042
04	0.030	0.029		16	0.071	0.063
05	0.030	0.029		17	0.071	0.063
06	0.033	0.034		18	0.071	0.063
07	0.033	0.034		19	0.071	0.063
08	0.033	0.034		20	0.071	0.063
09	0.033	0.034		21	0.071	0.063
10	0.034	0.042		22	0.030	0.029
11	0.034	0.042		23	0.030	0.029

Table 50: Emissions for Dec. 30, 1996 (Monday)

hour	g/sec		hour	g/sec
00	425		12	483
01	425		13	483
02	425		14	483
03	425		15	483
04	425		16	1011
05	425		17	1011
06	469		18	1011
07	469		19	1011
08	469		20	1011
09	469		21	1011
10	483		22	425
11	483		23	425

Projection Year **2000** Days

Projections of woodstove activity levels were not readily available. Emission factors in g/HDD-person for the projection year 2000 was assumed the same as those calculated for 1999. Steps 3 and 4 above were repeated, using population estimates for the projection year 2000 (see Appendix C-2).

Onroad Mobile Sources

The method for estimating modeling day emissions was essentially the same as that used for the base year1996 and typical day year 2000 inventories.

Activity Level

ADVMT specific for the year of each modeling day was used for the modeling inventories. Detailed information on the derivation of ADVMT may be found in Appendix C-1.

Calculation of Emission Rates

As for the base year, the model MOBILE5b was used to calculate emission rates. Parameters used in the 1996 base year inventory were changed as appropriate for each modeling day. The inputs that were changed were: maximum temperature, minimum temperature, ambient temperature, registration distribution, changes in the Inspection and Maintenance (I/M) program, and oxygen content of fuel. Each input is detailed below, followed by a description of the temporal adjustment factors.

Temperatures

Hourly temperatures fiom the Crown Zellerbach meteorological station were used to calculate daily maximum and minimum temperatures for each modeling day.[64] Hourly emission factors were run using each hour's temperature as the input ambient temperature. The projections to 2000 assumed the same temperature profiles as those used in the base case days.

Registration Distribution

Registration distributions were available for 1995, 1996 and 1998. All modeling days from 1993-95 used the 1995 distribution. The 1996 distribution was used for all days in 1996. The 1998 distribution was used for all modeling days from 1998-99 and projection year 2000.

Changes in the Inspection and Maintenance Program

Acceleration simulation mode (ASM) testing began in 1997. The effects of the test were modeled for days in 1998-99 and for all projections.

A change in the model years tested will take effect in the year 2000. Vehicles with model year newer than four years old or older than twenty-four years old will no longer be tested. This change in test requirements was incorporated into the projection years' inventories.

Oxygenated Fuel Program

The level of oxygen required in fuel has varied over years. Each day was run with the oxygen level in effect for that day. Projections were modeled assuming an oxygen content of 3.5%.[65]

Temporal Adjustment Factors

The Washington State Department of Transportation provided monthly, daily and hourly adjustment factors based on traffic counts.[43] Hourly VMT was calculated:

VMT/hour = (ADVMT) x (month adjustment) x (day adjustment) x (hour adjustment)

Table 51: Onroad Mobile Monthly Adjustment Factors

Month	Interstate	non-Interstate		Month	Interstate	non-Interstate
01	0.878	0.914		07	1.083	1.061
02	0.896	0.947		08	1.114	1.077
03	0.963	1.001		09	1.044	1.013
04	0.997	1.02		10	1.02	0.987
05	1.013	1.024		11	0.975	0.95
06	1.057	1.065		12	0.959	0.942

Table 52: Onroad Mobile Daily Adjustment Factors

Sun	Mon	Tue	Wed	Thu	Fri	Sat
0.742	0.970	0.993	1.000	1.007	1.099	0.893

Table 53: Onroad Mobile Hourly Adjustment Factors (Percent)

Hour	Wkday	Wkend		Hour	Wkday	Wkend		Hour	Wkday	Wkend
00	0.88	1.86		08	5.27	3.54		16	8.67	7.42
01	0.45	1.16		09	4.67	4.79		17	8.44	7.29
02	0.36	0.85		10	4.79	6.01		18	6.46	6.59
03	0.33	0.5		11	5.08	6.68		19	4.53	5.38
04	0.63	0.52		12	5.48	7.42		20	3.61	4.35
05	2.06	0.9		13	5.64	7.36		21	3.12	3.68
06	4.91	1.6		14	6.25	7.38		22	2.2	2.85
07	7.06	2.48		15	7.63	7.35		23	1.5	2.03

Sources Not Included in the Modeling Files

Residential yard waste burning was not included in the modeling files. Burning is only allowed during short intervals. It was not allowed during any of the chosen modeling days. Several other small sources of CO were not included in the modeling files. They made up only 1% of the base year 1996 inventory. Sources not included are listed below.

point sources < 100 tons potential emissions
general aviation aircraft from Felts Field
locomotives
agricultural equipment
airport service equipment
recreational boats
logging equipment
recreational vehicles
residential non-wood fuel use
commercial fuel use
small industrial fuel use
commercial/industrial incineration
trash burning
yard waste burning
prescribed burning
wildfires
structure fires

References

[1] Letter to Eric P. Skelton, Director of the Spokane County Air Pollution Control Authority from Anita Frankel, Director, Office of Air Quality, EPA Region 10, dated June 11, 1996.

[2] Washington Emissions Data System, 1996.

[3] Ron Edgar, Spokane County Air Pollution Control Authority.

[4] "Spokane International Airport Traffic and Operations Report," Jan-Feb, Oct-Dec 1997 (1996 data). Marketing and Public Relations Department. 509-455-6470.

[5] "Airport Operations at Airports with FAA Operated Traffic Control Towers by Towers, State and Aviation Category." Table 6-1 Fiscal Year 1997. Federal Aviation Administration. 202-267-9942.

[6] Procedures for Emission Inventory Preparation, Vol. IV: Mobile Sources. EPA-45014-81-026d (Revised) 1992, Sections 5.2.4.2 (aircraft), 4.0 (nonroad), 6.3 (locomotives).

[7] facsimile from Office or Airline Information, Bureau of Transportation Statistics, U.S. Department of Transportation to Sally Otterson, Dept. of Ecology. 1996 aircraft statistics for Spokane International and Felts Field carrier departures by carrier and aircraft type. May 1998.

[8] Procedures for Emission Inventory Preparation. Vol. IV: Mobile Sources. EPA-45014-81-026d(Revised), Draft Guidance issued in Aug. 1991, Section 6.0.

[9] Fuel Oil and Kerosene Sales, 1990 and 1996. Energy Information Administration. Table 4.

[10] Data from Fuel Use Section of BN switch yard in Spokane, 509-536-2347.

[11] Data from Mechanical Section of UP switch yard in Spokane, 509-536-5241.

[12] "Form R-1, Annual Report to the Interstate Commerce Commission." Burlington Northern Railroad. 1990.

[13] 1990 Density Chart. Burlington Northern Railroad, Pacific Division. System Engineering, March 1991.

[14] Nonroad Engine Emission Inventories for CO and Ozone Nonattainment Boundaries Spokane and Seattle-Tacoma CMSA. Energy and Environmental Analysis, Inc. Arlington, Virginia. Inventory (A+B)/2. Spreadsheets dated Aug. 25 and 26,1992.

[15] Nonroad Engine and Vehicle Emissions Study - Report. USEPA, Office of Air and Radiation

(ANR-433), Washington DC, 20460. 21A-2001, November 1991.

[16] Spokane Regional Transportation Council. 1996,2000,2005 and 2012 county and nonattainment area estimates of population and employment.

[17] 1990 Population Trends for Washington State. Office of Financial Management, Forecasting Division. August 1990. (population revised April 19, 1991).

[18] Employment and Payrolls in Washington State by County and Industry, 1990 Annual Averages. WA Employment Security Department.

[19] Personal Conversation with John Wines, Washington State Department of Employment Security. 1996 Spokane County employment by SIC code.

[20] "Vessel Registration Count by Moorage County and Length." Washington State Department of Licensing. 4/91 and 4/97 data (peak 1990 and 1996 registrations, respectively).

[21] Evaluating Effects of Wood Smoke Control Legislation in Washington State on Electrical Customers. Prepared for Bonneville Power Administration by Mike Nelson of the Washington State Energy Office and Stewart Kaufman of the Gilmore Research Group. June 1990. Accompanying raw survey data.

[22] Washington State Department of Revenue. Solid fuel burning device sales records 1990-1996.

[23] 1991 Population Trends for Washington State. Office of Financial Management. August 1991. General Characteristics of Population and Housing (by county) tables, and Table 3.

[24] 1996 Population Trends. Office of Financial Management. October 1996. Tables 4 and 7. Supplemented by population for 1998 obtained from Office of Financial Management Internet site.

[25] Chapter 173-433 Washington Administrative Code.

[26] personal conversations with Fred Greef – Ecology, Linda Schultz – USFS Spokane Office, DNR wood permit office.

[27] Hugh J. Hansen, Extension Agricultural Engineer. "Fuelwood Facts." Oregon State University. Nov. 1977. p 5.

[28] Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources. AP42, Fifth Edition. January 1995. Tables: Coal 1.1-3 (10/96), Natural Gas 1.4-1 (10/96), Fireplaces 1.9-1 (10/96), Woodstoves 10.1-1 (10/96), Wildfire 13.1-2 (10/96), Outdoor burning 2.5-1 (10/92), Yard Waste 2.5-5 (10/92).

[29] Climatoloaical Data, Washington. National Oceanic and Atmospheric Administration. Spokane WSO Airport. Monthly summaries from July 1989 to June 1990.

[30] National Climate Data Center. Data available through Internet homepage (http://www.ncdc.noaa.gov/). 1996 daily heating degree days for Spokane International Airport.

[31] Procedures for Emission Inventory Preparation, Vol. III: Area Sources. EPA 450/4-81-026C, September 1981. Sections 2.1, and 5.8.

[32] Energy Information Administration Internet site (http://www.eia.doe.gov/index.htrnl). Coal Consumption Report: Coal Industry Annual, "Table 71: Coal Consumption at Other Industrial Plants by Census Division and State, Table 75: Coal Consumption by Residential and Commercial Sector, by Census Division and State."

[33] Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Vol. I: General Guidance for Stationary Sources. EPA-450/4/91-016. May 1991. Section 4.8.4, Table 5.8-1.

[34] Letter from Hank Nelson, Washington Water Power to Sally Otterson, Department of Ecology. Natural gas usage for 1996 by sector and region. June 2, 1998.

[35] MOBILE5b Model and User's Guide. Environmental Protection Agency. Office of Mobile Sources. National Motor Vehicle and Fuels Emission Laboratory. 2565 Plymouth Road. Ann Arbor, MI 48105.

[36] "Motor Vehicle Registrations by Year W/N Class." Washington State Department of Licensing. Monthly reports from July 1995 to June 1996, and July 1997 to June 1998.

[37] "Motor Vehicle Fuel Properties." Washington State Department of Agriculture. 1994.

[38] Spokane County Air Pollution Control Authority rule. Section 616.

[39] Department of Ecology. Vehicle Inspection and Maintenance Database Records. 1994.

[40] Personal conversation with David Brzezinski, USEPA Office of Mobile Sources.

[41] Analysis of I/M Program Options in Spokane, Washington. Sierra Research, Inc. July 6,1995 (draft).

[42] 1987 Survey of Travel in I/M area – Puget Sound and Spokane. Washington State Department of Ecology.

[43] "Adjustment Factors for Vehicle Miles Traveled." Washington State Department of Transportation. Barbara Hertzog and Hank Borden. July 1992.

[44] Conference call with David Misenheimer, EPA Office of Air Quality Planning and Standards. Sept. 16, 1992.

[45] "Survey of Waste Disposal and Woodstoves." Puget Sound Air Pollution Control Agency. Jan. 1990. Peter Bosserman.

[46] Memo from Denise Fenn, Radian, to SIP Inventory Preparers and EPA Regions. April 17, 1992. Accessed via the EPA CHIEFS electronic bulletin board.

[47] Spokane County Air Pollution Control Authority records.

[48] "Stationary Area Source Carbon Monoxide Emissions Inventory 1986-1988." Puget Sound Air Pollution Control Agency. March 28. 1990.

[49] Ecology area source inventory, 1989.

[50] Department of Natural Resources, burn permit database, 1996.

[51] Smoke Management System Information (SMSINFO). US Forest Service fuel consumption and emissions estimates model developed for the Pacific Northwest.

[52] Annual Fire Statistics, 1985-90, 1996. Department of Natural Resources. Report. 35019.

[53] Cassidy, Kelly M. Land Cover Washington State, Description and Management. Washington State GAP Analysis Proiect Final Report, 1997. Land Cover of Washington State map. Forest, mesic steppe and grass/shrub meadows, shrubfields and meadows land use categories.

[54] Spokane County Air Pollution Control Authority Fire Department Survey, August 1991.

[55] "Fuel Consumption and Fire Behavior Associated with Prescribed Fires in Sagebrush Ecosystems." David B. Sapsis and J. Boone Kauffman (503-737-3341). Department of Rangeland Resources, Oregon State University.

[56] Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume II: Emission Inventory Requirements for Photochemical Air Quality Simulation Models (Revised). Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, NC 27711. EPA-454/R-92-026. December 1992. Table 6-11.

[57] Kaiser Aluminum & Chemical Corporation Mead Works Title V Air Operating Permit Application.

[58] Ecology Order No. DE 96AQ-I071 for Kaiser, Mead Works, Bake Oven.

[59] letter from Michael J. Sawatsky, Kaiser Mead to Sally Otterson, Dept. of Ecology. June 1, 1999.

[60] email from Mike Sawatsky, Kaiser Mead to Sally Otterson, Dept. of Ecology. June 8, 1999.

[61] personal conversation with Mike Sawatsky. June 8, 1999.

[62] Kaiser Aluminum & Chemical Corporation, Mead Works Building 300, Method 6 – SO2 Results. flow rate of new bake furnace. March 9, 1999.

[63] Potential to emit calculations for Kaiser Trentwood and Waste to Energy. Kelle Vigeland, Spokane Air Pollution Control Authority. June 4, 1999.

[64] Crown Zellerbach meteorological station. Heating degree days calculated from hourly temperature data for each modeling day.

[65] personal conversation with Ron Edgar, Spokane County Air Pollution Control Authority.

Appendix C-A: Vehicle Miles Traveled

The estimation of VMT involves several agencies. Actual traffic counts as well as travel demand modeling is utilized to determine the amount and location of vehicle travel. The key activities and responsible agencies are outlined below.

1. Agency Roles

Transportation activities are distributed across the five jurisdictions or agencies responsible for the planning, programming, and implementation in the Spokane NAA.

1.1 Traffic Counting

Traffic counting is conducted by the City of Spokane, Spokane County and Washington State Department of Transportation (WSDOT). Annual Traffic Count programs are conducted, as well as special counts used in studies.

The State of Washington (WSDA) maintains two permanent traffic recording (PTR) count locations, one on SR-90 at Havana Street; the other on SR-2 (Division Street) north of Walton Street. These PTR collect and summarize hourly traffic count data, which are issued as part of a monthly statewide report.

Vehicle classification counts are used to determine the types and percentage of vehicles using transportation facilities. While the City of Spokane, Spokane county and WSDOT each have some degree of vehicle classification capability, WSDOT travel data branch is used for the majority of vehicle classification count requests.

1.2 Network Modeling

SRTC as the metropolitan planning organization provides network modeling capabilities for all jurisdictions in Spokane County. SRTC utilized TMODEL2 to conduct network modeling activities. The network model has been developed and calibrated as a p.m. peak hour model, with the capability to develop hourly trip table and assignment data for a 24 how period.

The network itself is based on the federal functional classification utilizing freeways, principal, minor and selected collector arterials.

1.3 Regional Growth Forecast

SRTC develops regional growth forecasts used for transportation planning activities. As Spokane County growth continues to escalate, the County will be required to plan under the State of Washington's Growth Management Act (GMA). Planning under GMA will require all jurisdictions with Spokane to use forecasts developed through the State of Washington, Office of Financial Management.

1.4 HPMS reporting to FHWA

WSDOT has the responsibility for reporting Highway Performance Monitoring System (HPMS) data to the Federal Highways Administration (FHWA). This data is developed by WSDOT as well as by local jurisdictions providing updated information as requested.

1.5 Forecasting fi-om HPMS data

SRTC is responsible for forecasting HPMS data for developing vehicle miles of travel estimate for the attainment year, as well as other years contained within the analysis used in the State Implementation Plan (SIP).

2. Derivation of Vehicle Miles Traveled (VMT) Data

Because HPMS data is not available at the link level, and does not include speeds, the network model continues to be used for link level emissions inventories. HPMS and the network model are in close agreement, as has been evident in the Section 187 VMT Forecasting and Tracking annual reports. The following information focuses on the network model estimation process.

Vehicle miles traveled data was provided by the SRTC. The following information was provided by the SRTC and addresses items important for quality assurance.'

2.1. Transportation Demand Modeling Process

SRTC derives VMT fi-om its regional transportation demand model (TMODEL2). This land use-based model has been calibrated for a base year of 1996. SRTC used actual land use and network files for 1996 so VMT could be calculated directly fi-om the model. Trip assignments were performed so VMT estimates could be obtained by functional classification.

A complete description of SRTC's transportation modeling methodology may be found in appendices A (Technical Report) and B (Transportation Modeling Procedures) of SRTC TMODEL2.[2,3] These appendices outline specific transportation modeling processes and procedures and are updated annually. SRTC can provide the manuals on request.

2.2. Model Calibration

2.2.1 Calibration Methodology

SRTC receives and maintains traffic count information collected by various jurisdictions. Vehicle volumes (ground counts) are taken at model screenline locations The data is collected, verified and used to create a model screenline file. This process was done in compliance with the guidelines contained in appendices A and B of TMODEL2.

2.2.2 Calibration Results

The modeled volumes and collected vehicle volumes were within nationally accepted parameters at the overall screenline and individual screenline levels.

2.3. Model Data

2.3.1 Introduction

To create trips, the model uses land use files with transportation analysis zones (TAZs). SRTC has divided Spokane County into 428 internal TAZs. This exceeds the general rule of one TAZ per 1000 population used for modeling moderate sized urban areas. In addition to the 428 internal zones, SRTC account for trips into, out of, and through the region with nine external zones.

After the gravity model "distributes" these internal and external trips, they are "assigned" to a network representing the regionally significant roadways in Spokane County. The network has been verified using SRTC's geographic information system (GIS) and field observation. The result of this distribution and assignment process is a "loaded" links file. This file contains model-generated data and is used to calculate VMT.

2.3.2 VMT

First, SRTC models all of Spokane County, but VMT calculations are limited to the links within the carbon monoxide nonattainment area. SRTC uses the "area" data field to limit VMT calculations to links inside this boundary.

SRTC's transportation model uses the weekday, p.m. peak hour. Therefore, VMT must be aggregated from the peak hour into a 24-how total. SRTC uses a p.m. peak hour factor based on regionally collected ground counts to determine the hour-to-hour distribution of VMT. Peak hour data is adjusted by hour using a traffic counts variation file. The air quality module in TMODEL2 aggregates VMT automatically and can screen VMT by functional classification.

The SRTC model includes all interstates, principal arterial and minor arterials within the nonattainrnent area boundary. Regionally significant collectors are also included. Local streets within the functional system are not specifically counted; however, since all trips are counted, local VMT is incorporated within the network.

Table 54: Vehicle Miles Traveled by Class, 1990, 1993, and 1996

Year	ADVMT	Class 1	Class 2	Class 3	Class 4
		Interstates	Princ. Art.	Minor Art.	All Others
1990	5,712,886	1,297,174	3,172,748	780,383	462,568
1993	6,264,969	1,413,970	3,470,934	865,165	514,497
1996	6,613,806	1,539,630	3,455,729	944,211	674,249

2.3.3 Vehicle Trips and Person Trips

SRTC models vehicle trips. Converting vehicle trips to person trips can be accomplished off model. SRTC maintains an ongoing program of vehicle occupancy (AVO) data collection. Vehicle occupancy data is used to convert vehicle trips to person trips when needed.

2.3.4 Transit Trips

Transit trips are not currently considered separately in the SRTC regional model.

2.3.5 Link Data

The model network includes freeways, principal arterials and minor arterials. Some collectors are modeled when they are considered regionally significant. Per lane link capacity is based on functional class. SRTC uses capacity restrained assignments; therefore, no link was loaded beyond its capacity. Trip assignments were performed on the validated base year network with no additions or alterations.

2.3.6 Trip Generation Rates and Land Use Control Totals

SRTC uses trip generation rates based on field collected data. Additional information on trip generation rates is available in the TMODEL2 appendices A and B. Table 55 lists SRTC's 1996 housing and employment control totals. These control totals are developed using state and local data sources.

Table 55: 1996 Population and Employment Totals, SRTC

single family dwelling units	134,918
multi-family dwelling units	31,968
hotel/motel rooms	5,541
manufacturing/industrial employment	50,581
central business district retail employment	6,541
services/offices employment	28,869
finance/insurance/real estate	9,977
medical employment	18,591
non-central business district employment	32,205
schools	18,768

2.3.7 External Trips

Internal-External Trips: TM2 creates internal-external trip data as a function of O-D information from the 1996 O-D Survey. Internal-external trips are balanced using ground counts from this study. External traffic analysis zones for the Spokane network are represented by zones 429-437.

External-External Vehicle Trips: In 1996, SRTC undertook an extensive survey of external trips throughout the Spokane region. Data derived from the study was utilized in developing trip data for external-externaltrips. This trip data is incorporated into the base and forecast year trip tables.

2.3.8 Assignment

2.3.8.1 Equilibrium

SRTC's transportation model is a traditional gravity model. Trip distribution and assignment are performed as described in the previously mentioned appendices with a few minor changes. Essentially, SRTC uses an iterative method of attaining equilibrium in trip assignment. As trips are loaded, volumes are assigned to links (and nodes). In each increment, these trip volumes create delay based on node and link delay equations. This delay allows the model to assign trips respecting volume-based congestion delay.

2.3.8.2 Constrained Equilibrium Speeds vs V/C Equations

SRTC uses the volume to capacity (V/C) equations included within TMODEL2 in the assignment process. The V/C equation impacts the constrained equilibrium speed. SRTC does not currently specify different V/C equation based on functional classification. In the facility-specific V/C algorithms are not specified in the SRTC model, the traditional Bureau of Public Roads formula is used. This formula adjusts the "no-load" travel time using the V/C ratio. See Appendix A of TMODEL2 for more information.

2.3.8.3 Average Speed

All emission calculation were done using individual link speeds, not network average speed. Node delay is included in emissions calculations. The node delay equation has been calibrated against actual delay as a measured by Highway Capacity Manual software. Percentage idle is accounted for by using inputs form MOBILE5.0ah in the TMODEL2 emissions module. In its link calculation, TMODEL2 does not explicitly consider idle percentage.

References

[1] Quality Review Guidelines for 1990 Base Year Emissions Inventories. EPA-454/R92-007, August 1992. App. C (Onroad Mobile Sources Detailed Review Checklist).

[2] TMODEL2 Transportation Modeling Procedures Manual, Spokane Regional Transportation Council.

[3] SRTC Policies and Procedures Manual.

Appendix C-B: Population and Employment

Base year 1996 and year 2000 projected population data for both the nonattainment area and county were supplied by SRTC. Base year employment data for specific Standard Industrial Classifications were supplied by SRTC and the Washington State Department of Employment Security.[1,2] Employment projections to the year 2000 were made only by SRTC.[3]

There were some differences between county employment totals supplied by SRTC and Employment Security. SRTC estimates were adjusted to reflect the Employment Security totals. Employment estimates used in this inventory were calculated using the following equation:

$$\text{1996 SRTC NAA employ.} \times \frac{\text{1996 Employ. Sec. county employ.}}{\text{1996 SRTC county employ.}} = \text{final NAA employ.}$$

Projections to the year 2000 were made by SRTC and were adjusted similarly to the base year:

$$\text{2000 SRTC NAA employ.} \times \frac{\text{1996 Employ. Sec. county employ.}}{\text{1996 SRTC county employ.}} = \text{final NAA employ.}$$

Table 56 shows the values used to calculate the base year 1996 and projection year 2000 final NAA employment.

Table 56: Employment Estimates, 1996 and 2000

SIC code(s)	SRTC NAA		1996 County Estimates		final NAA estimates	
	1996	2000	SRTC	Empl. Sec.	1996	2000
16	480	485	620	939	727	735
10-14, 20-39, 50-51	27,344	28,027	30,502	32,759	29,367	30,101

[1] Spokane Regional Transportation Council. 1996, 2000, 2005 and 2012 County and nonattainment area estimates of population and employment.

[2] Personal Conversation with John Wines, Washington State Department of Employment Security. 1996 Spokane County employment by SIC code.

[3] "Spokane Non-Attainment Area Housing Units, Population, and Employment Projections for 1999 SIP Documentation." Spokane Regional Transportation Council.

Appendix C-C: Quality Assurance Report

The quality assurance plan for the emissions inventory specified several quality assurance checks. A summary of the quality assurance checks performed and a description of the inventory process with emphasis on quality control/assurance activities follows.

