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Attainment Demonstration for the San Antonio Early Action Compact Region

Proposed Local Revision to the State Implementation Plan

AACOG
Alamo Area Council Of Governments

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LIST OF ACRONYMS

AACOG	Alamo Area Council of Governments
AFV	Alternative Fuel Vehicle
AIR	Air Improvement Resources Committee
AQTF	Air Quality Task Force
ARPDB	Acid Rain Program Data Base
CAPCO	Capital Area Planning Council
CAMS	Continuous Air Monitoring Stations
CAMx	**C**omprehensive **A**ir Quality **M**odel with E**x**tensions
CO	Carbon Monoxide
COSA	City of San Antonio
CPS	City Public Service
DFW	Dallas/Fort Worth
EAC	Early Action Compact
EGU	Electric Generating Unit
EI	Emissions Inventory
EPA	U.S. Environmental Protection Agency
FAR	Flexible Attainment Region
FCAA	Federal Clean Air Act
HC	Hydrocarbon
HDDV	Heavy Duty Diesel Vehicles
HGA	Houston/Galveston Area
HPMS	Highway Performance Monitoring System
ITS	Intelligent Transportation System
LED	Low Emission Diesel
NAAQS	National Ambient Air Quality Standards
NEGU	Non-electric Generating Unit
NOx	Nitrogen Oxides
NNA	Near Non-attainment Areas
PPB	Parts per Billion
PPM	Parts per Million
RRF	Relative Reduction Factor
RVP	Reid Vapor Pressure
SA-BC MPO	San Antonio-Bexar County Metropolitan Planning Organization
SAER	**S**an **A**ntonio **E**arly Action Compact **R**egion
SB	Senate Bill
SIP	State Implementation Plan
SOS	Southern Oxidants Study
TCEQ	Texas Commission on Environmental Quality
TDM	Travel Demand Management
TERM	Transportation Emission Reduction Measures
TIP	Transportation Improvement Plan
TPY	Tons per Year
TTI	Texas Transportation Institute
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds

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CHAPTER 1: GENERAL

1.1 INTRODUCTION

The Clean Air Act is the comprehensive federal law that regulates airborne emissions from area, mobile, and stationary sources across the United States. This law authorizes the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment.

Of the many air pollutants commonly found throughout the country, the EPA has recognized six "criteria" pollutants that can injure health, harm the environment, and cause property damage. EPA refers to these pollutants as "criteria" air pollutants because the agency has regulated them by first developing health-based criteria (science-based guidelines) as the basis for setting permissible levels. The NAAQS are a listing of the threshold levels, the concentration values above which human health is put at risk, for these criteria pollutants.

During the past several years, air quality planning in the San Antonio region has intensified since ozone concentrations have exceeded the values permitted in the 8-hour ozone NAAQS. Due to legal challenges to the NAAQS and ensuing litigation, the EPA has not formally designated any areas of the United States in violation of the 8-hour ozone NAAQS. However, that designation process is expected to begin as early as 2004. Areas formally designated in violation of the NAAQS and contributing to a violation are called "non-attainment areas," a term frequently used in this and many other air quality documents.

Local elected officials, concerned leaders in business and industry, and other citizens committed to air quality planning have worked together for years to create an air quality plan for the citizens of the San Antonio region. This group, meeting as the Air Improvement Resources (AIR) Committee of the Alamo Area Council of Governments (AACOG), has proactively created an air quality plan that is comprehensive, flexible, and relies on EPA-approved technical analysis for its control strategy recommendations.

1.2 BACKGROUND

During the ozone seasons of 1997 through 2000, local air quality monitors recorded ozone levels above the concentrations allowed under the 8-hour ozone NAAQS. Moreover, in June of 2002, area monitors recorded some of the highest 8-hour and 1-hour ozone values on record since 1998[1]. In December 2003, the EPA indicated its intent, barring review of compelling evidence from the State to the contrary, to designate the counties of Bexar, Comal, Guadalupe, and Wilson as non-attainment of the 8-hour ozone NAAQS. These counties constituted the San Antonio Metropolitan Statistical Area at the time an Early Action Compact, a major component of the area's Clean Air Plan, was developed and submitted to the EPA. Since EPA guidance suggests that Metropolitan Statistical Areas be considered for establishing the boundaries of new 8-