Inventory Process with Emphasis on Quality Control/Assurance Activities

The inventory process is divided into several tasks. The tasks are: prioritization and identification of emissions sources, data collection procedures, emission estimations procedures, geographical allocation, validation procedures, measures to avoid double counting, calculations, rule effectivenesslpenetration, and seasonal/daily adjustments. Not all tasks apply to all sources. Details for each major source category are listed below.

Point Sources

Prioritization and Identification of Emissions Sources

In Washington, the major source threshold for CO is 100 tons (potential to emit). SCAPCA tracks major, synthetic minor, and smaller " Bsources in the annual Washington Emissions Data System (WEDS). Six sources with the potential to emit 50 tons were identified. Ten sources emitted at levels less than 50 tons. They were accounted for under appropriate categories.

Experienced inspectors and engineers from Ecology and/or SCAPCA have identified the emissions sources and the points within the sources. It is believed that all sources and emissions points have been counted.

Collection Procedures

Each year Ecology, in conjunction with SCAPCA and DOE-IS, updates the point source inventory. Update Request forms (questionnaire forms) are sent to the sources. The previous year's data is on the forms for the source to review for errors and to update. Sources return the forms to SCAPCA or DOE-IS for review before returning to HQ Ecology for further review and data entry by inventory personnel. By using this procedure, the quality of the data is enhanced since the plant, local authority and Ecology headquarters all review the data.

Emission Estimations Procedures

Emissions are estimated in one of several ways. In order of preferences/accuracy they are: source test, material balance, AP42 and other EPA factors, non-AP42 factors, or engineering guess. Over 95% of the emissions were estimated using material balance.

Calculations were not included in the SIP documentation since calculations may require throughput rates which may be co dential for a source. Calculations can be made available to EPA at request. All of the CO emissions were uncontrolled, so rule effectiveness was not applied.

Emissions in pounds per day were calculated by dividing the annual emissions by the number of days the source operated.

nfi

Geographical Allocation

Point sources were located in the area by use of UTM coordinates. Locations were verified by SCAPCA and DOE-IS.

Validation Procedures

As stated under Collection Procedures, all data has been reviewed by the plant, local air authority and Ecology inventory staff. RACT studies further refined emissions estimates for Kaiser, Mead. This ensures reasonableness and consistency of data and calculations performed.

Measures to Avoid Double Counting as Area Sources

Point sources did not duplicate any of the area source categories, except fuel use and incineration. The area source fuel use category calculations exclude all point source contributions, and the point source incinerator was excluded from the area source category. Therefore, none of the emissions from point sources were double counted.

Area and Nonroad Mobile Sources

Prioritization and Identification of Sources

There is no size cutoff for area sources. All source categories listed in the CO Inventory Guidance (EPA-45014191/011) and Procedures Manual @PA-45014-91-016) were inventoried or stated to be of little or no significance. Sources inventoried as point sources emitting below the cutoff level of 50 tons potential to emit were identified as small point sources and counted as area sources.

Collection Procedures

Area source data collection methods were mainly dictated by EPA guidance and inventory constraints. With these considerations the best methods were used. Where good local data was accessible, it was used and documented in the inventory text.

Emission Estimation Methods and Consistency of Application

Inventory methods were mainly chosen from Volumes III and IV of the Procedures for Emission Inventory Preparation, EPA-450/4-81-026a-e and the Procedures Manual and are documented in the inventory text. Resource constraints and the relative importance of the source category were considered when choosing estimation methodology.

Calculations

All calculations are documented along with assumptions, engineering judgments, and references in the inventory text. All information required to perform the calculations was provided. Calculations for most of the area/nonroad sources were done in electronically. Emissions were calculated according to EPA guidance. Any deviation was documented in the inventory text.

Rule Effectiveness/Penetration

There were no control regulations affecting CO emissions, so RE/RP was not applicable. The concept of RE/RP was used to estimate residential trash and garden waste burning (see category in text).

Seasonal Adjustment and Typical Day

Verified air quality violation data was used to determine the original 1990 base year inventory three month CO season (Oct-Dec, documented in the Onroad Mobile source section). A broader view of season was taken in this inventory and is detailed in the inventory text. Seasonal adjustment factors from EPA Procedures manuals were used in most cases. To cover the longer CO season, they were augmented with 2/3 of the fall season (Oct-Nov). Any deviation from the seasonal adjustment factors is documented in the inventory text.

Geographical Allocation

Area sources not specifically pinpointed were located using population statistics, local agency knowledge, methods from Vol. II of the Procedures Manual, and other methods. Allocations are documented in the inventory text.

Validation Procedures

Spot checks to ensure reasonableness and consistency of data and calculations were performed as the inventory was being completed and during proofing of the draft. Some consistency checks include: year of data, reporting units, population statistics used, and apportioning of area source data.

Onroad Mobile Sources

Estimating emissions from onroad mobile sources required developing emission factors to be used with vehicle miles traveled data. Derivation of VMT was documented by the SRTC and may be found in the onroad mobile source section and Appendix C-1. QA associated with SRTC's network model may be found in the model documentation. The focus of QA was on MOBILE5b runs and the combining of the resulting emissions factors with the VMT data.

Prioritizing Sources and Data Elements

MOBILE inputs for which there were no defaults were priority fields. One additional priority field was the model year registration distribution. A distribution specific to Washington was developed using State Dept. of Licensing data.

Emission Estimation Methods and Consistency of Application

All MOBILE5b inputs are fully documented in the inventory text. A sample input file is provided in hardcopy. All input and output files are available on disk on request from EPA. Use of emission factors and VMT data are also explained in the inventory text.

Calculations

Emissions calculations were performed electronically. Summaries were obtained from SRTC's computer programs listing total emissions by roadway classification. Seasonal adjustments and individual vehicle type emissions allocations were made electronically.

Seasonal Adjustment and Typical Day

Verified air quality violation data was used to determine the three month CO season (Oct-Dec, documented in the Onroad Mobile source section). The VMT provided by the SRTC represented a typical weekday, so no daily adjustment was necessary. A seasonal adjustment was made using WSDOT estimates from traffic data. The average monthly adjustment value for Oct. - Feb. was used.

Geographical Allocation

The VMT provided could be segregated specifically for the NAA; therefore, no adjustments were necessary.

Validation Procedures

Checks performed ensured that:

1. M5b input files contain the flag settings and inputs documented in the inventory text
2. all calculations (temperature, RVP, I/M parameters) were accurate

3. I/M factors were applied as specified in the inventory text
4. emissions estimates generated by link were similar to those calculated by using the VMT system average speed and total VMT

Summary of Quality Checking Procedure

Inventory Preparation Plan Adherence, Reality/Peer Review and Sample Calculations

The inventory source category list in the inventory preparation plan was checked against the inventory for inclusion of all appropriate source categories. Information sources and emissions estimation methods specified in the inventory preparation plan were also checked against the inventory. Reality/peer review, and sample calculations checks were performed on the final inventory as specified in the quality assurance plan.

Overall, the inventory preparation plan had been followed. Methods, data, and inventory assumptions were judged reasonable. Spot sample calculations verified inventory results. The checking procedure brought out errors in the inventory text, and areas where the readability of the text could be improved. The checking procedure initiated discussion on the concept of CO season, resulting in the choice of a 5 month season (Oct - Feb). The procedure also identified improvements to the inventory; for example, in encouraging use of 1996 heating degree days to seasonally adjust the woodstove inventory instead of relying on long-term heating degree day averages.

The results of the checking process are kept on file. Follow-up corrective actions were taken, documented and will be kept on file.

Standard Range Check

The standard range check specified in the quality assurance plan is shown in the next table. The check involved comparing the 1996 base year inventory to the 1993 periodic inventory. A brief explanation is given for discrepancies greater than 10% involving sources that made up greater than 2% of either the 1993 or the 1996 daily inventories. More detailed information on the emissions estimates may be found in the detailed inventory text.

Comparison Discrepancies

Point Sources: Primary difference was higher CO emissions from Kaiser Aluminum and Chemical Corp, Mead

Locomotives: Values reflect increased diesel use in 1996.

Recreational Boats/Lawn and Garden Equipment: The definition of season was expanded to include 5 months – 3 winter, 2 fall. The 1993 estimates only considered winter, when emissions from these sources are at their lowest.

Commercial, Industrial Equipment: Changed days of operation from assumptions of 7 days per week (EPA Nonroad Report) to 6 days per week (EPA temporal guidance). This increased the daily emissions estimates since the annual emissions were emitted over a smaller number of days.

Construction Equipment: The definition of season was expanded to include 5 months – 3 winter, 2 fall. The 1993 estimates only considered winter, when emissions from these sources are at their lowest. Also changed days of operation from assumptions of 7 days per week (EPA Nonroad Report) to 6 days per week (EPA temporal guidance). This increased the daily emissions estimates since the annual emissions were emitted over a smaller number of days.

Residential Non-wood fuel Use: No residential coal in 1996.

Commercial and Industrial Fuel Use: The methodology has large uncertainty. Not a significant category.

Commercial/Industrial Incineration: Moved the single largest emitter (Waste to Energy facility) to the point source section in 1996. Otherwise, this category is almost identical to the 1993 estimates.

Trash Burning: Higher population and somewhat higher trash generation rate per person.

Wildfires: There were more fires in 1996, and used different temporal and spatial allocations.

Table 57: Comparison of 1993 and 1996 Emissions Estimates

Category	1993		1996		percent
	ppd	% ei	ppd	% ei	increase
POINT SOURCES					
Point Sources	109,083	17	159,648	23	46
NONROAD MOBILE SOURCES					
Aircraft	4,781	1	4,451	1	-7
Locomotives	591	0	826	0	40
Agricultural Equipment	0	0	0	0	0
Airport Service Equipment	1,517	0	1,609	0	6
Recreational Boats	144	0	287	0	99
Commercial Equipment	18,259	3	21,949	3	20
Construction Equipment	2,116	0	4,115	1	94
Industrial Equipment	4,355	1	6,336	1	45
Lawn and Garden Equip	5,742	1	21,030	3	266
Logging Equipment	0	0	0	0	0
Recreational Vehicles	485	0	2,148	0	343

Category	1993		1996		percent
	ppd	% ei	ppd	% ei	increase
STATIONARY AREA SOURCES					
Woodstoves & Fireplaces	116,266	18	120,704	18	4
Residential Non-wood Fuel	12,788	2	1,109	0	-91
Commercial Fuel	1,385	0	586	0	-58
Industrial Fuel	726	0	412	0	-43
Commercial/Industrial Incineration	372	0	9	0	-98
Trash Burning	708	0	798	0	13
Yard Waste Burning	16928	3	15,482	2	-9
Prescribed Burning	0	0	0	0	0
wildfires	274	0	1,008	0	268
Structure Fires	651	0	685	0	5
ONROAD MOBILE SOURCES					
Onroad Mobile	347,896	54	334,423	48	-4
TOTAL ALL SOURCES	***645,067***	***100***	***697,615***	***100***	***8***

Assessment of Sensitivity Analysis and Inventory Limitations

The inventory ranking clearly shows that onroad mobile sources are the major contributor to CO emissions in the nonattainment area. Point sources and woodstoves are also significant sources in the emissions inventory. More detailed analysis showed that point sources (mostly due to a single source) were not significant sources for achieving attainment with the standard. This helps point out weaknesses in the "typical" day, nonattainrnent area approach that is required for a base year inventory. Exceedances have occurred on very cold days, as well as on warmer days, and the mix of sources may be quite different due to temperature differences. The user of the inventory must keep this in mind.

Conclusion

The inventory accuracy, completeness and comparability objectives were met. All estimates were calculated and documented using accepted methods (accuracy). All source categories in the IPP were included in the inventory, and all information required to estimate emissions was present (completeness). Data was comparable with the 1993 periodic update inventory.

Appendix D. Vehicle Miles Traveled

Spokane Regional Transportation Council VMT Methodology

- Spokane Regional Transportation Council, *Section 187 VMT Forecasting and Tracking Guidance* (September 1995)
- Emissions Calculator 1.7.2

- 1999 VMT Tracking Report submitted by Ecology to EPA
  - 9 September 28,2000, Submittal Letter from Ecology to EPA
  - 1999 Vehicle Miles Traveled (VMT) Report Summary
    August 7,2000, Letter from SRTC to Ecology Transmitting the VMT Forecasting and Tracking Update

Spokane Regional Transportation Council Memorandum of Understanding with Washington State Department of Ecology, Lacey, Washington

Spokane Regional Transportation Council

SECTION 187 VMT FORECASTING AND TRACKING GUIDANCE

September 1995

1. Transportation Demand Modeling Process

This report describes how the Spokane Regional Transportation Council (SRTC) calculates regional vehicle miles traveled (VMT). SRTC derives VMT from its regional transportation demand model (TMODEL2). This land use-based model has been calibrated for a base year of 1995.

Because SRTC has updated its base year to 1995, there is no longer a need to "forecast" the years 1990 through 1995. SRTC has actual land use and network files for each required year so VMT can be calculated directly fiom the model. Trip assignment for each required year have been performed so VMT estimates can be obtained by functional classification.

For a complete description of SRTC's transportation modeling methodology, see Appendix A, SRTC TMODEL2 Technical Report; and Appendix B, SRTC TMODEL2 Transportation Modeling Procedures. These documents outline specific transportation modeling processes and procedures and are updated annually. Upon request, the manuals can be provided.

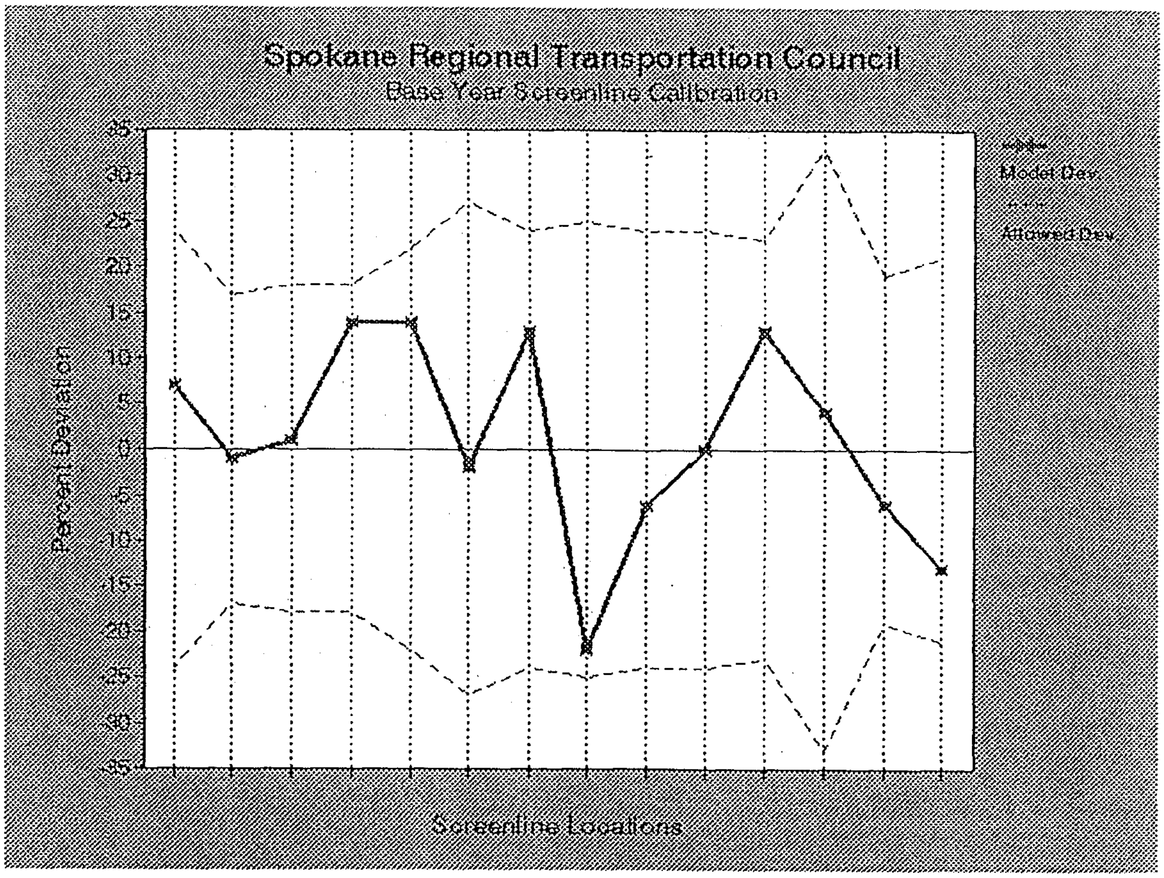
2. Model Calibration

2.1. Calibration Methodology

In May 1995, SRTC contracted the Washington State Department of Transportation to collect vehicle volumes (ground counts) at all model screenline locations simultaneously. Based on available information, SRTC is the only transportation modeling agency in Washington State to perform simultaneous screenline data collection. The data was collected, verified and used to create a model screenline file. The 1995 base network results were compared to this screenline file. This process was done in compliance with the guidelines contained in Appendices A and B.

2.2 Calibration Results

At the overall screenline level, the modeled volumes were within two percent of the collected vehicle volumes. The fourteen individual screenlines were within nationally-accepted parameters. The following chart demonstrated this calibration graphically. The dashed lines represent allowable deviations. These deviations change from screenline to screenline because of changes in link volumes. The heavy line is the deviation between the 1995 ground counts and the 1995 base year model. As one can observe, the SRTC model is within accepted parameters.



Graph 2.1

3. Model Data

3.1, Introduction

To create trips, the model uses land use files with transportation analysis zones (TAZs). SRTC has divided Spokane County into 428 internal TAZs. This exceeds the general rule of one TAZ per 1000 population used for modeling moderate-sized urban areas. In addition to the 428 internal zones, SRTC accounts for trips into, out of and through the region with nine external zones.

After the gravity model "distributes" these internal and external trips, they are "assigned" to a network representing the regionally significant roadways in Spokane County. The network has been verified using SRTC's geographic information system (GIS) and field observation.

The result of this distribution and assignment process is a "loaded" links file. This file contains model-generated data and is used to calculate VMT.

3.2. VMT

First, SRTC models all of Spokane County, but VMT calculations are limited to the links within the carbon monoxide nonattainment area. SRTC uses the "area" data field to limit VMT calculations to links inside this boundary.

SRTC's transportation model uses the weekday, p.m. peak hour. Therefore, VMT must be aggregated from the peak hour into a 24-hour total SRTC uses a p.m. peak hour factor based on regionally collected ground counts to determine the hour-to-hour distribution of VMT. Peak hour data is adjusted by hour using a traffic counts variations (.TCV) file. The air quality module in TMODEL2 aggregates VMT automatically and can screen VMT by functional classification. Chart 3.2 lists VMT by functional class based on SRTC's transportation modeling.

	Daily VMT	Class 1	Class 2	Class 3	Class 4-99
1990	5,712,886	1,297,174	3,172,748	780,383	462,568
1993	6,264,969	1,413,970	3,470,934	865,165	514,497
1994	6,349,538	1,435,897	3,509,678	882,268	521,698
1995	6,511,252	1,501,766	3,584,534	887,313	537,646

Chart 3.2

Class 1 - Interstate
Class 2 - Principal Arterial
Class 3 - Minor Arterial
Class 4 to 99 - Collectors, Ramps, Misc.

The SRTC model includes all interstates, principal arterials and minor arterials within the nonattainment area boundary. Regionally significant collectors are also mcluded. The local functional system is not specifically counted; however, all trips are counted, so local VMT is counted within the network.

3.2. Vehicle Trips and Person Trips

SRTC models vehicle trips. Converting vehicle trips to person trip can be accomplished off model. SRTC maintains an ongoing program of AVO data collection. Vehicle occupancy data is used to convert vehicle trips to person trips when needed.

3.3 Transit Trips

Transit trips constitute only two percent of the total trips in the Spokane region. They are not currently considered in the SRTC regional model.

3.4. Link Data

The model network includes freeways, principal arterials and minor arterials. Some collectors are modeled when they are considered regionally significant. Per lane link capacity is based on functional class. SRTC uses capacity restrained assignments, therefore, no link was loaded beyond its capacity. Trip assignments were performed on the validated base year network with no additions or alterations.

3.5. Trip Generation Rates & Land Use Control Totals

SRTC uses trip generation rates based on field-collected data. Additional information on trip generation rates is available in Appendices A and B. Chart 3.5. lists SRTC's most current housing and employment control totals for the past three years. These control totals are developed using state and local data sources.

Year	SFDU	MFDU	Retail	Nonretail
1993	129,069	29,504	43,716	116,612
1994	130,297	30,037	44,039	119,173
1995	131,524	30,571	44,389	121,742

Chart 3.5.

3.6. External Trips

Internal-External Trips: Data from a **1975** external survey was used, in conjunction with **1995** vehicle ground counts at external locations, to develop an external-internal vehicle trip matrix for **1995.** This data **is** then incorporated into the **1993** origin and destination data file which is used by the model to create a trip table. External TAZs for the Spokane network are represented by **TAZs 429-437.**

External-External Vehicle Trips: The **1975** external survey also provided data on external-external (through) trips. This data is used in conjunction with ***Origin*** and Destination data to create a trip table.

SRTC has received tentative funding for a new external survey. This data **will** be incorporated into the model when available.

3.7 Assignment

3.7.1. Equilibrium

SRTC's transportation model is a traditional gravity model. Trip distribution and assignment are performed as described in the technical appendices with a few minor changes:

- Trip assignment has been changed from 5 steps (.3 .2 .2 .2 .1) to 6 steps

(.3 .2 .2 .1 .1 .1).
- The travel time/distance split has been changed from .75/.25 to .9/.1.
- Creation of the impedance file (Steps 7 and 8) are repeated to generate greater sensitivity to capacity restraint.

Essentially, SRTC uses an iterative method of attaining equilibrium in trip assignment. As trips are loaded, volumes are assigned to links (and nodes). In each increment, these trip volumes create delay based on node and link delay equations. This delay allows the model to assign trips respecting volume-based congestion delay.

3.7.2 Constrained Equilibrium Speeds vs V/C Equations

SRTC uses the V/C equations included within TMODEL2 in the assignment process. The V/C equations impact the constrained equilibrium speeds. SRTC does not currently specify different V/C equations based on functional classification. In that facility-specific V/C algorithms are not specified in the SRTC model, the traditional Bureau of Public roads formula is used. This formula adjusts the "no-load" travel time using the V/C ratio as follows:

Adjusted Travel Time = T (1 + 0.15 (V/C) x 4)

For additional information see Appendix A.

3.7.3. Average Speed

All emissions calculations were done using individual link speeds, not network average speed. Node delay is included in emissions calculations. The node delay equation has been calibrated against actual delay as measured by Highway Capacity Manual software. Percentage idle is accounted for by using inputs from Mobile 5h in the TMODEL2 emissions module. In its link calculations, TMODEL2 does not explicitly consider idle percentage.

Each of the EMISSIONS CALCULATOR MENU options is discussed below. As with other TMODEL2 menus, option 19 provides a shell to DOS, and option 20 returns control to the Network Characteristics Menu.

Entering a question mark (?) while in the editor will display the possible key-commands available and a description of their uses.

1.7.2.1 ENTER/EDIT EMISSIONS FACTORS

This option allows for entry and edit of an Emissions Factors file. This file contains Emissions Factors for six emission types. An individual rate is entered for each speed using miles per hour or kilometres per hour. These rates will be multiplied by the Vehicle Miles of Travel (VMT) or Vehicle Kilometres of Travel (VKT) operating at the specified speed. The exception is the values entered in the first row. The values in the first row (for the 0 to 1 speed range) will be multiplied by the Vehicle Hours of VHT. The maximum speed for using VHT versus VMT or VKT must be set using option 1.7.2.2.

Values may be entered for speeds up to 120 MPH or KPH. In contrast to most other TMODEL system files, this file is always saved in its entirety, a 120 by 6 array of REAL (decimal) numbers. Therefore, for the Emissions Factors File, it does not matter from which entry location you leave the editor.

Upon leaving ENTER/EDIT by typing a slash (/), all values are retained in memory for further use.

1.7.2.2 SETUP COMPUTATION PARAMETERS

This option allows you to establish the maximum speed for using VHT and the name of the emission to be used in the report. All values will use the VMT or VKT rates for speed above the maximum speed established for VHT.

This module currently uses the average speed on the link including node delay time to select the emission rate to be used. A future enhancement may include idle time and link speed to compute the emissions more accurately.

It is assumed that the link volumes used for computation purposes are for one hour (usually a peak hour). The amount and pattern of variation over the day can be established using section 1.7.2.12. However, this section is used to describe which traffic volume variation group the individual link class uses. You will be prompted with the individual link classes and asked to enter the traffic variation group number. This number can range between 1 and 10. Traffic variations are entered for each of the 24 hours of the day.

These computation parameters are stored with the Emissions Factors in the .EFC file.

EMISSIONS CALCULATOR 1.7.2

This module will compute emissions based upon vehicle hours of delay and vehicle miles or kilometres of travel. You may enter emission rates based upon operating speed, and this module will compute aggregate emissions. Up to 6 emission types can be summarized at once.

Daily traffic variations for up to ten groups of functional classes may be used to adjust the peak hour traffic assignment volumes to hourly volumes for the emissions estimates. This module uses a loaded link file, node file, link and node delay coefficient files, and **a** trip table file for its computations. Sometimes during model calibration the model speeds are adjusted to reflect the perceptions of the driver. By starting at the link file level and recomputing operating speeds, true design speeds can be used if they are known. In addition, traffic volumes can be adjusted for model deviations before the emissions estimates are made.

Before using this module, you must have information based upon speed for your area. This should take into account the age-use mix of the vehicles used in your area, % cold starts, and other factors. The emission rates are entered in section 1.7.2.1.

Traffic variations are entered for each hour of the day in order to estimate the traffic volumes and resulting speeds for the hours of the day that were not modeled. These volumes are used to compute the emissions for selected hours of the day, or for a full 24 hours.

RUNNING THE EMISSIONS CALCULATOR

Upon entering the EMISSIONS CALCULATOR module, the menu presents you with the following options:

```
      1.7.2  EMISSIONS CALCULATOR
=================================================
 1) ENTER/EDIT EMISSIONS FACTORS
 2) SETUP COMPUTATION PARAMETERS
 3) LIST EMISSIONS FACTORS
 4) CLEAR EMISSIONS FACTORS MEMORY
 5) LOAD EMISSIONS FACTORS FILE (.EFC)  :
 6) SAVE EMISSIONS FACTORS FILE (.EFC)  :
 7) LOAD LOADED LINK FILE
 8) LOAD LINK DELAY COEFFICIENTS FILE   :
 9) LOAD NODE FILE
10) LOAD NODE DELAY COEFFICIENTS FILE   :
11) LOAD TRIP TABLE FILE
12) LOAD/SETUP TRAFFIC VARIATIONS
13) COMPUTE AND PRINT EMISSIONS SUMMARIES
19) SHELL TO DOS
20) RETURN TO NETWORK CHARACTERISTICS MENU
99) EXIT TMODEL2
```

Each of the EMISSIONS CALCULATOR MENU options is discussed below. As with other TMODEL2 menus, option 19 provides a shell to DOS, and option 20 returns control to the Network Characteristics Menu.

Entering a question mark (?) while in the editor will display the possible key-commands available and a description of their uses.

1.7.2.1 ENTER/EDIT EMISSIONS FACTORS

This option allows for entry and edit of an Emissions Factors file. This file contains Emissions Factors for six emission types. An individual rate is entered for each speed using miles per hour or kilometres per hour. These rates will be multiplied by the Vehicle Miles of Travel (VMT) or Vehicle Kilometres of Travel (VKT) operating at the specified speed. The exception is the values entered in the first row. The values in the first row (for the 0 to 1 speed range) will be multiplied by the Vehicle Hours of VHT. The maximum speed for using VHT versus VMT or VKT must be set using option 1.7.2.2.

Values may be entered for speeds up to 120 MPH or KPH. In contrast to most other TMODEL system files, this file is always saved in its entirety, a 120 by 6 array of REAL (decimal) numbers. Therefore, for the Emissions Factors File, it does not matter from which entry location you leave the editor.

Upon leaving ENTER/EDIT by typing a slash (/), all values are retained in memory for further use.

1.7.2.2 SETUP COMPUTATION PARAMETERS

This option allows you to establish the maximum speed for using VHT and the name of the emission to be used in the report. All values will use the VMT or VKT rates for speed above the maximum speed established for VHT.

This module currently uses the average speed on the link including node delay time to select the emission rate to be used. A future enhancement may include idle time and link speed to compute the emissions more accurately.

It is assumed that the link volumes used for computation purposes are for one hour (usually a peak hour). The amount and pattern of variation over the day can be established using section **1.7.2.12.** However, this section is used to describe which traffic volume variation group the individual link class uses. You will be prompted with the individual link classes and asked to enter the traffic variation group number. This number can range between 1 and 10. Traffic variations are entered for each of the **24** hours of the day.

These computation parameters are stored with the Emissions Factors in the .EFC file.

1.7.2.3 LIST EMISSIONS FACTORS

This option Lists the Emissions Factors to the Screen, Printer, or a Disk File. Please see the List section in the Appendix for more information.

1.7.2.4 CLEAR EMISSIONS FACTORS MEMORY

Selecting this option allows you to reset the entire Emissions Factors array in memory to zeros (0).

1.7.2.5 LOAD EMISSIONS FACTORS FILE (.FAC)

This menu selection loads a previously saved Emissions Factors file into memory from the disk. See the Appendix for a description of the file names and formats.

1.7.2.6 SAVE EMISSIONS FACTORS FILE (.FAC)

This section allows you to save an Emissions Factors file from memory to the disk.

1.7.2.7 LOAD LOADED LINK FILE (.LLX)

A loaded link for or one with volumes must be loaded here. This is used to compute the speed and values for vehicle miles of travel or vehicle kilometres of travel and vehicle hours of travel. You may use a file that has been adjusted for more accurate speeds or volumes after the assignment process for this file.

See the Appendix for a description of the file names and formats.

1.7.2.8 LOAD LINK DELAY COEFFICIENTS FILE (.LDC)

The link delay coefficients loaded here will be used to compute the new travel times. These are used on each hour selected for analysis. If you do not load a link delay coefficients file, the default values will be used similar to the assignment process.

See the Appendix for a description of the file names and formats.

1.7.2.9 LOAD NODE FILE (.NDE)

The node file must be loaded before summarizing the emissions. The node file is used to This menu selection loads a previously saved Emissions Factors file into memory from the disk. See the Appendix for a description of the file names and formats.

1.7.2.10 LOAD NODE DELAY COEFFICIENTS FILE (.NDC)

The node delay coefficients loaded here will be used to compute the new travel times. These are used on each hour selected for analysis. If you do not load a node delay coefficients file, the default values will be used similar to the assignment process.

1.7.2.11 LOAD TRIP TABLE FILE (.TTB)

This menu selection loads the trip table for analysis of average trip lengths and total trip summaries. See the Appendix for a description of the file names and formats.

1.7.2.12 LOAD/SETUP TRAFFIC VARIATIONS

This menu selection will access a submenu that allows you to enter/edit, list, load, and save traffic volume variations files. These are used to estimate emissions over periods greater than that forecast by the model. A traffic variations file must be established even if emissions are being computed for only one hour.

Upon selecting this option, you will be presented with the following menu:

```
1.7.2.12    LOAD/SETUP TRAFFIC VARIATIONS
------------------------------------------------------
 1) ENTER/EDIT TRAFFIC VARIATIONS
 2) LIST TRAFFIC VARIATIONS
 3) LOAD TRAFFIC VARIATIONS FILE (.TCV) :
 4) SAVE TRAFFIC VARIATIONS FILE (.TCV) :

19) SHELL TO DOS
20) RETURN TO EMISSIONS CALCULATOR MENU
```

Choosing one of these options will direct control to the proper section.

1.7.2.12.1 ENTER/EDIT TRAFFIC VARIATIONS

This option allows for entry and editing of the traffic variations file. This file contains an entry line for each hour for hour one (1) through hour 24. Variations for ten groups can be entered. You must enter data for at least one group. If you do not have local data, Chapter 6 of NCHRP 187 "QUICK RESPONSE URBAN TRAVEL ESTIMATION TECHNIQUES AND TRANSFERABLE PARAMETERS, USER'S GUIDE" has information that should be useful. The values should be entered as percentages. When the variations are applied they are applied by group and class as established in Section 1.7.2.2.

In contrast to most other TMODEL system files, this file is always saved in its entirety. Therefore, for the Traffic Variations File, it does not matter from which entry location you leave the editor. Upon leaving ENTER/EDIT by typing a slash (/), all values are retained in memory for further use.

1.7.2.12.2 LIST TRAFFIC VARIATIONS

This option Lists the Traffic Variations Files to the Screen, Printer, or a Disk File. Please see the List section in the Appendix for more information.

1.7.2.12.3 LOAD TRAFFIC VARIATIONS FILE (.TCV)

This menu selection loads a previously saved Traffic Variations file into memory from the disk. See the Appendix for a description of the file names and formats.

1.7.2.12.4 SAVE TRAFFIC VARIATIONS FILE (.TCV)

This section allows you to save an Traffic Variations file from memory to the disk.

1.7.2.12.19 SHELL TO DOS

This menu item temporarily returns control to DOS. The program and any data are retained in memory. However, it is recommended that you save your files before going to DOS.

To return to the program from DOS, simply type EXIT from the DOS prompt. You should return to the TMODEL2 directory (if you have changed sub-directories while in DOS) before typing EXIT. Do not rerun TMODEL2 after you have used this option.

1.7.2.1 2.20 RETURN TO EMISSIONS CALCULATOR MENU

Selecting this menu item returns control to the Emissions Calculator Menu. No data is lost by selecting this option.

1.7.2.13 COMPUTE AND PRINT EMISSIONS SUMMARIES

This section is the one that computes, summarizes and prints the emissions totals. The initial setup is similar to the other print sections. You may select to print to Screen, Printer, or Disk File. If you select Screen, the initial setup information will scroll up on the screen as the summaries are printed.

You may limit the computations for a group of Link Classes. Overall summaries will be printed and the summaries for the selected Link Classes will also be printed. Summary statistics for the overall model include: Total Vehicle Trips, Total VMT, Total VHT, Total Average Travel Distance, Total Average Travel Time, and Total Average Speed. Summary statistics for the selected link Classes include Group VMT or VKT, VHT, Group Average Speed, and the total emissions for each emission type in kilograms.

You may save total emissions in an output link file at the conclusion of the computation process. Emissions are computed in grams. You will be prompted to enter a factor for the emission totals for the links. They will be reported in kilograms for each link if you enter this factor as 1000. If you check your results and have any values reported as 32767, they have exceeded the integer limit. You may wish to use a larger factor. The total emissions for the summary sheet are kept as grams before being totalled. If you notice significant differences between the link totals and the summary sheet totals, you may wish to use a smaller factor to minimize the rounding differences.

Emissions will be saved in the SZ1 and the SZ2 link file fields. You will be prompted for the name of the output link file.

Computations are made for each link for each hour. The peak hour model link volumes are used to estimate the individual link volumes for the other hours of the day using the traffic count variation factors.

The average operating speeds are computed using the link and node delay coefficients files. The delay coefficients describe the impact of the volume to capacity ratio on travel speed and delay, resulting in an average operating speed for each directional link. The average operating speed is used in a "look-up" procedure to determine the appropriate emission factor.

The length of the link and the traffic volumes on that link are used to compute vehicle miles of travel (VMT) and vehicle hours of travel (VHT). If the average speed is below the specified idle speed, the emission factor is multiplied by the VHT. If the average speed is above the specified idle speed the emission factor is multiplied by the VMT.

The peak hour model volumes are directional. Because an A.M. peak hour would have different directionality than a P.M. peak hour the emissions are added for the two directions of the link to average the differences in directionality.

The emissions are computed in this manner for each specified hour. If multiple hours were requested for computation, the emissions for each individual hour are totalled as they are computed. All computations, however, are made on an hourly basis, using hourly forecast volumes and accompanying average speeds.

1.7.2.19 SHELL TO DOS

This menu item temporarily returns control to DOS. The program and any data are retained in memory. However, it is recommended that you save your files before going to DOS.

To return to the program from DOS, simply type EXIT from the DOS prompt. You should return to the TMODEL2 directory (if you have changed sub-dircctories while in DOS) before typing EXIT. Do not rerun TMODEL2 after you have used this option.

1.7.2.20 RETURN TO NETWORK CHARACTERISTICS MENU

Selecting this menu item returns control to the Network Characteristics Menu. Bc certain to save the files that you want to keep before selecting this option. You are asked if you have saved the files you want to keep. If you answer Yes, control is returned to the Network Characteristics Menu and the data in memory is lost.

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

P.O. Box 47600 • Olympia, Washington 98504-7600
(360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

September 28,2000

Barb McAllister, Director
Office of Air Quality
U.S. EPA Region 10 OAQ-107
1200 6th Avenue
Seattle, WA 98101

RE: 1999 Vehicle Miles Traveled (VMT) Tracking Report

Dear Ms. McAllister:

The 1999 VMT tracking report for Spokane, Washington's serious carbon monoxide (CO) nonattainment area is enclosed. The report provides a comparison of the estimate of actual VMT to the forecast VMT for 1999, and a revision to the 2000 forecast. This information is being incorporated into the serious CO attainment plan. Contingency measures do not need to be implemented since forecast VMT is higher than actual VMT and the increase in the 2000 forecast is less than one percent.

If you have any questions please call Doug Schneider at (360) 407-6874.

Sincerely,

Mary E. Burg, Program Manager
Air Quality Program

MEB:nf
Enclosures

cc: Wayne Elston, Environmental Protection Agency
Pam Tsuchida, Spokane Regional Transportation Council
Eric Skelton, Spokane County Air Pollution Control Authority
Doug Schneider, Department of Ecology

1999 Vehicle Miles Traveled (VMT) Report Summary

The VMT report provided by the Spokane Regional Transportation Council (SRTC) compares estimates of actual daily VMT to daily VMT forecasts. The report also revises the initial forecast of VMT for the year 2000.

The Transportation Data Office of the Washington State Department of Transportation developed the estimate of actual VMT from Highway Performance Monitoring System (HPMS) data. SRTC developed the forecast VMT from TMODEL2 transportation model. Minor land use modifications to the model network resulted in a less than one percent increase to the VMT forecast for 2000. The VMT information summarized below will be incorporated into the serious carbon monoxide attainment plan currently being prepared for review.

SPOKANE VMT SUMMARY				
YEAR	FORECAST VMT	REVISED FORECAST VMT	ESTIMATE OF ACTUAL (HPMS) VMT	PERCENT DIFFERENCE
1998	6,603,756		6,520,000	–5.4 %
1999	6,838,481		6,635,000	–3.0 %
2000	6,867,839	6,918,031		0.7 %

VMT contingency measures do not need to be implemented. Under the U.S. Environmental Protection Agency's, *Section 187: Forecasting and Tracking Guidance* (January 1992), VMT contingency measures are to be implemented if actual VMT exceeds forecast VMT by more than three percent or if the VMT forecast is increased by more than three percent. As the table shows, actual VMT is less than forecast VMT. The increase in the VMT forecast for 2000 is less than one percent.

SRTC

Spokane Regional Transportation Council
221 W. First Avenue, Suite 310 • Spokane, WA 99201-3613
5091343-6370 FAX: 5091343-6400

August 7,2000

Mr. Doug Schneider
Washington State Department of Ecology
Air Quality Program
P.O. Box 47600
Olympia, WA 98504-7600

RE: **1999** VMT Reporting for Spokane Carbon Monoxide (CO) Nonattainment Area (revised)

Dear Mr. Schneider,

The following tables provide the updated 1999 Vehicle Miles Traveled (VMT) data for the Spokane CO **nonattainment** area and thus **fulfill** the HPMS reporting requirements, Section 187 of the Clean Air Act. **Minor** land use modifications to the transportation model network resulted in a small change in the 2000 **forecast** VMT **from** 6,867,839 to **6,918,03**1. The year 2000 forecast has been updated with this revised figure to be consistent with the SIP currently being completed.

FORECAST VMT INFORMATION
for the Spokane CO nonattainment area

Year	SIP Forecast '93	HMPS Data	Percent Difference	Revised and New SIP Forecasts	Percent Difference
1990		5,712,886			
1993	6,982,200	6,010,000	-13.9	6,283,980	-4.36
1994	7,089,700	6,232,000	-12.1	6,380,730	-2.32
1995	7,232,300	6,057,000	n/a	6,511,252	-6.95
1996		6,182,000		6,613,806	-6.50
1997		6,365,000		6,727,365	-5.39
1998		6,520,000		6,603,756	-1.27
1999		6,635,000		6,838,481	-2.98
2000				6,918,031	

HPMS Data for **1999**
by functional class
miles DVMT (in 1,000s)

Interstate	Freeway/ Expressway	Principal Arterial	Major Collector	Minor Collector	Local	Total
1,363	86	2,629	1,475	352	730	6,635

If you have any questions or if I can be **of further** assistance please contact me at (509)343-6370.

Sincerely,

Pam Tsuchida

Pam **Tsuchida**
Transportation Air Quality Planner

pmt/VMT1999

**Spokane Regional Transportation Council
Memorandum of Understanding
with
Washington State Department of Ecology
Lacey, Washington**

Originally Prepared Pursuant to:
Intermodal Surface Transportation Efficiency Act of 1991
Dated: June 30, 1994
Approved: July 14, 1994
Signed: December 1994

Revised Pursuant to:
Transportation Equity Act for the 21st Century
Dated:
Signed:

MEMORANDUM OF UNDERSTANDING
between the
Spokane Regional Transportation Council
and the
Washington State Department of Ecology

Implementing the
Transportation Equity Act for the 21st Century
TEA-21

This MEMORANDUM OF UNDERSTANDING, between the Spokane Regional Transportation Council, hereinafter called the "SRTC", and the Washington State Department of Ecology hereinafter called "Ecology", is created pursuant to 23 CFR 450.310(c), and Title 23 U.S.C., subsection 134, which addresses responsibilities for carrying out transportation planning within a Transportation Management Area.

Witnesseth,

WHEREAS, the SRTC and Ecology are mutually interested in the exchange of information related to transportation planning, vehicle miles of travel, transportation control measures and the effects transportation has on achieving and maintaining air quality in the Spokane Metropolitan area; and

WHEREAS, the SRTC and Ecology are mutually interested in assuring that transportation plans, programs, and projects that are proposed in or that affect the Spokane non-attainment area are in conformance with the State Implementation Plan (SIP) for both Particulate Matter and Carbon Monoxide; and

WHEREAS, the SRTC and Ecology have existing responsibilities for complying with federal and state regulations related to transportation and air quality issues;

NOW THEREFORE:

THE SRTC AGREES TO:

1. Maintain and update the land use based regional transportation model for the Spokane Metropolitan area, which provides existing and forecasted travel demand.

2. Provide travel demand information for the regional transportation system that includes data such as, but not limited to, vehicle miles of travel, operating speed, and traffic volumes by link. .

3. Provide for a coordinated and collaborative transportation planning process that includes public involvement, necessary to review and select transportation control measures for inclusion within the State Implementation Plan for air quality.

4. Conduct air quality conformity determinations for transportation plans, programs, and projects located on the regional transportation system as defined by the Metropolitan Planning Organization (MPO), consisterit with federal and state regulations.

5. Prepare the annual Vehicle Miles Traveled (VMT) tracking report required by the Clean Air Act for the Spokane CO nonattainment area in consultation with the Washington State Department of Transportation and Ecology.

ECOLOGY AGREES TO:

1. Involve the SRTC in development of the State Implementation Plans for PM-10 and CO, as they relate to transportation related emissions sources.

2. Maintain and update the emissions inventories with current data provided by SRTC and using current releases of EPA emissions models as necessary to comply with state and federal transportation conformity regulations.

3. Consult with SRTC on proposed transportation related changes to the SIP as well as Transportation Control Measures that may be considered for achieving the National Ambient Air Quality Standards (NAAQS) or contingency measures in the event either the standard is not achieved or the vehicle miles of travel forecasts are exceeded.

4. Submit reports and revised plans demonstrating air quality attainment in the Spokane area when required, in order to avoid Federal sanctions for non-compliance with the Clean Air Act Amendments (CAAA) of 1990.

5. Submit the annual VMT tracking report, prepared by SRTC to fulfill requirements of the Clean Air Act for a CO nonattainment area, to EPA by September 30 of each year.

IT IS MUTUALLY AGREED:

1. Both Ecology and SRTC support and promote attainment and maintenance of the NAAQS in the Spokane Area. Further, both desire to fulfill the requirements of the Federal Clean Air Act and TEA-21. Thus, each agency understands that it is its obligation to provide one another with accurate, timely information on requirements affecting both agencies.

2. When action is required to meet requirements of the Federal Clean Air Act and TEA-21, SRTC and Ecology will develop and agree to an understanding of what is required and develop a process for resolution.

3. This Memorandum of Understanding (MOU) will be reviewed periodically to reflect changes in regulations, commitments, and responsibilities.

The undersigned agencies in the State of Washington, in accordance with 23 CFR 450.310 (c) and of Title 23 U.S.C., subsection 134, do hereby commit to cooperate in the development and submission of data, analyses, reports, and documents necessary to fulfill the obligations set forth in CAAA of 1990, Clean Air Washington Act, and TEA-21 as they relate to regional transportation planning, and the SIP for mobile source emissions, and air quality conformity determinations.

Glenn F. Miles (signature) — June 26, 2000

Glenn F. Miles, Transportation Manager
Spokane Regional Transportation Council
Date

Mary E. Burg by ART (signature) — 7-13-00

Mary Burg, Program Manager
Air Quality Program
Washington State Department of Ecology
Date

Appendix E. Demonstration of Attainment

- Systems Applications International, Inc., *Regional Carbon Monoxide Dispersion Modeling for the Spokane Serious Nonattainment Area Plan,* Final Report, SYSAPP-99/22rl (October 1999). Available in repositories and upon request. For more information, please contact Tami Dahlgren at (360) 407-6830.

- CH2MHill, "Analysis of Kaiser Mead Contribution to Ambient CO Concentrations," (May 2, 2001)

- "Supplementary CO Emissions Calculations Using the Sierra Research Cold CO Model," Washington State Department of Ecology

- "Performance Evaluation of the Modeling of Ambient CO Concentrations in Spokane," Washington State Department of Ecology

- February 23,2000, request from Ecology to EPA for permission to use CAL3QHC in the refined mode for analyzing CO at roadway intersections for the Spokane serious CO attainment and maintenance plans

- April 13,2000, response from EPA to Ecology granting permission for the use of CAL3QHC in the refined mode for analyzing CO at roadway intersections for the Spokane serious CO attainment and maintenance plans

- "Modeling Carbon Monoxide from Roadway Intersections in Spokane Using CAL3QHC," Spokane Regional Transportation Council (February 16,2000; modified: July 21,2000)

- WAC 173-422-0311, Vehicle emission inspection schedules; WAC 173-422-170, Exemptions; Rule-making Order, CR-103 (10-30-00)

- Meeting Minutes, Thursday, February 10,2000, Spokane Regional Transportation Council. Spokane WA

- Revision to *Washington State S. T. I. P., 1999 to 2001* (March 9,2000)

- "Emissions Budget for On-Road Mobile Sources," Spokane Regional Transportation Council (June 2000)

- Consultation on Spokane Carbon Monoxide Motor Vehicle Emissions Budget, Minutes (finalized November 9,2000)

Analysis of Kaiser Mead Contribution to Ambient CO Concentrations

PREPARED FOR:	Clint Bowman/Department of Ecology Mahbubul Islam/EPA Region X
PREPARED BY:	Mary Beth Yansura/CH2M HILL
COPIES:	Bud Leber/Kaiser Aluminum & Chemical Corporation Don Caniparoli/CH2M HILL
DATE:	May 2,2001

In support of preparation of the State Implementation Plan (SIP) for carbon monoxide (CO) in the Spokane area, the Washington State Department of Ecology requested Kaiser perform a dispersion modeling analysis of its CO emissions. The request was based on results obtained by Ecology using the Urban Airshed Model (UAM), which indicated that the model was not able to accurately characterize Kaiser's contribution to the airshed concentration estimate. A modeling protocol describing the proposed methodology for this analysis was submitted to the Department of Ecology in October, 2000. This memorandum summarizes the methodology and results of modeling CO emissions from Kaiser's Mead facility. The analysis focused on the 8-hour average CO concentration since it is the 8-hour CO NAAQS which is of primary concern in the SIP.

Methodology

Source Information

The sources of CO emissions and the CO emission rate are identified in Table 1. The emission level represents an aluminum production rate of 703 tons per day. This corresponds to a maximum daily emission rate of 300 pounds per ton of aluminum produced to correspond to the short term standards for CO. Annual emission and production rates are lower than this but the higher emission rates were used for this modeling to demonstrate compliance with the CO standards. This is described in detail in Appendix A to the modeling protocol. Note that the Potroom vents were characterized as one area source with a horizontal dimension equivalent to the length of the potlines

Table 1 – Source Characterization and Emissions

Parameter	Calciner	Bake Furnace	Scrubber Stacks (8)	Potroom (Area source)
Height (m)	54.4	54.9	17.1	15.24
Diameter (m)	1.37	2.13	3.45	109.6*
Temperature (K)	77.4	352.6	352.4	7.1**
Velocity (m/sec)	24.9	11.6	16.1	NA
CO Emission rate (g/sec)	0.3	26.6	131.3 (each)	55.2
Daily CO Emissions (tons per day)	0.03	2.5	100.0 (total)	5.3

"Horizontal dimension of area source
"*Vertical dimension of area source

Models Selection

The ISC-PFUME (version 99020) model was run to evaluate impacts at receptors at an elevation of 594.7 meters or less to more accurately characterize the affects of building downwash on concentrations calculated there. This elevation represents stack base elevation plus 25% of the scrubber stack height, which is the primary source of CO emissions from the facility. The AERMOD model (version 99351) was run at receptors above 607 meters. This cutoff elevation was based on the stack height of the primary source of CO emissions, the scrubber stacks. The BPIP program (and BPIP-PRIME) was run to calculate wind direction-specific building parameters to calculate the affects of building downwash.

Based on model results and discussion with Mr. Bowman at the Department of Ecology, ISCST3 was also run for the intermediate terrain receptors (elevation greater than 594.7 meters but less than 607 meters) since comments made at the 7th Conference on air Quality Modeling indicate the PRIME algorithm produces unrealistically high concentrations when nearby terrain rises up to approach stack top elevation.