[1] On June 24, 2002, the CAMS 23 monitor, located near Marshall High School in San Antonio, recorded a 1-hour average ozone value of 126 parts per billion, an exceedance of the 1-hour ozone NAAQS. The most recent exceedance of the 1-hour standard prior to this date was 141 ppb recorded September 4, 1998 at CAMS 58 in Camp Bullis. Also on June 24, 2002, the CAMS 23 monitor recorded an 8-hour average ozone reading of 110 ppb, an exceedance of the 8-hour average ozone NAAQS. The most recent 8-hour reading prior to this date above 100 ppb was a reading of 110 ppb recorded September 4, 1998 at CAMS 58 in Camp Bullis.

hour ozone non-attainment areas, air quality planning focused on Bexar, Comal, Guadalupe and Wilson Counties.

1.2.1 History of Air Quality Planning in the San Antonio Region

As early as 1995, the Air Quality Committee of the Alamo Area Council of Governments, chaired by Senator Jeff Wentworth, first met to address air quality issues in the San Antonio region. This committee requested the first emissions inventory, for inventory year 1994.

In January 1996, the San Antonio Mayor's Blue Ribbon Committee on Air Quality merged with the Air Quality Committee of the Alamo Area Council of Governments (AACOG) to form the Air Quality Task Force (AQTF). The charge of the AQTF was to develop public education and provide advice to elected officials on air quality issues. The major accomplishment of the early AQTF was the establishment of the Ozone Action Day program. During FY 1996 - 1997, the AQTF provided input on the first Near Non-Attainment grant, authorized by the 1997 Texas Legislature.

However, when, in the summer of 1996, the EPA proposed the new eight-hour ozone NAAQS, the focus of the AQTF began to shift, first by providing comments and guidance on the impact of the new eight-hour ozone NAAQS. In the summer of 1998 a local contingency met with EPA's Region 6 to begin discussion on the development of a Flexible Attainment Region (FAR) agreement.

The AACOG developed its first photochemical model in 1997 along with sponsoring air quality monitoring efforts at St. Hedwig (southeast Bexar County) during the 1997 ozone season. Monitoring results indicated that on high ozone level days, background levels coming into Bexar County were at or near ozone NAAQS threshold levels. Later that year when EPA finalized the eight-hour NAAQS it became apparent that, based on historical data, the SAER could well be designated non-attainment when the EPA made the first eight-hour non-attainment designations initially scheduled for July 2000.

During July 1998, the City of San Antonio (COSA), San Antonio-Bexar County Metropolitan Planning Organization (MPO), Bexar County, and AACOG staff recommended to elected officials that the AQTF be revised to fit the structure advised by the Texas Commission on Environmental Quality (TCEQ), then known as the Texas Natural Resource Conservation Commission (TNRCC). During January - February 1999, the Boards of Directors and other responsible parties representing COSA, Bexar County, MPO, and AACOG approved the formation of the Air Improvement Resources (AIR) Committee consortium including the Executive/Advisory, Technical, and Public Education Committees and member appointments. The AIR Committee conducted its first official meeting during April 1999 with the goal to establish an organized, comprehensive, and aggressive plan of action to keep the SAER from slipping into non-attainment of the ozone standard.

Working with partners in the near non-attainment areas across Texas, the AACOG has developed a second photochemical model for September 1999. This episode models ozone formation for four of the five near non-attainment areas of the state, Corpus Christi, Austin, Victoria and San Antonio. AACOG is now expanding the network of ozone and meteorological monitoring stations in the San Antonio region. The TCEQ is responsible for maintaining monitors upon which official air quality data depends. Better monitoring allows for refined technical analysis of human exposure to ozone, a greater

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understanding of the formation and movement of ozone in the region, and provides a database for verification of the performance of future photochemical models.

1.2.2 The Clean Air Plan

On December 9, 2002 the Clean Air Plan for the San Antonio Region was signed by elected officials representing the SAER. The Clean Air Plan was designed to enable a local approach to ozone attainment and to encourage early emission reductions that will help keep the SAER in attainment of the 1-hour ozone NAAQS and ensure attainment of the 8-hour ozone NAAQS, and so protect human health.