Receptors

A nested receptor grid was used consisting of a 100 meter-spaced grid, extending 1000 meters from the Kaiser site, within a 500 meter-spaced grid extending 5000 meters from the site boundary. Receptors were also placed at 25-meter intervals around the Kaiser property line. To resolve maximum concentrations, a 50-meter spaced grid was centered on the receptor where the maximum concentration was calculated by the model.

Meteorology

The protocol for this analysis indicated that four years on on-site meteorological data would be processed for use in the two sets of model runs. This was to correspond with the years modeled by Ecology for the SIP analysis (1993-1996). However, problems were encountered with the 1996 data, because manual cloud cover observations were discontinued during that year, so only 1993-1995 data were used for this analysis. The surface data was processed with upper air data from Spokane airport. AERMET, the meteorological preprocessor for AERMOD, requires the use of airport cloud cover. Concurrent data from the Spokane airport was used. Table 2 shows the assumptions used in setting up the AERMET input files.

Model Performance

Kaiser has collected ambient CO data at a location to the Northeast of the plant for a number of years. This data was examined to help evaluate model performance. Although the monitoring station was not located at the point of maximum impact, as currently modeled, comparison of maximum modeled concentrations to monitored concentrations at the monitoring station is useful in evaluating model performance.

This comparison shows the models to over predict significantly at the monitoring station. During the December 1995 high concentration period which was evaluated in the Spokane SIP, the highest 1-hour concentration measured at the Kaiser monitor site was 2 ppm. This corresponds to the highest 1-hour modeled concentration during the same time period of 5.6 ppm. Consequently, the models were believed to over predict CO concentrations from this source.

Table 2 – AERMET Input Assumptions

Parameter	Value Chosen
Albedo	Winter - 0.35, Spring - 0.14, Summer - 0.16, Autumn – 0.18
Bowen Ratio	Assume average, Urban moisture conditions: Winter - 1.5, Spring - 1.0, Summer - 2.0, Autumn – 2.0
Surface Roughness	Winter - 0.6, Spring - 1.00, Summer - 1.00, Autumn – 1.00 (Reviewed snow cover data at SPK airport to determine winter surface roughness~39% snowcover for winter months of Dec, Jan, Feb. Therefore assume –40 percent snow cover and adjusted winter surface roughness to reflect this)
Wind Direction Sector(s)	Assumed one sector differentiation. The sector selected is 0 to **360.**
Mixing height	Spokane Airport

As mentioned earlier, questions have been raised regarding the use of ISCST3 and ISC-PRIME. Because of the strong tendency of the models to over predict, it is believed that ISC-PRIME is most accurate for the flat terrain receptors and ISCST3 is most accurate for intermediate terrain receptors.

Background Concentrations

Evaluation of concurrent monitoring data from downtown Spokane and the Kaiser Mead monitoring station during December 1995 shows the high concentrations at the downtown location are not reflected in concentrations measured near the plant. This is believed to be because concentrations in the Spokane central city area are not transported to the Kaiser site. Therefore, to determine the total concentration during periods when the CO impacts from Kaiser are at a peak, data from the Kaiser monitoring station were further evaluated to obtain a representative "background concentration.

Data from the period January 1, 2000 to November 30, 2000 were examined and periods when winds were from the Northwest were identified. This sector was chosen to capture periods both when the monitor would not likely be impacted by Kaiser emissions and when maximum modeled impacts occur to the southeast of the facility. Northwest winds were defined as wind directions from 300 to 350 degrees. The highest monitored 1-hour CO concentration in the data set during these wind conditions was determined to be **1.6** ppm and occurred on February 19, 2000. This value was used as a background concentration to be added to the modeling results.

Results

Preliminary results indicated that maximum 8-hour CO concentrations were predicted using the 1995 meteorological data. The maximum concentrations calculated using the two models are shown in Table **3.**

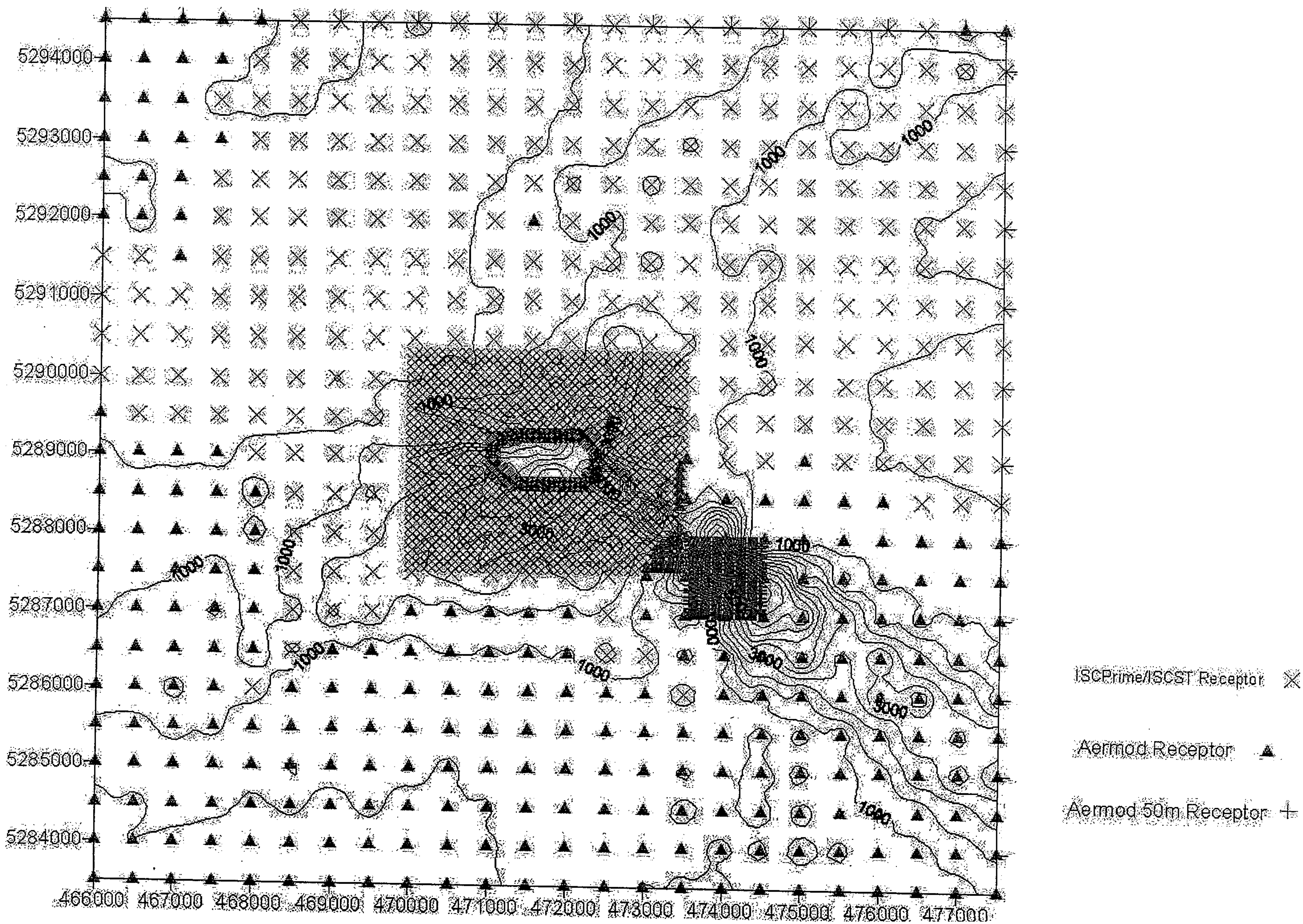
The highest 8-hour concentrations, including the maximum monitored 1-hour concentration used as background, are below the 8-hour CO standard of 9 ppm. The modeled concentrations are still believed to be quite conservative since monitoring conducted at the Mead site has never shown concentrations approaching the modeling results. This analysis is believed to conservatively represent air concentrations in the vicinity of the Kaiser Mead plant.

Table 3 – Maximum Modeled Concentrations

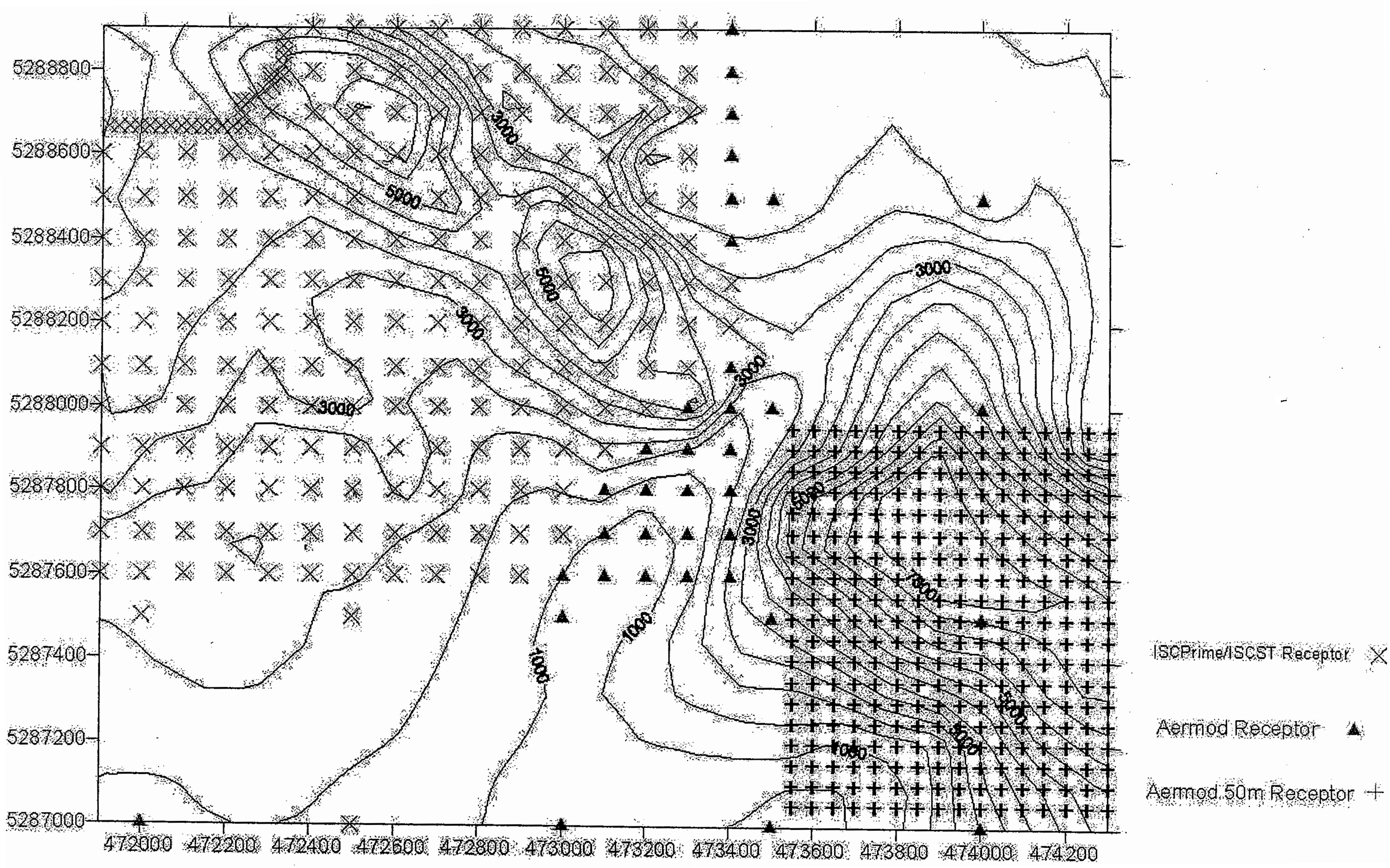
Model	Maximum 8-Hour Average Model Concentration		Background Concentration (ppmv)	Total (ppmv)
	(µg/m3)	(ppmv)		
AERMOD	8,191	7.0	1.6	8.6
ISCST3 (~100m from property line)	7,225	6.2	1.6	7.8

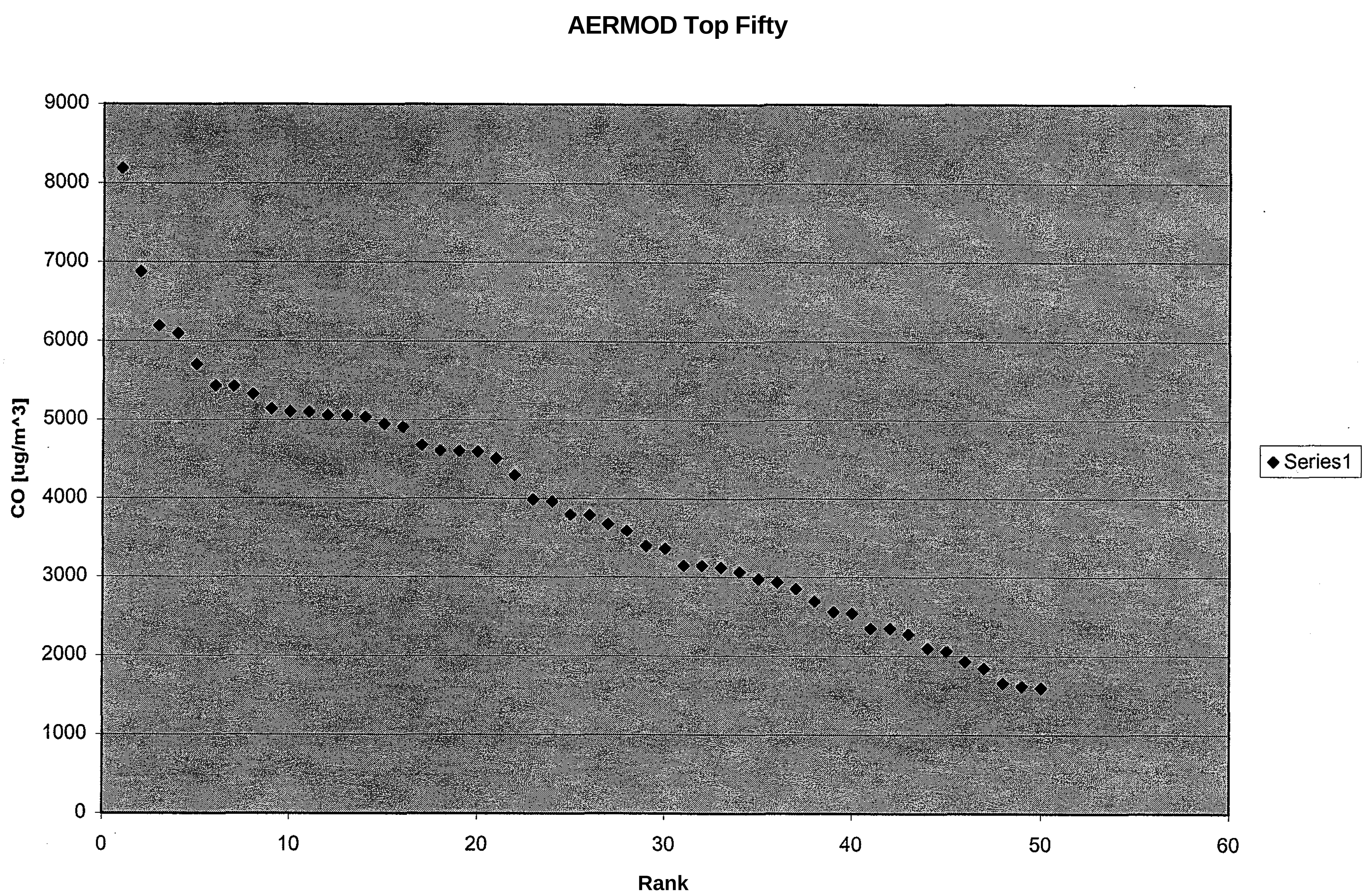
Two plots are attached to this memorandum, the first showing the Kaiser facility and model receptors, and the second showing the same for only the southeast quadrant of the grid, where the maximum concentration was predicted by AERMOD. Also attached is a table of the 50 high concentrations at the maximum AERMOD receptor, and a chart showing the distribution of these 50 concentrations by date. With the exception of one 8-hour period, all occurred within the month of December, 1995.

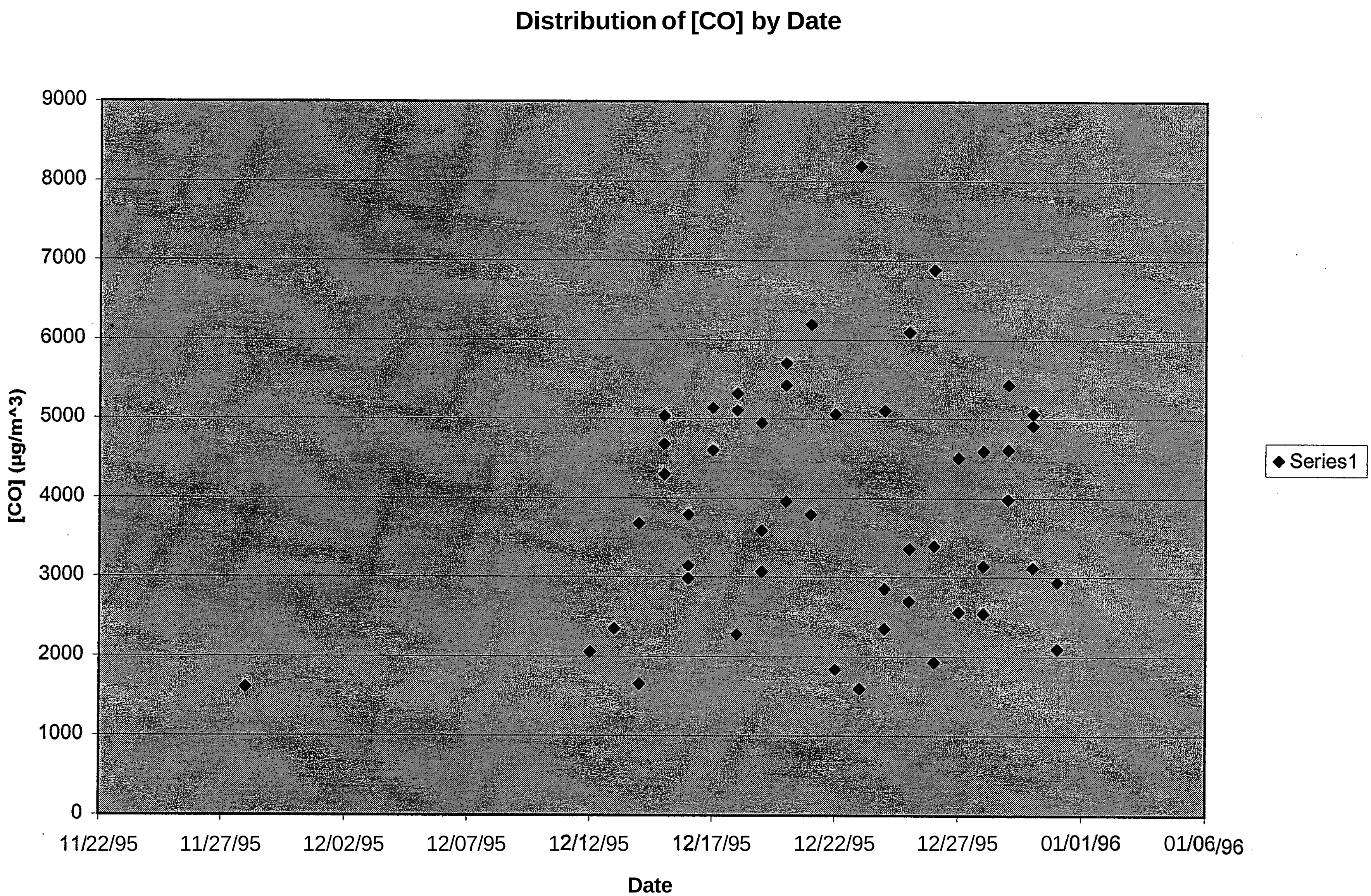
Kaiser Mead 8-Hour Average CO Concentration Contour (µg/m^3)



Kaiser Mead 8-Hour Average CO Concentration Contour (μg/m^3)
Southeast Quadrant of Model Grid




AERMOD Top Fifty
CO [ug/m^3]
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
10
20
30
40
50
60
Rank
Series1



Distribution of [CO] by Date
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
[CO] (µg/m^3)
11/22/95
11/27/95
12/02/95
12/07/95
12/12/95
12/17/95
12/22/95
12/27/95
01/01/96
01/06/96
Date
Series1

Supplementary CO Emissions Calculations Using the Sierra Research Cold CO Model

Mass CO emissions were computed as the product of emissions rates (grams/mile) from the MOBILE and Sierra CO models times the average daily (Tuesday – Thursday) vehicle miles traveled (VMT). Emissions for all model runs are calculated based upon an average speed of 24 miles per hour, and minimum and maximum temperatures of 24° F and 38° F, respectively. The Spokane Clean Air Pollution Control Authority (SCAPCA) provided VMT data.

Emission comparisons between the two models include:
1) Daily emissions in pounds per day for an average winter day for the calendar years 1996, 2000, 2005, and 2012.
2) Emissions for the 1996 base year are set to one and emissions for subsequent calendar years are defined as a fraction of the base year.

Sierra Cold CO Model Summary

The Sierra MOBILE model developed for Alaska, although not identical to MOBILE6, is somewhat MOBILE6-like. Although the most recent EPA Tier 2 motor vehicle emission regulations are not included in the model, National Low Emission Vehicle (NLEV) standards and fuel sulfur content adjustments for Alaska are in the model. The Sierra model should more realistically evaluate MOBILE emissions than the MOBILE5b model, especially in projecting future emissions.

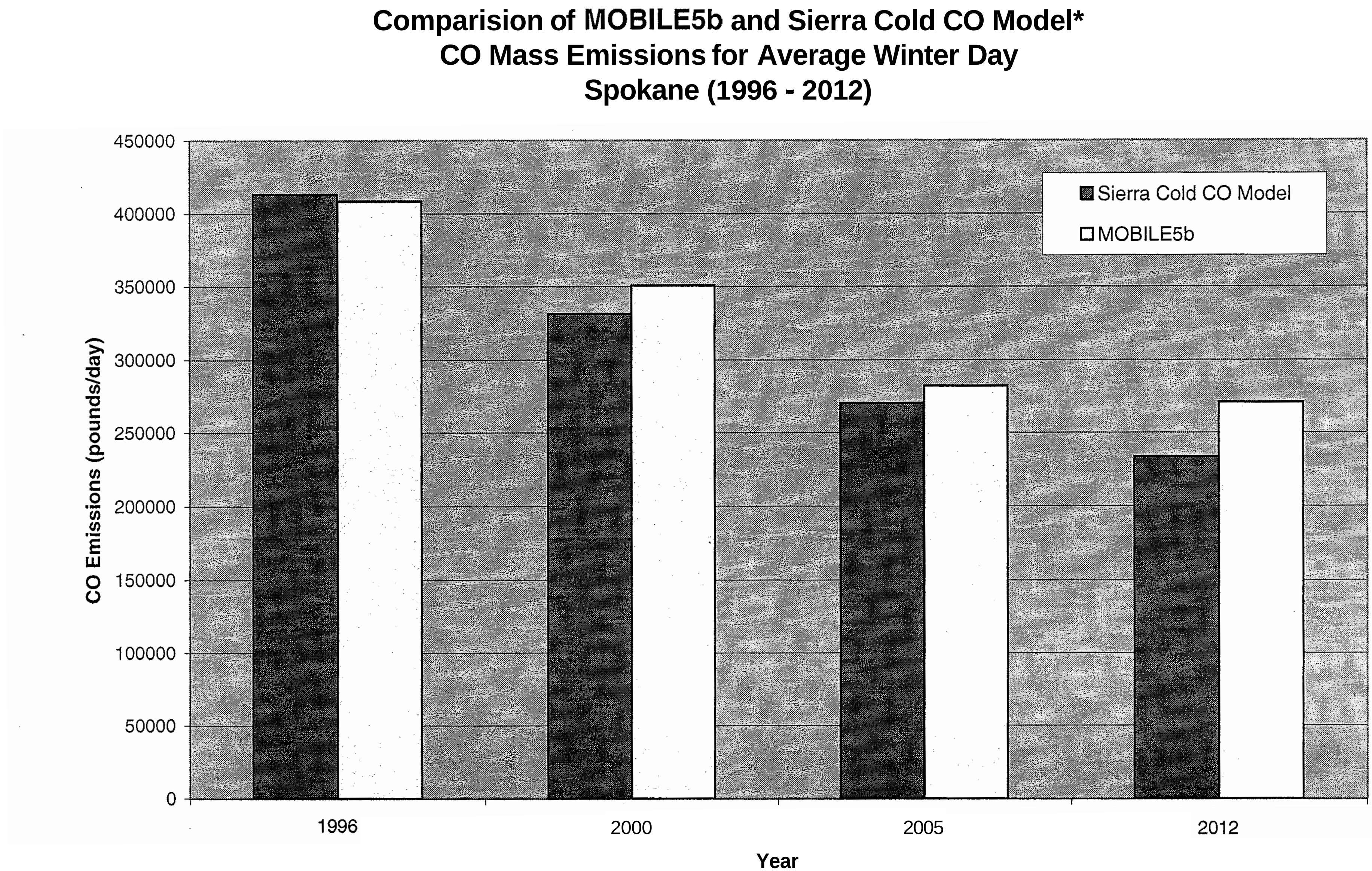
Federal Regulations Affecting CO Emissions

1. Tier 1 Exhaust Standards (1994-1996).
2. Phase 1 Cold CO standards (1994-1996).
3. On-Board Diagnostics.
4. Supplemental Federal Test Procedure (FTP – 200012001).
5. National Low Emission Vehicle Program (NLEV – 2001).
6. Tier 2 Standards/Low Sulfur Gasoline Program (2004-2009).