This Clean Air Plan also incorporates the Early Action Compact for the San Antonio area. The Early Action Compact protocol was endorsed by EPA Region 6 on June 19, 2002, and is designed to develop and implement control strategies, account for growth, and achieve and maintain the 8-hour ozone standard. As such, it represents a key component to finalizing this area's Clean Air Plan.

Since its first meeting, the AIR Committee has worked to transform the results of its planning effort into a protocol able to address air quality planning requirements originating with the Clean Air Act. The AIR Committee recognizes that the Clean Air Plan provides the means to sustain the region's air quality by proactively seeking local solutions within a suitable state and federally approved protocol.

The Clean Air Plan is designed to be a working document providing comprehensive planning for the ozone challenge faced by the citizens of the entire SAER. Adoption of this Clean Air Plan requires development of control strategies, or methodologies for lowering ozone concentrations to acceptable levels, which are designed to meet the region's clean air challenge. The technical analysis of the photochemical modeling, used to demonstrate the effectiveness of the control strategies, is performed by the staff of AACOG and is reviewed and approved by the AIR Committee, the staff of AACOG, the TCEQ, and the EPA.

1.3 PUBLIC INVOLVEMENT PROGRAM

The EAC for the San Antonio region requires that the AIR Committee be responsible for the assessment and reporting of the region's progress against milestones with deliverables sent to TCEQ and the EPA and reported in a regular, public process at least every six months. Public reporting of assessment and progress against milestones occurs at least once every six months during the regularly scheduled, public meetings (scheduled on a monthly basis), of the joined AIR Executive/Advisory Committees of the AACOG. Every regularly scheduled meeting of the AIR Executive and Advisory Committees is a public meeting, with notification of the meeting time and location published by AACOG according to the Texas Open Meetings Act.

EAC milestones were discussed during the AIR Executive/Advisory Committee meetings conducted at the Alamo Area Council of Governments, 8700 Tesoro Drive, Suite 100, San Antonio, Texas on the dates provided in table 1-1.

In addition to the meetings listed in table 1-1, AACOG conducted public workshops in all four SAER counties to discuss elements of the Clean Air Plan and obtain citizen feedback. Meeting topics and meeting dates for these public workshops are provided in appendix J, "Modeling/Analysis Protocol."

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Table 1-1. Public Reporting of EAC Milestones.

Milestone	Date of Air Improvement Resources (AIR) Public Meeting in which Progress was Assessed/Reported
Emissions Inventory Milestones	
Development of a 1999 or later episode emissions inventory	4-23-03 Agenda Item: Clean Air Plan Update – MOBILE6 On-Road Update
Incorporation of MOBILE6 data with link-based Travel Demand Model data	4-23-03 Agenda Item: Clean Air Plan Update – MOBILE6 On-Road Update 10-1-03 Agenda Item: Milestones and Timelines in the Clean Air Plan – Attainment Demonstration Model Status
Development of additional emission inventory episode data based on local Conceptual Model update. Development of other episode inventories, if required, made in concert with EPA, TCEQ, and local entities	4-23-03 Agenda Item: Clean Air Plan Update – Conceptual Model
Development of NONROAD model data adjusted for local equipment populations and usage rates and development of area source data based, when possible, on local survey data	8-27-03 Agenda Item: Milestones and Timelines in the Clean Air Plan – 2007 Projection in the Photochemical Model
Completion of an Emissions Trend Analysis Report utilizing the National Emissions Trends Emissions Inventories	8-27-03 Agenda Item: Milestones and Timelines in the Clean Air Plan – Trend Analysis 10-1-03 Agenda Item: Milestones and Timelines in the Clean Air Plan – Final Approval of the Trend Analysis
Modeling Milestones	
Development of SIP-quality modeling episodes that perform within the EPA's accepted margin of accuracy by completion of the following modeling-related tasks: ▪ Develop base case on or before December 31, 2007 ▪ Develop future case on or before December 31, 2007 ▪ Provide documentation to TCEQ and EPA ▪ Evaluate quantifiable emission reduction measures in the future case to produce one or more control cases ▪ Evaluate control strategies against control case model.	4-23-03 Agenda Item: Clean Air Plan Update – Photochemical Model Update 7-23-03 Agenda Item: Clean Air Plan Update – Photochemical Modeling Update 8-27-03 Agenda Item: Milestones and Timelines in the Clean Air Plan – 2007 Projection in the Photochemical Model