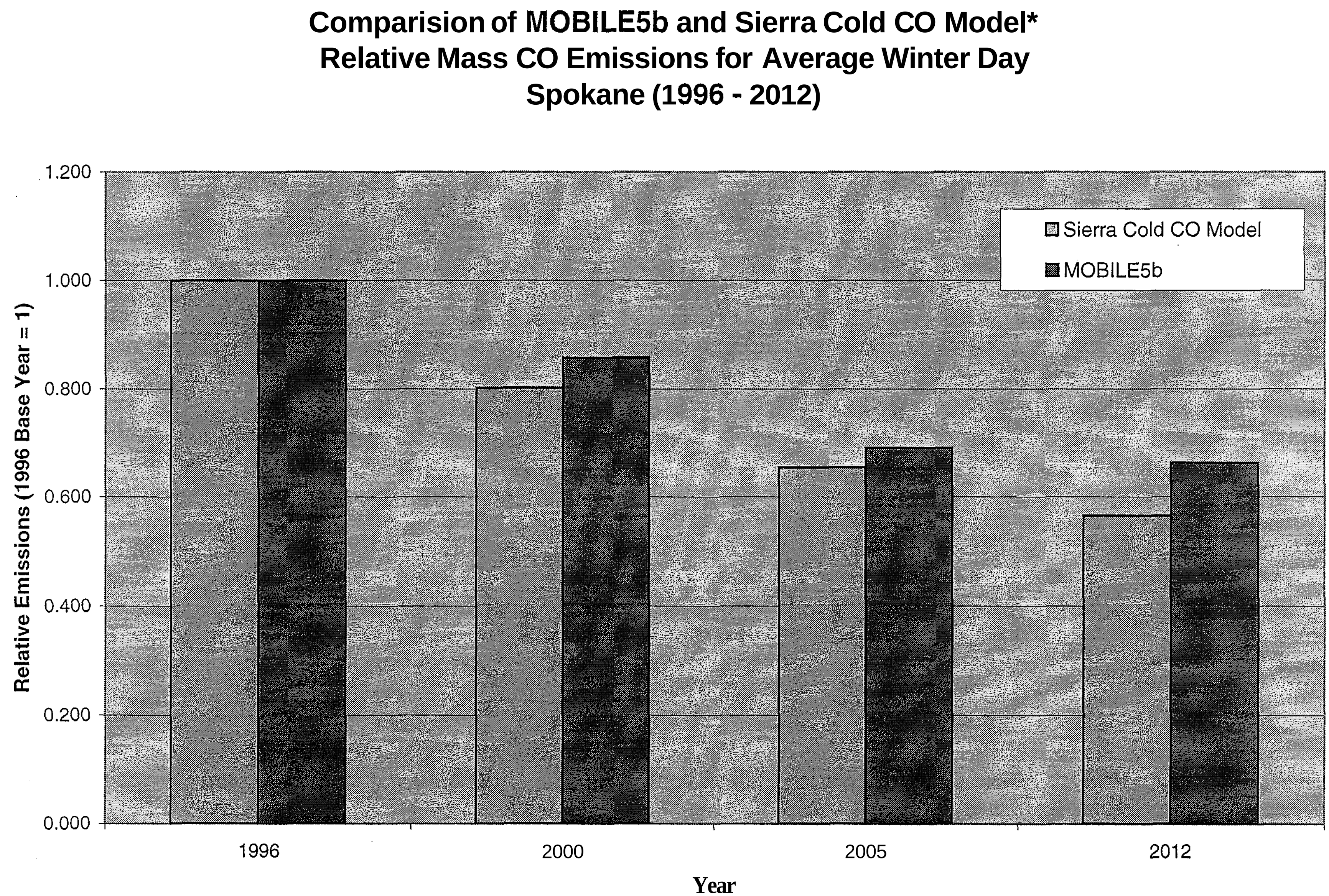
Revisions Included in Sierra Cold CO Model

1. Basic Emission Rates (BER) – Lower deterioration rates for Tier 1 and LEV.
2. Revised cold temperature algorithm
3. Off-cycle effects – Does not include air conditioning analysis.
4. Revised oxygenated fuel effects – Reduced benefits.
5. Fuel Sulfur Effects on LEV-category vehicles – The Sierra model does not allow inputs for variations in fuel sulfur content. Small refineries in the Rocky Mountain States (WY, MT, CO, UT) supply most of the gasoline for the Spokane area.

Average fuel-sulfur content from these refineries is approximately 450-500ppm as compared to an Alaskan average of 350-400ppm. Sulfur interferes with the performance of the catalytic converter. CO emissions in Spokane for calendar years 1996,2000, and 2005 might be expected to exceed the modeled emissions produced by the Sierra model. The EPA Tier 2 regulations and national low-sulfur gasoline program that phase in 2004-2007 should significantly reduce CO emissions. MOBILE6 would then project CO emissions lower than the Sierra model for the 2012 calendar year.



*Sierra Cold CO Model includes NLEV; does not include EPA Tier 2 standards or national low sulfur gasoline program.



*Sierra Cold CO Model includes NLEV; does not include EPA Tier 2 standards or national low sulfur gasoline program.

Performance Evaluation of the Modeling of Ambient Carbon Monoxide (CO) Concentrations in Spokane

Washington State Department of Ecology

There are three phases to the model performance evaluation: 1) Evaluation of the regional modeling which used Urban Airshed Model V (UAM-V, 2) Evaluation of the combined UAM-V and CAL3QHC screening mode calculation, and 3) Evaluation of the combined UAM-V and CAL3QHC in the refined mode.

1.0 Evaluation of the Regional Modeling

The evaluation of the regional modeling does not have the desired level of confidence, as there are data for only a single winter for which there were no high CO concentrations. There was but a single site, Gonzaga University, which qualifies as a regional or background site for the intersections in Spokane. Although Systems Application International's (SAI) analysis shows a slight tendency towards under-prediction it is instructive to explore the model performance in other ways to better understand the model behavior.

The four figures (EE-1a-d) show the performance of UAM-V in modeling the one-hour concentrations of CO at the Gonzaga monitoring site. In all figures the ordinate is model performance as computed by dividing the predicted concentration by the observed concentration and then plotted on a logarithmic scale. In this way, model over-prediction and under-prediction of a given amount, say a factor of two, will lie the same distance from the 1.0 line, which indicates perfect model performance. In the analysis of the figures the terms over- and under-prediction refer to model performance outside the factor of two that has been customarily used for bounding acceptable model performance.

In the first figure (EE-1a) note that the periods of under-prediction nearly all occur between 1000 and 1600 and the larger over-prediction primarily occur between 0600 and 1100. Such behavior seems to indicate that there is a problem in the way the turbulence parameterization scheme adjusts to the effects of solar heating. Model prediction during the hours of darkness seems to be unbiased.

In the second figure (EE1b) the model performance extends from gross over-prediction at the lowest observed concentrations (a usual result of dispersion models although the factor of five is a bit extreme) to a decided tendency to under-predict at the higher concentrations which is also characteristic of most dispersion models. Significant under-prediction begins at observed concentrations as low as 1 parts per million (ppm). It is a bit disconcerting that the degree of over-prediction at the lowest observed concentrations (–0.5 ppm) is matched by an equal amount of under-prediction at the highest observed concentrations (–5.5 ppm).

The third figure (EE-lc) shows that there is no significant change of model performance with temperature (although the range, from 271 K to 279 K, is very small) which implies that the temperature dependent emission factors do not have a significant bias.

In the final figure (EE-1d) note that none of the model over-prediction occurred at wind speeds less than about one mile per how and nearly all of the under-prediction was confined to wind speeds less than 1.5 miles per hour. I find it a bit disconcerting that model performance at wind speeds greater than three miles per hour was unacceptable.

In spite of the foregoing analysis of the one-hour performance, the SAI analysis showed that overall model performance for the high eight-hour average CO concentration periods was acceptable.

2.0 Evaluation of the Combined UAM-V and CAL3QHC Models

Once the regional modeling was accepted, attention turned to assessing the performance of the combined regional and hot spot modeling to predict the CO concentrations observed at three sites in Spokane. The goal of the performance evaluation was to determine whether the modeling met the goals stated in the modeling protocol and whether any significant effects exist that could be traced to important atmospheric parameters such as temperature, wind speed, or observed concentration. The evaluation also checked for trends related to the contribution of each of the two models.

The performance metric for each intersection and date was computed by adding the highest modeled concentration from the hotspot modeling from CAL3QHC to a matrix of nine values from the regional scale modeling fi-om UAM-V. The nine values are the values from a 3 x **3** sub-grid of cells centered on the location of the intersection. The use of adjacent cells in a grid model is an attempt to quantify the uncertainty produced by the underlying resolution of the wind field which can fully resolve only features which have a characteristic size of about five times the grid spacing. The effect of this lack of resolution by the meteorological model is tempered somewhat by the different characteristics of the dispersion model which does resolve features down to the grid size. Each set of nine values was used to construct a boxplot showing the median, the limits of the upper and lower quartiles and the 95^{th} and 5^{th} percentiles.

3.0 Comparison of Various Modes of CAL3QHC

For the use of CAL3QHC in the refined mode to be acceptable the proponent must show that the model performance is superior to its use in the screening mode. In the following analysis the use of CAL3QHC is evaluated for the screening mode against its use in the refined mode at two different receptor locations, the actual location of the monitor and at the modeled maximum.

Data sets for two intersections (Third & Washington and Hamilton & Sharp) for each of the two days (November 10,1993 and November 11, 1993) were developed to address the two CAL3QHC modes: CAL3QHC in the screening mode (designated by "s"), CAL3QHC in the refined mode at the maximum receptor (designated by "x"), and CAL3QHC in the refined mode at the monitor location receptor (designated by "m").

For each data set there are nine ratios of the predicted concentration (UAM nine cells plus the appropriate CAL3QHC receptor) to the observed concentration. The ratios, which range from 0.43 to 1.35, are shown in Table 3-1 below.

Table 3-1. Ratios of Predicted-to-Observed Concentrations

DATE	3rd & WASHINGTON			HAMILTON & SHARP		
	"s"	"x"	"m"	"s"	"x"	"m"
10-Nov-93	1.00	0.67	0.43	0.99	0.96	0.96
	1.17	0.83	0.51	1.05	1.02	1.02
	1.09	0.75	0.45	0.94	0.93	0.93
	1.18	0.89	0.65	1.08	1.05	1.05
	1.28	0.95	0.68	1.14	1.12	1.12
	1.24	0.90	0.59	1.02	1.01	1.01
	1.01	0.72	0.47	1.08	1.03	1.03
	1.09	0.79	0.53	1.03	0.99	0.99
	1.08	0.77	0.49	1.03	0.99	0.99
11-Nov-93	1.08	0.83	0.80	1.17	1.10	0.79
	1.23	1.02	0.82	1.21	1.14	0.84
	1.15	0.96	0.66	1.07	1.00	0.69
	1.35	1.04	1.03	1.27	1.20	0.90
	1.33	1.07	0.96	1.25	1.18	0.88
	1.18	0.98	0.81	1.06	0.99	0.69
	1.19	0.87	0.87	1.27	1.20	0.90
	1.14	0.85	0.82	1.15	1.08	0.77
	1.03	0.79	0.72	1.06	1.00	0.69

For the analysis, all the "s" ratios were lumped into one data set, all the "x" into a second, and all the "m" into a third. Then 1.0 was subtracted from every value. Thus the data consist of the residuals showing the amount that each ratio deviated from perfect performance (which will be shown by zero in the figures).

Further analysis depends on each data set being nearly normal and having no outliers. The histograms, boxplots, density plots, and normal qqplots in Figures EE 2-4 allow visual assessment of the data sets. Both the screening set and the monitor location set seem to look a bit non-normal and one should be careful with interpretations. The maximum receptor data are closer to being normal. The boxplot also provides a visual assessment of the bias in the median and whether the perfect prediction lies within the inter-quartile range. The perfect prediction lies outside the inter-quartile range for both the screening mode and the monitor location data.

Figure EE-5 shows the cumulative distribution of each data set as compared against one of the other data sets. The right-most line (solid) shows the cumulative distribution of the screening ("s") data. The left-most line (dotted) shows the cumulative distribution of the monitor location ("m") data. The middle line (dashed) shows the cumulative distribution of the maximum ("x") data. This figure shows that the concentrations computed using the screening mode are clearly higher than the observations, the concentrations at the monitor location using the refined mode are below those observed, and the highest calculated concentration using the refined mode is the best estimate of the observations.

4.0 Evaluation of the Combined UAM-V and CAL3QHC Refined Mode

The final evaluation that must be done is the model performance evaluation using the refined mode with maximum calculated concentrations from CAL3QHC. Although the overall model performance has been deemed acceptable under the terms set forth in the modeling protocol, there are additional analyses needed to rule out undesirable model behavior such as trends that depend on temperature or wind speed. Accordingly, model performance is plotted as a function of date, temperature, wind speed, observed concentration, the UAM-V contribution, and the CAL3QHC contribution. Figures EE-6 through EE-8 show these plots for the three intersections: Third and Washington, Hamilton & Sharp, and Main & Monroe. The six dependent variables: date, temperature, wind speed, observed concentration, and individual model contributions used in the evaluation were chosen for the following reasons:

Date - to confirm that there is no trend with date, which might be caused by a failure to estimate emissions accurately for the four years.

Temperature - to confirm that there is no failure of the emissions estimation techniques in accounting for the effects of temperature on emission rates.

Wind Speed - to confirm that the meteorological and dispersion models do not have a significant bias in performance that is related to wind speed.

Observed Concentration - the observed concentration is a function of the actual emissions and meteorological conditions that are only approximated in the emissions, meteorological, and dispersion models. A significant trend with respect to the observed concentration would indicate that one or more of the models might not be accounting for an important effect.

Model Contribution - a trend that shows up as a function of model contribution to the total predicted concentration may be indicative of the importance that model plays in overall performance.

4.1 Third and Washington

Figure EE-6 shows plots of model performance as functions of the six parameters discussed above. Except for model performance as a function of CAL3QHC contribution there is sufficient scatter in the data to rule out any trends. The model performance definitely trends from slight under-prediction at small CAL3QHC contributions to over-prediction at the largest CAL3QHC contributions.

4.2 Hamilton and Sharp

The evaluation of model performance for the Hamilton and Sharp intersection is not quite so clear cut. Apparent trends with respect to date, temperature, and wind speeds as well as the already noted change in performance with respect to CAL3QHC contribution are seen. Since the same two dates (930401 and 940302) are contributing to all of the apparent trends and only trend seen at Third and Washington was in the CAL3QHC contribution, it seems likely that CAL3QHC behavior is causing the trends seen in the date, temperature, and wind speed figures.

4.3 Monroe Street

Model performance at Monroe Street varied from awful to marginally acceptable with all performance in the over-prediction category. Since the observed concentrations at Monroe Street were all less than 7 ppm (Monroe street was included solely on the basis of its concurrent data with the other sites), the poor performance, which does seem to trend towards acceptability at the higher concentrations, may be dismissed as unimportant.

4.4 Summary

Based on the analyses described in this appendix, it was decided to go forward with control strategy evaluation using the sum of the UAM-V and the CAL3QHC models where the CAL3QHC model was run in the refined mode and used the highest modeled receptor.

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

P.O. Box 47600 • Olympia, Washington 98504-7600

(360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

February 23,2000

Ms. Christine Lee
U.S. Environmental Protection Agency
Washington Operations Office
P.O. Box 47600
Olympia, Washington 98504-7600

Dear Christi ~~Ms. Lee:~~

On behalf of the three agencies cooperating on the development of the serious carbon monoxide (CO) attainment plan and maintenance plan for Spokane, I request that we be granted permission to use CAL3QHC in the refined mode for analyzing CO impacts at roadway intersections. The three agencies are Spokane County Air Pollution Control Authority, Spokane Regional Transportation Council, and Washington State Department of Ecology. Our request is supported by the enclosed analysis and consistent with section 6.2.2 of 40 CFR Part 51 Appendix W, which provides that "... a refined approach may be considered on a case-by-case basis." Staff from the three agencies and EPA reviewed the analysis during a January 24,2000, conference call regarding SIP development,

Should you have any questions about the enclosed analysis or our request, please feel free to contact Clint Bowman at (360) 407-6815 or me at (360) 407-6874.

Thank you for your consideration and assistance.

Sincerely,

Doug Schneider

Douglas L. Schneider
Senior SIP Planner

DLS:cp
Enclosure

cc: Roger Dovel, Ecology
Eric Skelton, SCAPCA
Glenn Miles, SRTC

Analysis of Alternatives for Intersection Modeling of Carbon Monoxide in Spokane

Washington State Department o fEcology

January 2000

THEDATASETS

The Spokane Regional Transportation Council in cooperation with the Spokane County Air Pollution Control Authority developed three distinct data sets for each of two monitored intersections (Third & Washington and Hamilton) for each of the two days (10 November 1993 and 11 November 1993). All three data sets provide predicted maximum 8-hour carbon monoxide (CO) concentrations for a 3 x 3 grid centered on the intersection of interest. The data sets differ on how the predicted 8-hour concentration was determined. The three data sets are the following:

- CAL3QHC in the screening mode (designated by "s"). The maximum 8-hour CO concentration represents a worst case scenario. The concentration is the sum of the maximum 8-hour background CO concentration and the maximum 8-hour local traffic contribution. The maximum background concentration is the highest daily 8-hour running average concentration for each grid as determined by Urban Airshed Model –V (UAM-V). The local traffic contribution was determined by CAL3QHC modeling of the peak hour CO concentration in the screening mode and converting the hourly into an 8-hour CO concentration by multiplying the peak hour concentration by the persistence factor of 0.7. This persistence factor has been confirmed by an analysis of Spokane CO monitoring data. The CAL3QHC concentration is based on the maximum receptor.
- CAL3QHC in the refined mode at the maximum receptor (designated by "x"). The maximum 8-hour concentration is calculated from the running average of the hourly CAL3QHC concentration and corresponding hourly UAM-V concentration. The hourly CAL3QHC concentration is based on running the model in its refined mode—that is, with defined meteorological inputs. The meteorological inputs come from UAM-V modeling. The CAL3QHC concentration is based on the maximum receptor.
- CAL3QHC in the refined mode at the monitor location receptor (designated by "m"). This data set is developed from the same procedures as data set x except that the CAL3QHC receptor is located **at** the monitor.

THE ANALYSIS

The Washington State Department of Ecology performed an analysis of the data sets. First, the monitored maximum 8-hour concentrations at both intersections for both days was used to calculate the ratio of predicted to the observed concentration for each of the nine grid squares for all three data sets. The results, which range from 0.43 to 1.35, are presented below.

'DATE	RATIO OF PREDICTED TO OBSERVED 8-HOUR CO CONCENTRATIONS					
	Third & Washington			Hamilton		
	s	x	m	s	x	m
10 November 1993	1.00	0.67	0.43	0.99	0.96	0.96
	1.17	0.83	0.51	1.05	1.02	1.02
	1.09	0.75	0.45	0.94	0.93	0.93
	1.18	0.89	0.65	1.08	1.05	1.05
	1.28	0.95	0.68	1.14	1.12	1.12
	1.24	0.90	0.59	1.02	1.01	1.01
	1.01	0.72	0.47	1.08	1.03	1.03
	1.09	0.79	0.53	1.03	0.99	0.99
	1.08	0.77	0.49	1.03	0.99	0.99
11 November 1993	1.08	0.83	0.80	1.17	1.10	0.79
	1.23	1.02	0.82	1.21	1.14	0.84
	1.15	0.96	0.66	1.07	1.00	0.69
	1.35	1.04	1.03	1.27	1.20	0.90
	1.33	1.07	0.96	1.25	1.18	0.88
	1.18	0.98	0.81	1.06	0.99	0.69
	1.19	0.87	0.87	1.27	1.20	0.90
	1.14	0.85	0.82	1.15	1.08	0.77
	1.03	0.79	0.72	1.06	1.00	0.69

For this analysis, all ratios were converted into residuals that show the amount that each ratio deviated from perfect performance. The residuals were calculated by subtracting 1.0 from each value. The resulting residuals form three derivative data sets: **"total.s"** contains all the "s" residuals; **"total.x",** all the "x" residuals; and **"total.m",** all the "m" residuals.

All three derived data sets were evaluated to determine whether parametric statistical analysis may be used (see Figures 1, 2, and 3). For parametric statistical analysis to be valid, data must follow a "normal" distribution. Both the data set for screening mode residuals and the set for refined mode residuals at the monitor location seem to look a bit non-normal. Care should be taken with interpretations. The set for refined mode residuals at the maximum receptor is much closer to being normally distributed.

Next, the cumulative distribution frequencies of the residuals sets were plotted two sets at a time for purposes of comparison (see Figure 4). The cumulative distribution of the screening mode residuals (total.s) is definitely biased towards over-prediction— the line starts at about the perfect prediction (0.0) and extends to almost 0.4. On the other hand, the cumulative distribution frequency of the refined mode residuals at the maximum receptor (total.m) seems to be nearly centered about 0.0 and has a symmetrical distribution of about ± 0.2. The cumulative distribution frequency of the refined mode residuals at the monitoring location is skewed towards under-prediction.

CONCLUSION

Based on this analysis, the best estimate of observed maximum 8-hour CO concentrations is found running CAL3QHC in the refined mode and using the maximum receptor.

Figure 1. Total Data Set for Screening Mode

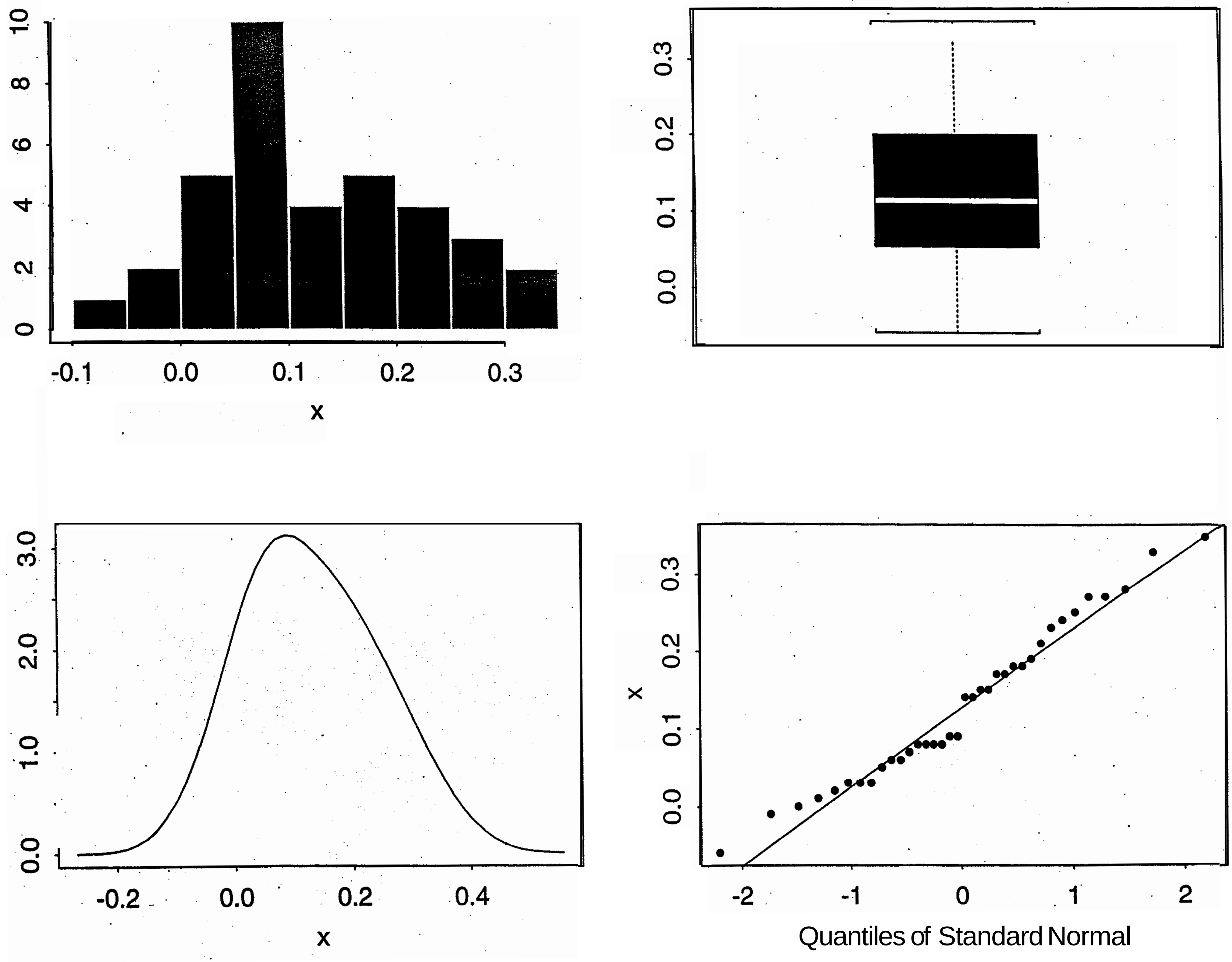


Figure 2. Total Data Set for Refined Mode at Maximum Location

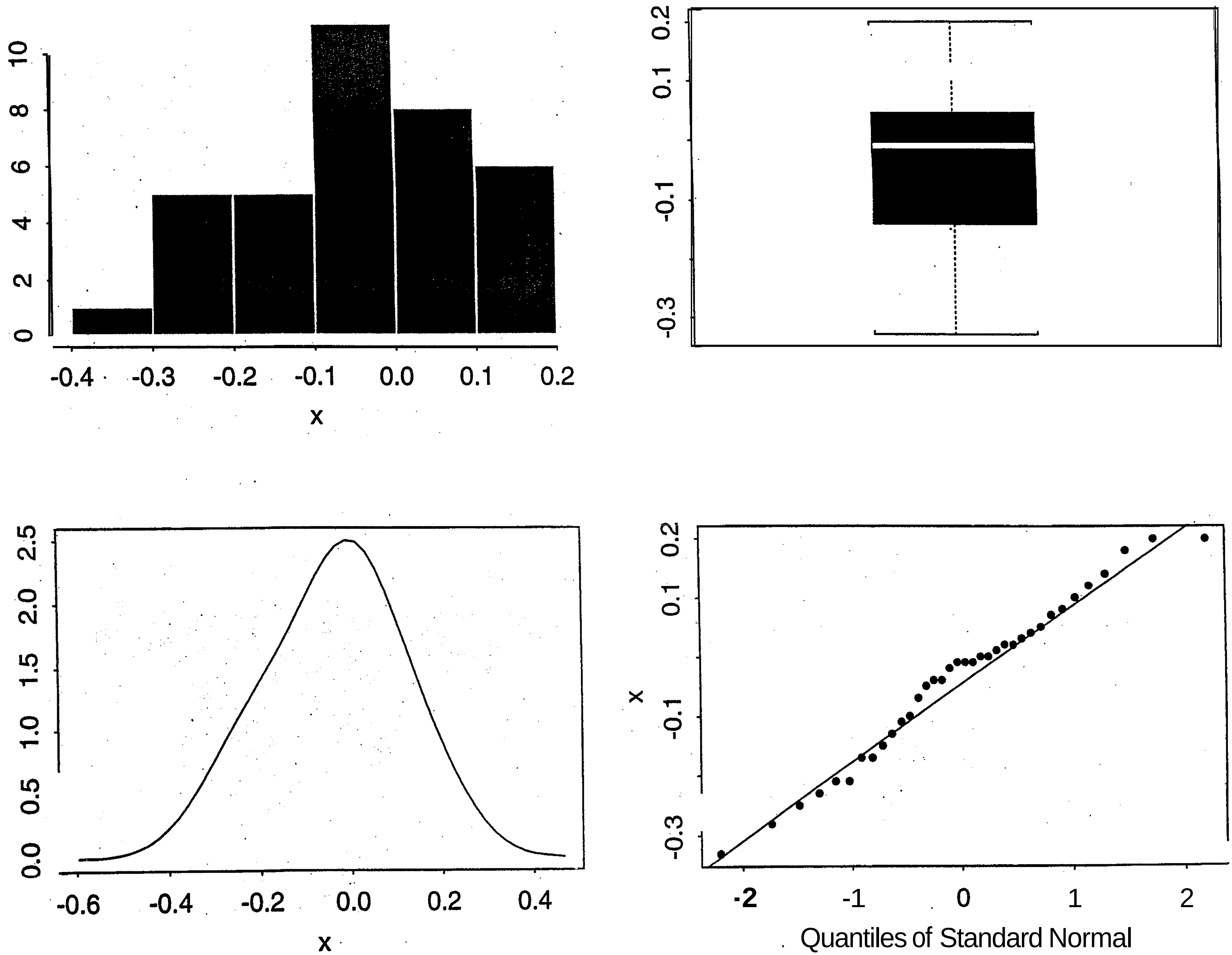


Figure 3. Total Data Set for Refined Mode at Monitor Location

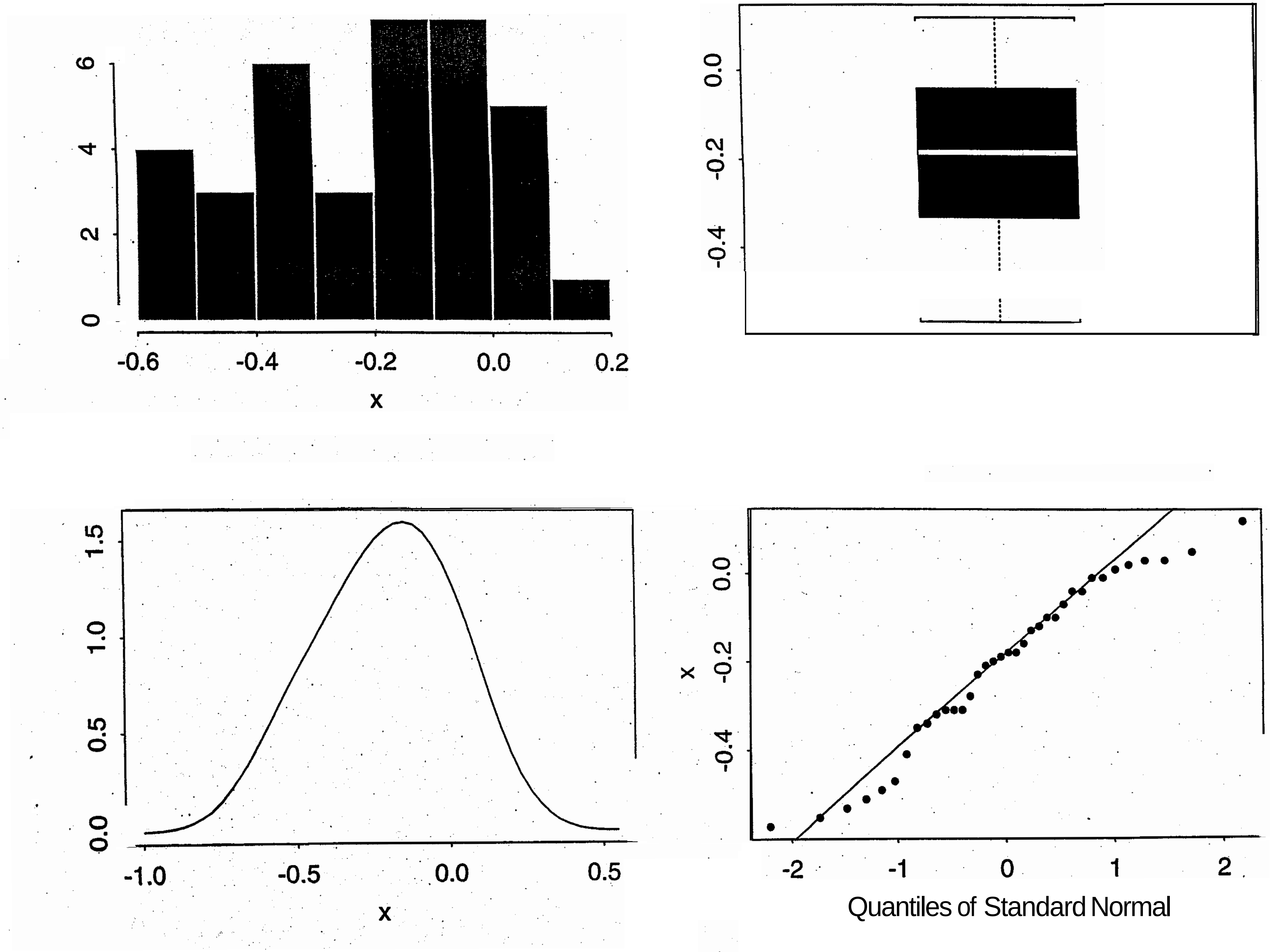
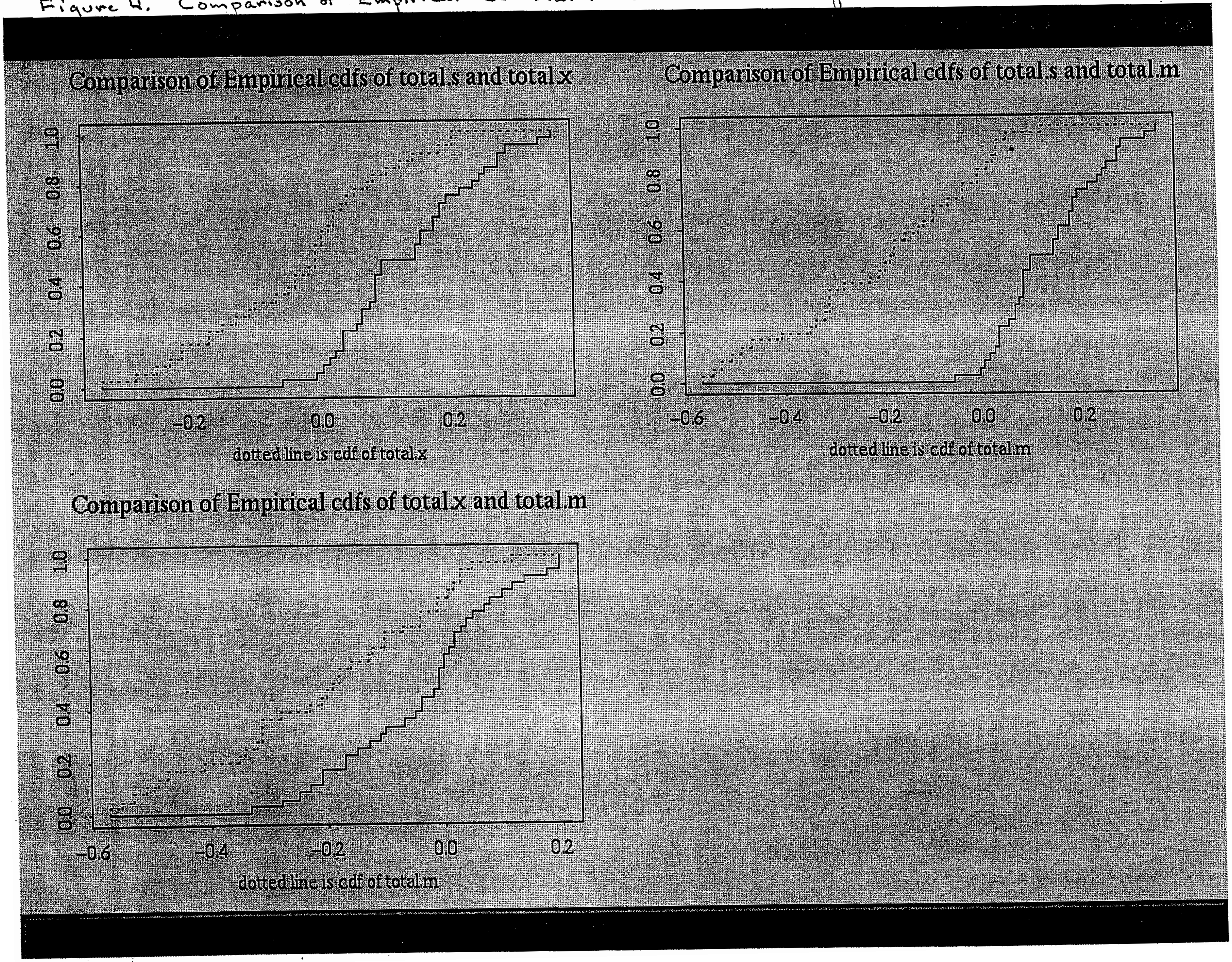


Figure 4. Comparison of Empirical Cumulative Distribution Frequencies



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

I 3 2000

Reply To
Attn Of: OAQ-107

Douglas L. Schneider
Washington Department of Ecology
Air Quality Program
P.O. Box 47600
Olympia, Washington 98504-7600

Sub: Approval for the Use CAL3QHC Refined Model in the Spokane Serious CO SIP Analysis

Dear Mr. Schneider:

After completing a review of the data for statistical performance measurement, EPA allows the use of CAL3QHC model in the refined mode for analyzing CO impacts at road way intersections in the development of Spokane serious CO attainment and maintenance plans. This approval is limited to the application of Spokane serious CO SIP development, because the Guideline of Air Quality Models (40CFR51, Appendix W, Section 6.2.2) authorizes the use of refined model on a case-by-case basis only. Should another application require the use of the refined model, a similar statistical performance measurement must be developed and approved by EPA prior to its regulatory application.

The basis for accepting a proposed model for a specific application, involves a comparison of performance between the proposed model and an applicable reference model. The proposed model will normally be approved for use if it meets any of the following three criteria:

- If a demonstration can be made that the model produces concentration estimates equivalent to the estimates obtained using a preferred model;
- If a statistical performance evaiuation has been conducted using measured air quality data and the results of that evaluation indicate the alternative model performs better for the application than a preferred model; or
- If there is no preferred model for the specific application but a refined model is needed to satisfy regulatory requirements.

The Washington Department of Ecology considered a parametric statistical analysis to compare performance of the proposed CAL3QHC refined mode with the preferred screening mode. The analysis met the above approval criteria and it showed that the least predicted bias occurs when refined mode of the model is used.

Should you have any questions about the approval of the CAL3QHC refined model in the Spokane serious SIP, please feel free to contact, Mahbubul Islam at (206)-553-6985.

Sincerely,

Bonnie Thie, Manager
State and Tribal Programs Unit

cc: Christine Lee, EPA

Modeling Carbon Monoxide from Roadway Intersections in Spokane Using CAL3QHC

Prepared By

Spokane Regional Transportation Council
221 W. First Avenue, Suite 310
Spokane, WA 99201-3613
5091343-6370 Fax: 5091343-6400

February 16,2000
Modified: July 21,2000

1. Introduction

As the Metropolitan Transportation Planning Organization, the Spokane Regional Transportation Council (SRTC) has completed the intersection modeling for the Spokane carbon monoxide (CO) non-attainment area. The year 2000 attainment demonstration for the Spokane non-attainment area includes regional dispersion simulations using Urban Airshed Model (UAM) in coordination with micro-scale intersection modeling using CAL3QHC (Version 2.0) for overall urban area analysis.

In order to select intersections for analysis, intersections throughout the nonattainment area were ranked by traffic volume and severity of level-of-service (LOS). Two CO monitoring sites were selected for model validation and five other intersections were selected based on the severity of LOS and highest traffic volumes.

The seven intersections included in the microscale hot-spot analysis are:

3rd Avenue & Washington Street (monitoring site)
Hamilton Street & Sharp Avenue (monitoring site)
2nd Avenue & Browne Street
3rd Avenue & Browne Street
2nd Avenue & Division Street
3rd Avenue & Division Street
Northwest Boulevard, Indiana Avenue & Monroe Street

An additional CO monitor is located at the intersection of Main Avenue & Monroe Street. While this intersection was selected for the attainment demonstration in the modeling protocol, EPA agreed to exclude this intersection from the SIP attainment hot-spot analysis due its poor model validation performance.[1] The poor model performance of this monitored intersection is attributed to its complex topographic features (i.e., proximity to the Spokane River canyon), location on the western fringe of the UAM one-kilometer grid cell, and the complexity of the intersection's current configuration.

Also, two other intersections (Sprague Avenue at Park and Fancher Roads) selected in the modeling protocol were also excluded as the construction of the South Valley Arterial Couplet is projected to reduce CO levels at these locations significantly.

CO hot spot analysis for the seven intersections has been completed for the worst-case episode of November 11, 1993 following the modeling protocol and EPA modeling guidelines (EPA, 1992). For the same seven intersections, the year 2000 attainment demonstration was completed for the same day of the week and week of the month for the forecast year 2000. For November 11, 1993, the forecast day in the year 2000 was November 9.

[1] Conference call between EPA Region 10 (w/ Mahbubul Islam), SRTC, SCAPCA and Ecology; Wednesday, December 29,1999.

2. CAL3QHC Methodology

2.1 Approval of the Refined Mode

EPA recommends analyzing CO impacts at roadway intersections using CAL3QHC (Version 2.0) with model procedures included in EPA's "Guideline for Modeling Carbon Monoxide from Roadway Intersections" (EPA, 1992).

For SIP analysis, the same EPA guidance recommends that CAL3QHC intersection modeling data include the hourly meteorological conditions used by the UAM for temperature, wind speed, and wind direction. The hourly UAM concentration of the grid square overlaying the intersection is added to the corresponding CAL3QHC concentration for the intersection. The maximum 8-hour concentration is then calculated fiom a running 8-hour average using the highest 1-hour receptor location within an 8-hour time period. According to EPA regulations, EPA may consider this refined model approach on a case-by-case basis (40 CFR Part 51, 1996).

Model validation by the Department of Ecology found that the refined mode using the maximum receptor at the monitor sites of 3rd & Washington and Hamilton & Sharp for the episode days of November 10, 1993 and November 11, 1993 provided the best estimation of the observed CO concentration. EPA Region 10 approved the use of CAL3QHC in the refined mode in an April 13,2000, letter to Ecology.

2.2 CAL3QHC Input Parameters for Refined Mode

The CAL3QHC model was run at the seven intersections using the UAM hourly temperature, wind direction, and wind speed fiom the grid square overlaying the intersection for each hour of the episode day. EPA (1995) guidance for CAL3QHC suggests that a minimum wind speed of 1.0 meter/second (m/s) be used, as CAL3QHC has not been validated for wind speeds below 1.0 m/s. Therefore, when the UAM wind speed was below, then 1 m/s was used in this data field. CAL3QHC model inputs also included hourly forecasted traffic counts, emission factors, and signal cycle times.

The forecasted traffic volumes were modeled using the SRTC Travel Demand Model (TModel2) and with directional modifications based on the most recent field counts available. Hourly traffic distribution for CAL3QHC inputs were calculated using traffic count variation percentages formulated by the National Cooperative Highway Research Program (NCHRP) for urban areas of populations ranging fiom 100,000 to 250,000.

November 10th and 11th of 1993 have been designated as the episode days for demonstrating attainment. The reason they were chosen was due to the occurrence of exceedances on two consecutive days and the meteorological parameters in the range typical for Spokane CO exceedances.

Hourly idle and running vehicle emission factors were calculated using MOBILE5b by Ecology with the model inputs identical to the UAM modeling. The emission factors consider the registration distribution by age, the default VMT mix, the inspection and maintenance program, operating mode (i.e., average cold start information), temperature, variation due to the day of the week, and the wintertime oxygenated fuel program in Spokane County.

2.3 Forecast Conditions

Table 2-1 presents the initial results of the refined mode attainment demonstration. CAL3QHC hourly results were added to the UAM hourly concentrations from the grid square where the intersection is located. The combined 1-hour results from CAL3QHC and UAM were then averaged over 8-hour segments to determine the maximum 8-hour concentration. Attachment A presents the hourly concentrations from both models and the combined running 8-hour average for all seven intersections.

Table 2-1. Initial Results for the Demonstration of Attainment on 11/09/00

INTERSECTION	GRID SQUARE	CAL3QHC+UAM MAXIMUM 8-HOUR AVERAGE (ppm)
3rd Avenue & Washington St	15,11	9.38
Hamilton St. & Sharp Ave	17,13	8.71
2nd Avenue & Browne St.	16,11	8.08
3rd Avenue & Browne St.	16,11	8.68
2nd Avenue & Division St	16,11	8.59
3rd Avenue & Division St.	16,11	7.59
Northwest Blvd & Indiana St.	15,14	8.76

The refined mode methodology resulted in only one intersection—3rd Avenue & Washington Street—failing to demonstrate attainment of the 8-hour CO NAAQS of 9 ppm. As a consequence, SRTC coordinated with local jurisdictions on the development of a Transportation Control Measure (TCM) and recommended operational modifications that would provide sufficient mobile source emission reductions to demonstrate attainment of the CO NAAQS at the failing intersection.

3. Transportation Control Measures and Operational Modifications

In December 1999, the SRTC Citizen's Advisory Committee on Transportation (CACT) and a subcommittee of the SRTC Transportation Technical Advisory Committee (TTC) developed a list of twenty-six (26) possible TCMs. All twenty-six (26) alternatives were analyzed and screened based on their potential to reduce vehicle traffic on the affected corridors, reduce regional emissions and prevent the creation of new CO hot spots. The subcommittee forwarded four transportation control strategies for consideration by the SRTC Board.

At its February 2000 meeting, the SRTC Board approved proposing the construction of an on-ramp from Division Street to eastbound Interstate 1-90 as a new TCM. Of the TCMs considered, the new on-ramp provides the greatest air quality benefit by reducing circuitous travel paths in and around the Division Street, Browne Street, and Washington Street, all of which are downtown corridors leading to the existing eastbound 1-90 on-ramp. The new eastbound 1-90 on-ramp will improve access for the 6,500 employees that work in the hospital district south of the downtown area.

Modeled traffic volumes for grid squares 15,11 and 16, 11 are anticipated to decrease by 920 vehicles and 500 vehicles respectively with the construction of this TCM. The end result is nearly a 20 percent decrease in traffic along the Third Avenue corridor.

In addition to the improvement resulting from the 1-90 eastbound ramp, SRTC evaluated a modification of signal timing to reduce the CO emissions further (SRTC 1997). The analysis indicated that a reduction in cycle length from the existing 90-second cycles to 70-second cycles and a change in red times would reduce vehicle queuing and thus CO emissions. The recommended signal modifications are given in Table 3-1.

Table 3-1. Recommended 70-Second Signal Timing for Downtown Intersections

INTERSECTION	TIMING (seconds) E/W – N/S
3rd Avenue & Washington St	42 – 28
3rd Avenue & Browne St.	35 – 35
3rd Avenue & Division St.	32 – 38

4. Forecast Conditions with TCM Implementation

Revised traffic volumes resulting from implementation of the TCM were modeled with the recommended 70-second signal timing for the three specified intersections to demonstrate attainment in the year 2000 at 3rd & Washington and four of the additional intersections selected for analysis that are affected by the TCM. TMODEL2 was used to define traffic volumes for 3rd & Washington, 2nd & Division, 3rd & Division, 2nd & Browne, and 3rd & Browne. Optimization of operational parameters such as signal timing is standard practice for analysis of a TCM (Transportation Research Board, 1994). Due to variations in driver behavior and land use changes, operational characteristics used for the analysis may differ from the operational modifications implemented for the TCM. Nonetheless, operational characteristics (i.e., signal phasing) at the critical intersections will be implemented to maintain or improve the emission reductions forecast for the 70-second signal cycle used for the analysis.

The combined CAL3QHC and UAM 8-hour maximum averages demonstrate attainment of the CO standard in the year 2000 at the five downtown intersections (Table 3-2). SAI revised the UAM results used in this demonstration to reflect inclusion of the eastbound Interstate 1-90 TCM. Attachment B presents the hourly concentrations from both models and the combined running 8-hour average for the five affected intersections.

Table 4-1. Demonstration of Attainment on 11/09/00 at Intersections Impacted by the 1-90 Eastbound On-Ramp and Recommended Signal Modifications

INTERSECTION	GRID SQUARE	CAL3QHC+UAM MAXIMUM 8-HOUR AVERAGE (ppm)
3rd Avenue & Washington St	15,11	8.64
2nd Avenue & Browne St.	16,11	8.45
3rd Avenue & Browne St.	16,11	8.85
2nd Avenue & Division St	16,11	8.63
3rd Avenue & Division St.	16,11	8.73

5. Summary

The initial forecast conditions demonstrated attainment at six of seven analyzed intersections. A TCM was selected to bring the seventh intersection into attainment. The TCM affected traffic and CO concentrations at five of the seven intersections. Revised forecast conditions demonstrated attainment of the CO standard at all five intersections with the TCM. Thus, attainment of the standard in 2000 is demonstrated for all seven analyzed intersections and the attainment plan requirement is satisfied.

References

National Cooperative Highway Research Program, Quick Response Urban Travel Estimation Techniques and Transferable Parameters, Report 187 (1978), Table 25, Hourly Distribution of Total Travel on Arterials: Urbanized Area Population, 100,000-250,000, page 99.

Spokane Regional Transportation Council, Evaluation of Mobile Source Emissions in the Second and Third Avenue Corridor (April 25, 1997).

Transportation Research Board, Highway Capacity Manual, Third Edition, Special Report 209, Washington, D.C. (1994).

U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *Guideline for Modeling Carbon Monoxide from Roadway Intersections*, EPA-454/R-92-005, Research Triangle Park, North Carolina (November 1992).

U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections*, EPA-454/R-92-06 (revised), Research Triangle Park, North Carolina (September 1995).

U.S. Environmental Protection Agency, Guideline on Air Quality Models, 40 CFR Part 51, Appendix W (August 12,1996).

Attachment A

Hourly UAM and CAL3QHC Concentrations and Combined Running 8-Hour Average Concentrations for the Seven Analyzed Intersections

Attainment Demonstration

MODELED CO CONCENTRATIONS
FOR NOVEMBER 9,2000 FORECASTED EPISODE
at maximum receptor located at
3rd AVENUE/WASHINGTON STREET (GRID CELL 15,11)

	UAM		CAL3QHC		UAM + CAL3QHC	
Beginning Hour	I-hour (ppm)	8-hour average (ppm)	I-hour (ppm)	8-hour average (ppm)	I-hour (ppm)	8-hour average (ppm)
24	1.13		1.50		2.63	
1	0.87		0.00		0.87	
2	0.76		0.00		0.76	
3	0.71		0.00		0.71	
4	0.77		0.00		0.77	
5	1.11		0.20		1.31	
6	2.09		1.60		3.69	
7	3.95	1.42	3.00	0.79	6.95	2.21
8	4.88	1.89	1.80	0.83	6.68	2.72
9	4.66	2.36	1.00	0.95	5.66	3.31
10	5.39	2.94	0.30	0.99	5.69	3.93
11	5.49	3.54	0.40	1.04	5.89	4.58
12	4.61	4.02	0.40	1.09	5.01	5.11
13	4.38	4.43	0.30	1.10	4.68	5.53
14	4.94	4.79	0.30	0.94	5.24	5.72
15	6.47	5.10	0.40	0.61	6.87	5.71
16	8.70	5.58	4.30	0.93	13.00	6.51
17	9.95	6.24	4.10	1.31	14.05	7.55
18	7.90	6.55	4.10	1.79	12.00	8.34
19	5.69	6.58	3.50	2.18	9.19	8.75
20	3.89	6.49	2.10	2.39	5.99	8.88
21	3.84	6.42	3.80	2.83	7.64	9.25
22	3.44	6.23	2.90	3.15	6.34	9.38
23	2.13	5.69	1.50	3.29	3.63	8.98
Maximum	9.95	6.58	4.30	3.29	14.05	9.38

Attainment Demonstration

MODELED CO CONCENTRATIONS
FOR NOVEMBER 9,2000 FORECASTED EPISODE
at maximum receptor located at
SHARP AVENUE/HAMILTON STREET (GRID CELL 17,13)

	UAM		CAL3QHC		UAM + CAL3QHC	
Beginning Hour	1-hour (ppm)	8-hour average (ppm)	1-hour (ppm)	8-hour average (ppm)	1-hour (ppm)	8-hour average (ppm)
24	2.09		0.00		2.09	
1	1.56		0.00		1.56	
2	1.11		0.00		1.11	
3	0.85		0.00		0.85	
4	0.81		0.00		0.81	
5	0.92		0.00		0.92	
6	1.40		0.00		1.40	
7	2.24	1.37	0.00	0.00	2.24	1.37
8	2.60	1.43	0.00	0.00	2.60	1.43
9	3.09	1.63	0.00	0.00	3.09	1.63
10	2.95	1.86	0.40	0.05	3.35	1.91
11	2.78	2.10	0.00	0.05	2.78	2.15
12	2.65	2.33	0.00	0.05	2.65	2.38
13	2.81	2.56	0.10	0.06	2.91	2.63
14	3.66	2.85	0.00	0.06	3.66	2.91
15	4.99	3.19	0.00	0.06	4.99	3.25
16	6.09	3.63	7.20	0.96	13.29	4.59
17	6.73	4.08	5.50	1.65	12.23	5.73
18	5.98	4.46	4.90	2.21	10.88	6.67
19	5.08	4.75	4.60	2.79	9.68	7.54
20	4.45	4.97	3.90	3.28	8.35	8.25
21	3.89	5.11	2.70	3.60	6.59	8.71
22	3.07	5.03	0.20	3.63	3.27	8.66
23	2.52	4.72	0.70	3.71	3.22	
Maximum	6.73	5.11	7.20	3.71	13.29	8.71

MODELED CO CONCENTRATIONS
FOR NOVEMBER 9,2000 FORECASTED EPISODE
at maximum receptor located at
2nd AVENUE/BROWNE STREET (GRID CELL 16,11)

	UAM		CAL3QHC		UAM + CAL3QHC	
Beginning Hour	1-hour (ppm)	8-hour average (ppm)	1-hour (ppm)	8-hour average (ppm)	l-hour (ppm)	8-hour average (ppm)
24	1.04		0.30		1.34	
1	0.77		0.10		0.87	
2	0.66		0.10		0.76	
3	0.60		0.10		0.70	
4	0.63		0.00		0.63	
5	0.89		0.30		1.19	
6	1.67		2.00		3.67	
7	3.28	1.19	4.00	0.86	7.28	2.05
8	4.06	1.57	3.70	1.29	7.76	2.86
9	3.85	1.95	4.40	1.83	8.25	3.78
10	4.07	2.38	4.50	2.38	8.57	4.76
11	3.76	2.78	4.50	2.93	8.26	5.70
12	3.48	3.13	4.30	3.46	7.78	6.59
13	3.15	3.41	3.30	3.84	6.45	7.25
14	3.45	3.64	3.70	4.05	7.15	7.69
15	4.70	3.81	4.40	4.10	9.10	7.91
16	6.51	4.12	1.70	3.85	8.21	7.97
17	7.38	4.56	1.70	3.51	9.08	8.08
18	6.30	4.84	0.50	3.01	6.80	7.85
19	5.23	5.03	0.40	2.50	5.63	7.53
20	4.31	5.13	0.30	2.00	4.61	7.13
21	3.78	5.21	0.50	1.65	4.28	6.86
22	3.25	5.18	0.60	1.26	3.85	6.44
23	2.34	4.89	0.20	0.74	2.54	5.62
Maximum	7.38	5.21	4.50	4.10	9.10	8.08

MODELED CO CONCENTRATIONS FOR NOVEMBER 9,2000 FORECASTED EPISODE at maximum receptor located at 3rd AVENUE/BROWNE STREET (GRID CELL 16,11)

	UAM		CAL3QHC		UAM + CAL3QHC	
Beginning Hour	l-hour (ppm)	8-hour average (ppm)	l-hour (ppm)	8-hour average (ppm)	l-hour (ppm)	8-hour average (ppm)
24	1.04		0.90		1.94	
1	0.77		0.20		0.97	
2	0.66		0.20		0.86	
3	0.60		0.20		0.80	
4	0.63		0.20		0.83	
5	0.89		0.30		1.19	
6	1.67		1.20		2.87	
7	3.28	1.19	2.50	0.71	5.78	1.90
8	4.06	1.57	2.00	0.85	6.06	2.42
9	3.85	1.95	2.80	1.18	6.65	3.13
10	4.07	2.38	4.20	1.68	8.27	4.06
11	3.76	2.78	4.00	2.15	7.76	4.93
12	3.48	3.13	3.80	2.60	7.28	5.73
13	3.15	3.41	3.00	2.94	6.15	6.35
14	3.45	3.64	3.40	3.21	6.85	6.85
15	4.70	3.81	4.00	3.40	8.70	7.21
16	6.51	4.12	4.30	3.69	10.81	7.81
17	7.38	4.56	4.50	3.90	11.88	8.46
18	6.30	4.84	3.60	3.83	9.90	8.67
19	5.23	5.03	2.60	3.65	7.83	8.68
20	4.31	5.13	1.50	3.36	5.81	8.49
21	3.78	5.21	2.90	3.35	6.68	8.56
22	3.25	5.18	2.20	3.20	5.45	8.38
23	2.34	4.89	1.00	2.83	3.34	7.71
Maximum	7.38	5.21	4.50	3.90	11.88	8.68

MODELED CO CONCENTRATIONS FOR NOVEMBER 9,2000 FORECASTED EPISODE at maximum receptor located at 2nd AVENUE/DIVISION STREET (GRID CELL 16,11)

	UAM		CAL3QHC		UAM + CAL3QHC	
Beginning Hour	1-hour (ppm)	8-hour average (ppm)	l-hour (ppm)	8-hour average (ppm)	l-hour (ppm)	8-hour average (ppm)
24	1.04		0.20		1.24	
1	0.77		0.00		0.77	
2	0.66		0.00		0.66	
3	0.60		0.00		0.60	
4	0.63		0.00		0.63	
5	0.89		0.10		0.99	
6	1.67		0.30		1.97	
7	3.28	1.19	3.30	0.49	6.58	1.68
8	4.06	1.57	0.80	0.56	4.86	2.13
9	3.85	1.95	0.40	0.61	4.25	2.57
10	4.07	2.38	0.00	0.61	4.07	2.99
11	3.76	2.78	0.10	0.63	3.86	3.40
12	3.48	3.13	0.10	0.64	3.58	3.77
13	3.15	3.41	0.00	0.63	3.15	4.04
14	3.45	3.64	0.00	0.59	3.45	4.22
15	4.70	3.81	0.00	0.18	4.70	3.99
16	6.51	4.12	5.20	0.73	11.71	4.85
17	7.38	4.56	5.20	1.33	12.58	5.89
18	6.30	4.84	4.70	1.91	11.00	6.75
19	5.23	5.03	3.60	2.35	8.83	7.38
20	4.31	5.13	2.70	2.68	7.01	7.80
21	3.78	5.21	3.60	3.13	7.38	8.33
22	3.25	5.18	2.30	3.41	5.55	8.59
23	2.34	4.89	1.90	3.65	4.24	8.54
Maximum	7.38	5.21	5.20	3.65	12.58	8.59

Attainment Demonstration

MODELED CO CONCENTRATIONS FOR NOVEMBER 9,2000 FORECASTED EPISODE at maximum receptor located at 3rd AVENUE/DIVISION STREET (GRID CELL 16,11)

	UAM		CAL3QHC		UAM + CAL3QHC	
Beginning Hour	l-hour (ppm)	8-hour average (ppm)	l-hour (ppm)	8-hour average (ppm)	l-hour (ppm)	8-hour average (ppm)
24	1.04		0.10		1.14	
1	0.77		0.10		0.87	
2	0.66		0.10		0.76	
3	0.60		0.10		0.70	
4	0.63		0.10		0.73	
5	0.89		0.20		1.09	
6	1.67		3.20		4.87	
7	3.28	1.19	6.50	1.30	9.78	2.49
8	4.06	1.57	6.30	2.08	10.36	3.64
9	3.85	1.95	6.30	2.85	10.15	4.80
10	4.07	2.38	2.40	3.14	6.47	5.52
11	3.76	2.78	3.30	3.54	7.06	6.31
12	3.48	3.13	3.20	3.93	6.68	7.06
13	3.15	3.41	1.70	4.11	4.85	7.53
14	3.45	3.64	1.90	3.95	5.35	7.59
15	4.70	3.81	2.10	3.40	6.80	7.21
16	6.51	4.12	3.20	3.01	9.71	7.13
17	7.38	4.56	3.00	2.60	10.38	7.16
18	6.30	4.84	0.30	2.34	6.60	7.18
19	5.23	5.03	0.20	1.95	5.43	6.98
20	4.31	5.13	0.00	1.55	4.31	6.68
21	3.78	5.21	0.20	1.36	3.98	6.57
22	3.25	5.18	0.30	1.16	3.55	6.34
23	2.34	4.89	0.10	0.91	2.44	5.80
Maximum	7.38	5.21	6.50	4.11	10.38	7.59

MODELED CO CONCENTRATIONS
FOR NOVEMBER 9,2000 FORECASTED EPISODE
at maximum receptor located at
NW BLVD/INDIANA AVENUE/MONROE STREET (GRID CELL 15,14)

	UAM		CAL3QHC		UAM + CAL3QHC	
Beginning Hour	I-hour (ppm)	8-hour average (ppm)	1-hour (ppm)	8-hour average (ppm)	I-hour (ppm)	8-hour average (ppm)
24	2.30		1.00		3.30	
1	1.74		0.10		1.84	
2	1.14		0.10		1.24	
3	0.80		0.10		0.90	
4	0.76		0.20		0.96	
5	0.90		0.60		1.50	
6	1.46		2.60		4.06	
7	2.58	1.46	5.90	1.33	8.48	2.78
8	3.08	1.56	4.10	1.71	7.18	3.27
9	3.44	1.77	4.60	2.28	8.04	4.04
10	4.24	2.16	6.20	3.04	10.44	5.19
11	3.99	2.56	6.10	3.79	10.09	6.34
12	3.37	2.88	5.30	4.43	8.67	7.31
13	3.74	3.24	4.20	4.88	7.94	8.11
14	4.27	3.59	4.40	5.10	8.67	8.69
15	3.45	3.70	5.60	5.06	9.05	8.76
16	4.52	3.88	1.50	4.74	6.02	8.61
17	6.07	4.21	2.30	4.45	8.37	8.66
18	6.17	4.45	2.00	3.93	8.17	8.37
19	4.30	4.49	1.00	3.29	5.30	7.77
20	2.94	4.43	0.80	2.73	3.74	7.16
21	2.97	4.34	1.70	2.41	4.67	6.75
22	2.95	4.17	1.60	2.06	4.55	6.23
23	2.29	4.03	0.90	1.48	3.19	5.50
Maximum	6.17	4.49	6.20	5.10	10.44	8.76

Attachment B

Hourly UAM and CAL3QHC Concentrations and Combined Running 8-Hour Average Concentrations for the Five Intersections Affected by the TCM

MODELED CO CONCENTRATIONS
FOR NOVEMBER 9,2000 FORECASTED EPISODE
at maximum receptor located at
3rd AVENUE/WASHINGTON STREET (GRID CELL 15,11)

	UAM		CAL3QHC		UAM + CAL3QHC	
Beginning Hour	1-hour (ppm)	8-hour average (ppm)	1-hour (ppm)	8-hour average (ppm)	1-hour (ppm)	8-hour average (ppm)
24	1.10		1.30		2.40	
1	0.85		0.00		0.85	
2	0.74		0.00		0.74	
3	0.69		0.00		0.69	
4	0.74		0.00		0.74	
5	1.06		0.10		1.16	
6	2.02		1.50		3.52	
7	3.78	1.37	3.10	0.75	6.88	2.12
8	4.74	1.83	1.50	0.78	6.24	2.60
9	4.51	2.29	0.90	0.89	5.41	3.17
10	5.13	2.83	0.30	0.93	5.43	3.76
11	5.11	3.39	0.40	0.98	5.51	4.36
12	4.37	3.84	0.40	1.03	4.77	4.87
13	4.22	4.23	0.30	1.05	4.52	5.28
14	4.85	4.59	0.30	0.90	5.15	5.49
15	6.33	4.91	0.40	0.56	6.73	5.47
16	8.27	5.35	3.80	0.85	12.07	6.20
17	9.46	5.97	3.60	1.19	13.06	7.16
18	7.61	6.28	3.50	1.59	11.11	7.86
19	5.52	6.33	2.80	1.89	8.32	8.22
20	3.78	6.25	1.60	2.04	5.38	8.29
21	3.73	6.19	3.20	2.40	6.93	8.59
22	3.37	6.01	2.20	2.64	5.57	8.64
23	2.09	5.48	1.10	2.73	3.19	8.20
Maximum	9.46	6.33	3.80	2.73	13.06	8.64

MODELED CO CONCENTRATIONS FOR NOVEMBER 9,2000 FORECASTED EPISODE at maximum receptor located at 3rd AVENUE/BROWNE STREET (GRID CELL 16,11)

	UAM		CAL3QHC		UAM + CAL3QHC	
Beginning Hour	1-hour (ppm)	8-hour average (ppm)	1-hour (ppm)	8-hour average (ppm)	1-hour (ppm)	8-hour average (ppm)
24	1.07		0.90		1.97	
1	0.79		0.20		0.99	
2	0.67		0.20		0.87	
3	0.61		0.20		0.81	
4	0.65		0.20		0.85	
5	0.96		0.30		1.26	
6	1.86		1.20		3.06	
7	3.65	1.28	2.50	0.71	6.15	1.99
8	4.45	1.70	2.00	0.85	6.45	2.55
9	4.19	2.13	2.70	1.16	6.89	3.29
10	4.37	2.59	3.90	1.63	8.27	4.22
11	4.08	3.03	3.70	2.06	7.78	5.09
12	3.72	3.41	3.50	2.48	7.22	5.89
13	3.38	3.71	2.70	2.78	6.08	6.49
14	3.65	3.94	3.10	3.01	6.75	6.95
15	4.98	4.10	3.60	3.15	8.58	7.25
16	6.83	4.40	4.00	3.40	10.83	7.80
17	7.85	4.86	4.20	3.59	12.05	8.45
18	6.61	5.14	4.00	3.60	10.61	8.74
19	5.46	5.31	3.00	3.51	8.46	8.82
20	4.46	5.40	1.80	3.30	6.26	8.70
21	3.99	5.48	3.30	3.38	7.29	8.85
22	3.42	5.45	2.80	3.34	6.22	8.79
23	2.42	5.13	1.30	3.05	3.72	8.18
Maximum	7.85	5.48	4.20	3.60	12.05	8.85

MODELED CO CONCENTRATIONS FOR NOVEMBER 9,2000 FORECASTED EPISODE at maximum receptor located at 2nd AVENUE/BROWNE STREET (GRID CELL 16,11)

	UAM		CAL3QHC		UAM + CAL3QHC	
Beginning Hour	**l-hour (ppm)**	**8-hour average (ppm)**	**l-hour (ppm)**	**8-hour average (ppm)**	**l-hour (ppm)**	**8-hour average (ppm)**
24	1.067		0.3		1.37	
1	0.7859		0.1		0.89	
2	0.669		0.1		0.77	
3	0.6125		0.1		0.71	
4	0.6475		0		0.65	
5	0.9613		0.3		1.26	
6	1.8591		2.1		3.96	
7	3.6518	1.28	4.2	0.90	7.85	2.18
8	4.4498	1.70	3.7	1.33	8.15	3.03
9	4.1946	2.13	4.4	1.86	8.59	3.99
10	4.3729	2.59	4.7	2.44	9.07	5.03
11	4.0756	3.03	4.5	2.99	8.58	6.01
12	3.7154	3.41	4.4	3.54	8.12	6.95
13	3.3815	3.71	3.4	3.93	6.78	7.64
14	3.6504	3.94	3.8	4.14	7.45	8.07
15	4.9813	4.10	4.5	4.18	9.48	8.28
16	6.8323	4.40	1.7	3.93	8.53	8.33
17	7.8549	4.86	1.7	3.59	9.55	8.45
18	6.61	5.14	0.5	3.06	7.11	8.20
19	5.4618	5.31	0.4	2.55	5.86	7.86
20	4.4614	5.40	0.3	2.04	4.76	7.44
21	3.9853	5.48	0.6	1.69	4.59	7.17
22	3.4196	5.45	0.6	1.29	4.02	6.74
23	2.4166	5.13	0.2	0.75	2.62	5.88
Maximum	7.85	5.48	4.70	4.18	9.55	8.45

MODELED CO CONCENTRATIONS FOR NOVEMBER 9,2000 FORECASTED EPISODE at maximum receptor located at 3rd AVENUE/DIVISION STREET (GRID CELL 16,11)

	UAM		CAL3QHC		UAM + CAL3QHC	
Beginning Hour	1-hour (ppm)	8-hour average (ppm)	1-hour (ppm)	average (ppm)	1-hour (ppm)	8-hour average (ppm)
24	1.07		0.20		1.27	
1	0.79		0.10		0.89	
2	0.67		0.10		0.77	
3	0.61		0.10		0.71	
4	0.65		0.10		0.75	
5	0.96		0.20		1.16	
6	1.86		0.50		2.36	
7	3.65	1.28	2.40	0.46	6.05	1.74
8	4.45	1.70	0.80	0.54	5.25	2.24
9	4.19	2.13	0.80	0.63	4.99	2.76
10	4.37	2.59	4.80	1.21	9.17	3.81
11	4.08	3.03	3.00	1.58	7.08	4.60
12	3.72	3.41	3.80	2.04	7.52	5.45
13	3.38	3.71	4.90	2.63	8.28	6.34
14	3.65	3.94	5.50	3.25	9.15	7.19
15	4.98	4.10	6.60	3.78	11.58	7.88
16	6.83	4.40	1.20	3.83	8.03	8.23
17	7.85	4.86	1.20	3.88	9.05	8.73
18	6.61	5.14	0.20	3.30	6.81	8.44
19	5.46	5.31	0.10	2.94	5.56	8.25
20	4.46	5.40	0.10	2.48	4.56	7.88
21	3.99	5.48	0.30	1.90	4.29	7.38
22	3.42	5.45	0.40	1.26	3.82	6.71
23	2.42	5.13	0.10	0.45	2.52	5.58
Maximum	7.85	5.48	6.60	3.88	11.58	8.73

MODELED CO CONCENTRATIONS FOR NOVEMBER 9,2000 FORECASTED EPISODE at maximum receptor located at 2nd AVENUE/BROWNE STREET (GRID CELL 16,11)

	UAM		CAL3QHC		UAM + CAL3QHC	
Beginning Hour	1-hour (ppm)	8-hour average (ppm)	1-hour (ppm)	8-hour average (ppm)	1-hour (ppm)	8-hour average (ppm)
24	1.067		0.2		1.27	
1	0.7859		0		0.79	
2	0.669		0		0.67	
3	0.6125		0		0.61	
4	0.6475		0		0.65	
5	0.9613		0.1		1.06	
6	1.8591		0.4		2.26	
7	3.6518	1.28	3.4	0.51	7.05	1.79
8	4.4498	1.70	0.9	0.60	5.35	2.30
9	4.1946	2.13	0.5	0.66	4.69	2.79
10	4.3729	2.59	0	0.66	4.37	3.26
11	4.0756	3.03	0.1	0.68	4.18	3.70
12	3.7154	3.41	0.1	0.69	3.82	4.10
13	3.3815	3.71	0	0.68	3.38	4.39
14	3.6504	3.94	0	0.63	3.65	4.56
15	4.9813	4.10	0	0.20	4.98	4.30
16	6.8323	4.40	4.6	0.66	11.43	5.06
17	7.8549	4.86	4.7	1.19	12.55	6.05
18	6.61	5.14	4.4	1.74	11.01	6.88
19	5.4618	5.31	3.4	2.15	8.86	7.46
20	4.4614	5.40	2.4	2.44	6.86	7.84
21	3.9853	5.48	3.5	2.88	7.49	8.35
22	3.4196	5.45	2.4	3.18	5.82	8.63
23	2.4166	5.13	1.9	3.41	4.32	8.54
Maximum	7.85	5.48	4.70	3.41	12.55	8.63

RULE-MAKING ORDER
(RCW 34.05.360)

CR-103 (7/10197)

☒ **Permanent Rule**
☐ **Emergency Rule**
☒ **Expedited Adoption**
☐ **Expedited Repeal**

Agency: Department of Ecology A.O. # 00 - 15

(1) Date of adoption: 10131100

(2) Purpose: Comply with revisions to state law regarding when emission inspections of vehicles can be required.

(3) Citation of existing rules affected by this order:
Repealed:
Amended: WAC 173 - 422
Suspended:

(4) Statutory authority for adoption: RCW 70.120.120
Other Authority:

PERMANENT RULE ONLY
Adopted under notice file as WSR #00.16.079 on July 28, 2000.
Describe any changes other than editing from proposed to adopted version: None

EMERGENCY RULE ONLY
Under RCW 34.05.350 the agency for good cause finds:
☐ (a) That immediate adoption, amendment, or repeal of a rule is necessary for the preservation of the public health, safety, or general welfare, and that observing the time requirements of notice and opportunity to comment upon adoption of a permanent rule would be contrary to the public interest.
☐ (b) That state or federal law or federal rule or a federal deadline for state receipt of federal funds requires immediate adoption of a rule.
Reasons for this finding:

EXPEDITED REPEAL ONLY
Under Preproposal Statement of Inquiry filed as WSR #__________ on __________ (date).

(5.3) Any other findings required by other provisions of law as precondition to adoption or effectiveness of rule?
☐ Yes ☒ No If yes, explain:

(6) Effective date of rule:

Permanent Rules or Expedited Rule Making	**Emergency Rules**
☒ 31 days after filing	☐ Immediately
☐ Other (specify) _________*	☐ Later (specify)

*(If less than 31 days after filing, specific finding in 5.3 under RCW 34.05.380(3) is required)

NAME (TYPE OR PRINT)
Tom Fitzsimmons

SIGNATURE
[signature]

TITLE
Director

DATE
10-31-00-

CODE REVISER USE ONLY
CODE REVISER'S OFFICE
STATE OF WASHINGTON
FILED
NOV 1 2000
TIME: 11:49 AM
WSR: 00-22-120

Note: If any category is left blank, it will be calculated as zero. No descriptive text.

Count by whole WAC sections only, from the WAC number through the history note. A section may be counted in more than one category.

The number of sections adopted in order to comply with:

Federal statute:	New ☐	Amended ☐	Repealed ☐
Federal rules or standards:	New ☐	Amended ☐	Repealed ☐
Recently enacted* state statutes:	New ☐	Amended ☐	Repealed ☐

*(current calendar year)

The number of sections adopted at the request of a nongovernmental entity:

New ☐ Amended ☐ Repealed ☐

The number of sections adopted on the agency's own initiative:

New ☐ Amended ☐ Repealed ☐

The number of sections adopted in order to clarify, streamline, or reform agency procedures:

New ☐ Amended ☐ Repealed ☐

The number of sections adopted using:

Negotiated rule making:	New ☐	Amended ☐	Repealed ☐
Pilot rule making:	New ☐	Amended ☐	Repealed ☐
Other alternative rule making:	New ☐	Amended ☐	Repealed ☐

NEW SECTION

WAC 173-422-031 Vehicle emission inspection schedules. (1) Vehicles five through twenty-five years old, other than state and local government vehicles, shall be inspected every other year as described in the table below. This does not apply to vehicles that have already been inspected during the current licensing period due to a change of ownership.

Year	Model Year of Vehicles Needing Inspection
2000	1976,1978,1980,1982,1984, 1986,1988, 1990,1992,1994
2001	1977,1979, 1981,1983,1985,1987, 1989, 1991,1993,1995,1996
2002	1978, 1980, 1982, 1984, 1986, 1988,1990, 1992,1994,1997
2003	1979,1981,1983,1985,1987,1989,1991, 1993, 1995,1996, 1998
2004	1980,1982,1984,1986, 1988, 1990,1992, 1994,1997,1999
2005	1981,1983, 1985, 1987,1989, 1991, 1993, 1995,1996,1998,2000
2006	1982, 1984,1986, 1988,1990, 1992,1994, 1997,1999,2001
2007	1983,1985,1987, 1989, 1991, 1993, 1995, 1996, 1998, 2000, 2002
2008	1984, 1986, 1988, 1990, 1992,1994, 1997, 1999,2001,2003
2009	1985,1987,1989, 1991,1993, 1995, 1996, 1998,2000,2002,2004
2010	1986,1988,1990, 1992,1994,1997, 1999, 2001,2003,2005

(2) State and local government vehicles five through twenty-five years old shall be inspected yearly as described in the table below.

Year	Model Year of Vehicles Needing Insvection
2000	1975 through 1995
2001	1976 through 1996
2002	1977 through 1997
2003	1978 through 1998
2004	1979 through 1999
2005	1980 through 2000
2006	1981 through 2001
2007	1982 through 2002

2008	**1983 through 2003**
2009	**1984 through 2004**
2010	**1985 through 2005**

AMENDATORY SECTION (Amending Order 99-19, filed 11/22/99, effective 12/31/99)

WAC 173-422-170 Exemptions. The following motor vehicles are exempt from the inspection requirement:

(1) Vehicles proportionally registered pursuant to chapter 46.85 RCW.

(2) New motor vehicles whose equitable or legal title has never been transferred to a person who in good faith purchases the vehicle for purposes other than resale; this does not exempt motor vehicles that are or have been leased.

(3) Motor vehicles that use propulsion units powered exclusively by electricity.

(4) Motor-driven cycles as defined in chapter 46.04 RCW as amended.

(5) Farm vehicles as defined in chapter 46.04 RCW as amended.

(6) Vehicles not required to be licensed.

(7) Mopeds as defined in chapter 46.04 RCW as amended.

(8) Vehicles garaged and operated out of the emission contributing area.

(9) Vehicles registered with the state but not for highway use.

(10) Used vehicles at the time of sale by a Washington licensed motor vehicle dealer.

(11) Motor vehicles fueled by propane, compressed natural gas, or liquid petroleum gas and so registered by the department of licensing.

(12) Motor vehicles whose manufacturer or engine manufacturer provides information that the vehicle cannot meet emission standards because of its design. In lieu of exempting these vehicles, alternative standards and or inspection procedures may be established.

(13) Motor vehicles whose registered ownership is being transferredbetween parents, siblings, grandparents, grandchildren, spouse or present co-owners and all transfers to the legal owner or a public agency.

(14) ((~~To ensure a biennial inspection of vehicles registered in the emission contributing areas, motor vehicles with model year matching (even to even, odd to odd) the expiration year of the license being purchased. This exemption does not apply to vehicles being inspected because the registered owner is being changed. However, (a) an emission inspection used to change the registered owner may also be used to renew the current license, (b) an~~

emission inspection used to obtain the current license may also be used to change the registered owner.

(15) When the difference between the model year of the vehicle and the expiration year of the license being purchased is four or less.

(16) When the difference between the model year of the vehicle and the expiration year of the license being purchased is twenty-six or greater.)) Vehicles less than five years old.

(15) Vehicles more than twenty-five years old.

MEETING MINUTES
Spokane Regional Transportation Council
Thursday, February 10, 2000
SRTC Office - Intermodal Center
Spokane, WA

1. Call to Order.

Ms. Kate McCaslin called the meeting of the Spokane Regional Transportation Council to order at 1:35 p.m.

2. Roll Call.

The following members were present:

Kate McCaslin, Spokane County Commissioner
Phyllis Holmes, City of Spokane
Jerry Lenzi, WSDOT - Eastern Region
Chris Marr, Washington State Transportation Commission
William Haley, System TWT Transportation
Rob Higgins, City of Spokane
John Roskelley, Spokane County Commissioner
John McHugh, Idaho Transportation Board

Absent:

Bill Brannan, Northwestern Stage Lines (Alternate)
Amy Jo Sooy, Spokane Transit Authority
A. Michele Maher, Washington State Transportation Commission (Alternate)
Pat Dalton, City Attorney's Office

Guests Present:

Ross Kelley, Spokane County
Bill Johns, Spokane County
Don Ramsey, City of Spokane
Jerry Sinclair, City of Spokane
Allen Schweim, STA, TTC Chair
Harold White, WSDOT
Pete Higgins, CACT Vice-Chair
Don MacDonald, City of Cheney
Steve Shrope, David Evans & Associates
Ron Bockstruck, Sverdrup Civil, Inc.
Kevin Cooley, CH2M Hill
Jim Correll, CH2M Hill

Staff Present:

Glenn Miles, Transportation Manager
Pam Tsuchida, Air Quality Planner
Terry Zeimantz, Pub Ed/Info. Coord
Ed Hayes, Transportation Planner
Judy Liljenberg, Admin. Secretary

3. Approval of January Meeting Minutes.

Mr. Jerry Lenzi made a motion to approve the January 13, 2000 meeting minutes. Ms. Phyllis Holmes seconded the motion, which was unanimously approved.

4. Committee Reports.

a) Citizens' Advisory Committee Report

No CACT report was given at this meeting.

b) Transportation Technical Committee Report

Mr. Allen Schweim reported that at the last TTC meeting the members made a motion to recommend a Transportation Control Measure be included in the State Implementation Plan as well as contingency projects, if needed at a later time. They also have had a subcommittee meeting to draft new criteria for the STP fbnding process, and a Model User's Group subcommittee has been formed to look at modeling throughout the area.

5. Administrative Matters.

a) Approval of January 2000 Vouchers

Mr. Jerry Lenzi made a motion to approve the payment of the January 2000 voucher list in the amount of $86,260.82. Mr. John Roskelley seconded the motion, which was unanimously approved.

b) Possible Executive Session on Personnel Matters

Item 5b on the agenda will be discussed at the end of the meeting.

c) Declaring Surplus Miscellaneous Furniture and obsolete Computers

SRTC is seeking to have certain items of **furniture** and old computers removed as assets and declared as surplus. The items will be available for sale, placed in the **City** public auction, or used as trade-in for newer equipment.

Mr. Roskelley made a motion to declare the furniture and old computers removed as assets and declared as surplus. Mr. Bill **Haley** seconded the motion, which was unanimously approved.

6. SRTC Board Member Comments.

No Board Member comments were given at this meeting.

7. Transportation Manager's Report.

Mr. Miles distributed a letter received from WSDOT, Department of Highways and Local Programs. They are concerned that to date, local agencies have only obligated approximately $29 million out of $236 million available through FFY 2000 funding. The three main reasons this is occurring is due to the Endangered Species Act (the requirement for biological assessments and historic and cultural resources), locating a local match, and coordinating projects with utilities that are going in. There are some projects in the Spokane area that were allocated finding in 1998 that have not gone to construction as yet and some may not go to construction this year. This money is all tied up in projects that have been identified and put into transportation improvement programs. The only way to unlock this money is to take a project out for non-performance and put something else in its place.

8. New Business.

a) State Implementation Plan – Transportation Control Measures

TTC and CACT members, as well as people with expertise from the various agencies, have been meeting for several months. They have now submitted their **final** recommendation for transportation control strategies to be included into the Serious ***CO*** State Implementation Plan (SIP). They have recommended that an eastbound on-ramp be constructed as Transportation Control Measure #1, which will be included in the SIP. They also recommended three contingency measures for future use, if necessary.

The estimated cost for implementing Transportation Control Measure #1 is $4.5 million. Due to its location, it is on the National Highway System (NHS) and connects to a principal arterial. Therefore it is anticipated that both NHS and CMAQ funds would be used to find that project. Under the guidelines for including a project in the SIP, Spokane is required to commit that this project would be built before credit can be taken for the benefits it has. Any project identified as being necessary to meet the air quality standards of a non-attainment area rises to the top of all funding available for transportation in that area.

Mr. Rob Higgins arrived at 2:00 pm.

After discussion, Ms. Phyllis Holmes made a motion to approve the recommendation made by the TTC and CACT as follows:

Transportation Control Measure #1:
Construction of an eastbound on-ramp from Division Street to Interstate 90

Contingency Measure #1:
Enhancements to increase capacity and access to **4th** Avenue to facilitate access to an eastbound on-ramp from Division Street to Interstate 90

Contingency Measure #2:
Channelization and signing improvement on Browne and Division corridor

Contingency Measure #3:
Improve access to 1-90 at Browne (scissor ramps and radius improvements)

Mr. **Roskelley** seconded the motion, which was unanimously approved.

b) SRTC Project Selection Criteria for STP Funding (Presentation)

After several months of meetings, the subcommittee for Project Selection Criteria for STP funding comprised of TTC members: Harold White (Chair), Allen Schweim, Ross Kelley, Doug Ross, and Christine Fueston, and CACT members: Pete Higgins and John Downes, has produced a *draft* document. The goals of the subcommittee were to review the project prioritization criteria, maintain the simplified point system, address preservation projects separately, and standardize the evaluation of the various project elements. This draft document is prepared in two segments: Improvement Projects, both urban and rural, and Preservation Projects, both urban and rural. Mr. Miles gave a presentation on its conclusions. This document is being given to both TTC and CACT to review. It is anticipated this document will be brought back to the Board in final form in March for adoption.

9. Old Business.

a) Bridging the Valley – Status Report

Bridging the Valley is the concept of bringing the Union Pacific (UP) Rail Line main track service into the BNSF corridor and, as a part of that, looking at the feasibility of creating grade separations by going either over or under the tracks in those corridors. Mr. Miles will be meeting with the Idaho Transportation Department and others tomorrow in Coeur d'Alene to discuss their side of this project as the tracks travel over into Idaho. Mr. Miles has entered into discussions the past week with both BNSF and UP and feels they went well. It is anticipated that the Request for Proposals, approved by this Board at last month's meeting, will be released next week.

b) Monroe-Lincoln Corridor – Status Report

SRTC hosted a public meeting on January 25th at the Corbin Senior Center on the Monroe-Lincoln Corridor. The meeting was very well attended and received positive feedback from the community. The three questions asked by the small group facilitators were:

1. What would you like to see protected or enhanced in your neighborhoods that are in this corridor?

2. What types of transportation characteristics would you like to see?

3. What transportation alternatives would you like us to look at?

Approximately 160 specific recommendations were received which were then summarized and the results provided back to the public at that same meeting. The workshop results have been tabulated and provided via website and mail to the public. From this workshop, SRTC has selected reasonable alternatives to move forward with, and these have also been distributed. The Request for Proposal on the Expertise Reports will be sent out on this also.

10. Public Comments.

A member of the public and Ms. Holmes thanked and commended Mr. Miles and SRTC for the work they do in the neighborhoods.

5c) Executive Session on Personnel Matters

The executive session was called to discuss the terms of the renewal of Mr. Glenn Miles contract. **A** recess was called for everyone except the Board. Upon reconvening, the Board announced they would like to continue this matter to the next meeting.

11. Adjournment.

There being no further business before the Spokane Regional Transportation Council Board, the meeting was adjourned at 2:50 pm.

Judy Liljenberg

JUDY LILJENBERG
Recording Secretary

Washington State S. T. I. P.
1999 to 2001
(Project Costs in Thousands of Dollars)

March 9, 2000

MPO : SRTC
County :
Agency : WSDOT

Func Cls	Project Identification	PIN No.	Imp Type	Total Length	Start Date	Federal Fund Code	Federal Cost	RAP, etc. Code	RAP, etc. Cost	Local/ State	Total
11			01	.00							Revision: 9
	1-90 EASTBOUND ON-RAMP AT DIVISION STREET DIVISION STREET From: 280.00 To: 280.00										
	SPOKANE SIP TCM #1, CONSTRUCT ON-RAMP.										
	Environmental Status is: CE		PE		4/01/2000	CMAQ	500			78	578
	RW Required: Yes		RW		7/01/2000	CMAQ	250			39	289
			CN		12/01/2001	CMAQ	3750			585	4335
					Project Total		4500			702	5202
14		629000N	07	000.970							Revision: 9
	MISSION AVENUE TO VIC FANCHER ROAD SR-290 From: 3.34 To: 4.31										
	ACP OVERLAY AND SAFETY RESTORATION										
	Environmental Status is: CE		CN		12/11/2000	STP	350			2	352
	RW Required: No										
					Project Total		350			2	352
14		629000Q	03	6.06							Revision: 9
	VIC FANCHER ROAD TO VIC SULLIVAN ROAD SR-290 From: 4.31 To: 10.37										
	PROVIDE CENTER TURN LANE; FIBRE OPTIC CABLE										
	Environmental Status is: CE		CN		12/11/2000	STP	6047			30	6077
	RW Required: No		CN		12/11/2000	CMAQ	649			101	750
					Project Total		6696			131	6827
			Agency Totals for		WSDOT		45401			90621	136022

SPOKANE REGIONAL TRANSPORTATION COUNCIL
FY 1999-2001 TRANSPORTATION IMPROVEMENT PROGRAM
AMENDMENT #9 RECAP
3/9/00

	Project	Approved TIP	Funding Source	Adjustment	Amended TIP	Funding Source
New Projects:						
p. 37	Spokane Transportation	0	STP(U)	405	405	STP(U)
	Operations Center	0	Local	63	63	Local
p. 37	Bridging the Valley	0	CMAQ	200	200	CMAQ
		0	Local	200	200	Local
p. 51	Bridge 278/6 Scour Repair	0	BR	51	51	BR
		0	Local	1	1	Local
p. 52	SR 2 / SR 206 I/S Study	0	STP(S)	198	198	STP(S)
		0	Local	2	2	Local
p. 52	Pine Crk Bridge to Vic Mount	0	STP	460	460	STP
	Hope Road	0	Local	5	5	Local
p. 52	Spokane Regional TMC	0	Disc.	500	500	Disc.
	Integration	0	Local	100	100	Local
p. 53	1-90 Eastbound On-Ramp at	0	CMAQ	4,500	4,500	CMAQ
	Division	0	Local	702	702	Local
Changes to TIP:						
p. 52						
	Mission Avenue to Vic	367	STP	(17)	350	STP
	Fancher Road	57	Local	(55)	2	Local
p. 52						
	Vic Fancher Road to Vic	6,075	STP	(28)	6,047	STP
	Sullivan Road	649	CMAQ	0	649	CMAQ
		1,076	Local	(945)	131	Local
	Reallocation Totals:			405		STP(U)
				500		Disc.
				415		STP
				198		STP(S)
				4,700		CMAQ
				51		BR
				73		Local
				6,342		

p. #'s refer to NEW TIP pages

Emissions Budget for On-Road Mobile Sources

Spokane Regional Transportation Council

June 2000

For the purposes of the State Implementation Plan (SIP), a regional emissions budget for carbon monoxide (CO) must be established for on-road mobile sources. The emissions budget sets a limit as to total CO emissions allowable within the Spokane nonattainment area. Based on regulatory language, projected emissions for the year 2000 become the emissions budget. To estimate emissions from on-road mobile sources in the year 2000, the activity level in vehicle miles traveled (VMT) is multiplied by an emission rate in grams per mile. The Spokane Regional Transportation Council (SRTC) has prepared this overview to provide information on how the regional emissions budget was established.

Activity Level in Average Daily Vehicle Miles Traveled (ADVMT)

Detailed information on the derivation of ADVMT may be found in Appendix C. SRTC tracks VMT in somewhat different classes than those used by the federal tracking system called Highway Performance Monitoring System (HPMS). In order to report estimates in units consistent with HPMS, SRTC categorized their ADVMT according to the HPMS classification system. The Spokane CO nonattainment area ADVMT for 2000 is shown in the table below.

Table 1. Vehicle Miles Traveled by Functional Class, Year 2000

RURAL	ADVMT	URBAN	ADVMT
Interstate	0	Interstate	1,609,690
Other Principal Arterial	0	Other Freeways and Expressways	3,561,623
Minor Arterial	2,329	Other Principal Arterial	1,017,471
Major Collector	18,978	Minor Arterial	610,858
Minor Collector	0	Collector	39,432
Local	0	Local	57,650
Total Rural	21,307	Total Urban	6,896,724
		Total All ADVMT	**6,918,031**

Calculation of Emission Rates in Grams per Mile

Environmental Protection Agency's (EPA) MOBILE model, version 5b, was used to calculate emission rates in grams per mile. A sample input file can be found in Appendix C.

Age Distribution

The most recent local registration distribution (July 1, 1998) was compiled using information from the Washington State Department of Licensing (DOL).

Oxygenated Fuel Program

The oxygenated fuel program parameters used were those expected to be in place during the winter of 1999-2000. The oxygenated fuel was an alcohol blend, with 3.5 percent oxygen content. No waivers to the oxygenated fuel program were granted.

Inspection and Maintenance (I/M) Program

Due to a change in state statute, vehicles with model year newer than four years old or older than twenty-four years old will no longer be tested, beginning in 2000. Acceleration simulation mode (ASM) testing began in 1997. The I/M program record was adjusted to reflect these changes. No changes were made to the stringency, waiver, or compliance rates.

Seasonal Adjustments

The budget and its components have been seasonally adjusted to reflect peek CO season weekday emissions as described in Appendix C. The peak CO season occurs during the winter.

Emissions Budget

Emissions estimates for the Spokane nonattainment area are in pounds per day. Using the procedures detailed in Appendix C, the CO emissions budget is 268,871 pounds per winter day. Table 2 below shows how the total was derived.

Table 2. On-Road Mobile Source CO Emissions Budget Components (Pounds per Day)

HPMS CLASS	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	**TOTAL**
RURAL									
Interstate	0	0	0	0	0	0	0	0	**0**
Principal Arterial	0	0	0	0	0	0	0	0	**0**
Minor Arterial	44	18	11	6	0	0	2	0	**81**
Major Collector	300	120	71	43	0	0	15	3	**552**
Minor Collector	0	0	0	0	0	0	0	0	**0**
Local	0	0	0	0	0	0	0	0	**0**
URBAN									
Interstate	26,787	10,690	6,369	3,800	7	4	1,362	251	**49,268**
Freeways/Expressways	77,222	30,817	18,360	10,955	19	11	3,927	724	**142,033**
Other Principal Arterial	23,674	9,447	5,629	3,358	6	3	1,204	222	**43,542**
Minor Arterial	15,360	6,130	3,652	2,179	4	2	781	144	**28,252**
Collector	1,176	469	280	167	0	0	60	11	**2,163**
Local	1,619	646	385	230	0	0	82	15	**2,978**
TOTAL	**146,182**	**58,337**	**34,756**	**20,737**	**36**	**20**	**7,433**	**1,370**	**268,871**

Consultation on Spokane Carbon Monoxide Motor Vehicle Emissions Budget

Minutes

Called by the Washington State Department of Ecology

Wednesday October 25, 2000, 11 a.m.

Conference Call Attendees

- Doug Schneider, Ecology
- Clint Bowman, Ecology
- Paul Carr, Ecology
- Ron Edgar, Spokane County Air Pollution Control Authority (SCAPCA)
- Pam Tsuchida, Spokane Regional Transportation Council (SRTC)
- Eve Nelson, SRTC
- Vern Mickelsen, Federal Highway Administration
- Sid Stecker, Federal Highway Administration
- Wayne Elson, United States Environmental Protection Agency (EPA)
- Mahbubul Islam, EPA
- Connie Robinson, EPA

Agenda

1. Introductions
2. Consultation
   - Projected 2000 mobile source emissions and the attainment demonstration
   - The Motor Vehicle Emissions Budget (MVEB)
3. Follow-up and preparation of the minutes

Minutes

The purpose of the consultation was to review the adequacy of the budget for transportation conformity purposes.

Projected 2000 mobile source emissions and the attainment demonstration

The transportation conformity regulations (40 CFR Part 93) require the MVEB to be consistent with requirements for attainment of the CO standard. The regulations further require the MVEB to be consistent with and clearly related to the emissions inventory and the control measures in the attainment plan.

After the plan inventories had been developed and the modeling completed to demonstrate attainment in 2000, Ecology revised its motor vehicle inspection and maintenance (I/M) program to exempt the newest model year of car being tested from the program. This complied with revised statutory requirements exempting vehicles newer than five years old. The change became effective on May 26,2000.

Prior to the consultation, there were e-mail exchanges between Ecology and EPA on the significance of the I/M program change for the demonstration of attainment. During the consultation, Mahbubul Islam of EPA confirmed that Ecology had taken an appropriately conservative approach to developing the mobile source inventory for the attainment demonstration. In the e-mail exchange, Mahbubul had suggested rerunning CAL3QHC modeling for the intersection with the highest projected 2000 concentration (3rd Avenue & Browne Street). The unrevised background modeled by Urban Airshed Model V would be added to the intersection concentration to determine compliance with the CO standard of 9 ppm. In response to EPA's request, SRTC remodeled the projected 2000 concentration at 3rd Avenue & Browne Street with the emission factors produced with the revised I/M program. Pam Tsuchida of SRTC reported that the remodeling resulted in a slight increase (0.2 percent) from 8.85 to 8.87 ppm at the maximum receptor. Mahbubul stated that this satisfied his concerns about the attainment demonstration. Mahbubul requested the remodeling and background on why it was performed be incorporated into the attainment plan.

MVEB

In the draft attainment plan, the MVEB is specified as 268,871 pounds per day. Wayne Elson of EPA requested that it be specified as "winter day." Doug Schneider of Ecology agreed since the budget reflects the peak CO season. After Wayne explained the importance of adequacy and the related procedures, Doug briefly explained how the plan and budget met or would meet adequacy requirements.

There was a general discussion about whether the attainment plan would present any problems for SRTC in implementing the conformity regulations. Pam Tsuchida pointed out that the seven intersections analyzed to demonstrate attainment had been identified on the basis of traffic volumes and level of service. Since these are some of the same criteria used to identify intersections for hot-spot conformity analysis, it would be helpful if the plan explicitly specified that, at a minimum, any projects in or affecting one or more of these identified intersections must complete CO project-level (hot-spot) analysis for these intersections. Additional requirements for project-level analysis are found in 40 CFR § 93.123. There was consensus on adding this to the plan.

Follow-up and Preparation of the Minutes

Doug Schneider of Ecology agreed to add the remodeling of the attainment demonstration to the plan as well as make sure that the MVEB was specified as "winter day." Pam Tsuchida of SRTC volunteered to prepare a short write up relating the analyzed intersections to project level conformity.

Doug Schneider volunteered to prepare the minutes.

Appendix F. Contingency Measures

- Hourly Urban Airshed Model (UAM) and CAL3QHC Concentrations and Combined Running 8-Hour Average Concentrations for 3rd Avenue & Browne Street with the Contingency Measure and the Eastbound On-Ramp to 1-90

MODELED CO CONCENTRATIONS
FOR NOVEMBER 9,2000 FORECASTED EPISODE
at maximum receptor located at
3rd AVENUE/BROWNE STREET (GRID CELL 16,11)
with the Contingency Measure and the TCM

	UAM		CAL3QHC		UAM + CAL3QHC	
Beginning Hour	1-hour (ppm)	8-hour average (ppm)	I-hour (ppm)	8-hour average (ppm)	I-hour (ppm)	8-hour average (ppm)
24	1.07		0.1		1.17	
1	0.79		0		0.79	
2	0.67		0		0.67	
3	0.61		0		0.61	
4	0.65		0		0.65	
5	0.96		0.1		1.06	
6	1.86		0.3		2.16	
7	3.65	1.28	0.8	0.16	4.45	1.44
8	4.45	1.70	0.8	0.25	5.25	1.95
9	4.19	2.13	1.9	0.49	6.09	2.62
10	4.37	2.59	5.2	1.14	9.57	3.73
11	4.08	3.03	3.8	1.61	7.88	4.64
12	3.72	3.41	3.8	2.09	7.52	5.50
13	3.38	3.71	5.6	2.78	8.98	6.49
14	3.65	3.94	5.4	3.41	9.05	7.35
15	4.98	4.10	6.1	4.08	11.08	8.18
16	6.83	4.40	0.1	3.99	6.93	8.39
17	7.85	4.86	0.1	3.76	7.95	8.62
18	6.61	5.14	0	3.11	6.61	8.25
19	5.46	5.31	0	2.64	5.46	7.95
20	4.46	5.40	0	2.16	4.46	7.57
21	3.99	5.48	0	1.46	3.99	6.94
22	3.42	5.45	0	0.79	3.42	6.24
23	2.42	5.13	0	0.03	2.42	5.16
Maximum	7.85	5.48	6.10	4.08	11.08	8.62