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Milestone	Date of Air Improvement Resources (AIR) Public Meeting in which Progress was Assessed/Reported
Modeling Milestones (continued)	10-1-03 Agenda Item: Milestones and Timelines in the Clean Air Plan – Attainment Demonstration Model Status 10-1-03 Agenda Item: Milestones and Timelines in the Clean Air Plan – Final Approval of the 2007 Photochemical Model Projection 10-29-03 Agenda Item: AIR Technical Committee Reports – Attainment Demonstration Model Status
Development of other episodes, as necessary, to fully represent the variety of situations that typically contribute to local ozone production	4-23-03 Agenda Item: Clean Air Plan Update – Conceptual Model Note: Based on current Conceptual Model analyses, no other photochemical model episodes are planned at this time
Control Strategy Development Milestones	
Identify additional local controls, as necessary, to demonstrate 2007 attainment of the 8-hour standard. Implement controls by December 31, 2005, with full local stakeholder participation.	2-26-03 Agenda Item: Clean Air Plan Update – Review of Control Strategy Matrix 3-26-03 Agenda Item: Clean Air Plan Update – Review of Control Strategy Matrix 4-23-03 Agenda Item: Clean Air Plan Update – Submission of Draft Clean Air Strategies 5-28-03 Agenda Item: Clean Air Plan Update – Submission of Draft Clean Air Strategies 8-27-03 Agenda Item: Milestones and Timelines in the Clean Air Plan – Update to the Clean Air Strategies

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Milestone	Date of Air Improvement Resources (AIR) Public Meeting in which Progress was Assessed/Reported
Control Strategy Development Milestones (continued)	10-1-03 Agenda Item: Milestones and Timelines in the Clean Air Plan – Update to the Clean Air Strategies 10-29-03 Agenda Item: AIR Technical Committee Reports – Update to the Clean Air Strategies 12-22-03 Agenda Item: Technical Updates - Further Modeling of Clean Air Strategies for the EAC
Provide control measures to TCEQ for incorporation into the State Implementation Plan	1-28-04 Agenda Item: Clean Air Plan – Action Item: Approve Clean Air Strategies List Recommended by the AIR Technical Committee for the State Implementation Plan 3-3-04 Agenda Item: Clean Air Plan – Clean Air Strategies Update 3-24-04 Agenda Item: Clean Air Plan – Clean Air Strategies Update and Action Item: Approval of finalized Clean Air Plan and Signed Letter of Submission addressed to TCEQ/EPA
Maintenance for Growth Milestones	
Address emissions growth at least 5 years beyond December 31, 2007 to ensure the area will remain in attainment of the 8-hour standard during that period	8-27-03 Agenda Item: Milestones and Timelines in the Clean Air Plan – Trend Line Analysis
Continue the planning process by including updates to modeling and verification of modeling assumptions (particularly growth assumptions)	4-23-03 Agenda Item: Clean Air Plan Update – Photochemical Model Update 7-23-03 Agenda Item: AIR Technical Committee Reports – Photochemical Modeling Update 8-27-03 Agenda Item: Milestones and Timelines in the Clean air Plan – 2007 Projection in the Photochemical Model

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Milestone	Date of Air Improvement Resources (AIR) Public Meeting in which Progress was Assessed/Reported
Incorporate additional measures to the plan if the review of growth demonstrates that adopted control measures are inadequate to address increases in emissions	10-1-03 Agenda Item: Milestones and Timelines in the Clean Air Plan – Final Approval of September 30 EAC Milestones Action Item: Final Approval: Trend Analysis
Public Involvement Milestones	
Encourage public involvement in all stages of the planning and implementation process. Involve stakeholders in the planning process as early as possible. ▪ Conduct public education programs to raise awareness regarding issues, opportunities for involvement in the planning process, and implementation of control strategies. ▪ Make draft plans publicly available and allow sufficient opportunities for comment from all interested stakeholders. ▪ Present and make publicly available semi-annual reports detailing, at a minimum, progress toward milestones	1-29-03 Agenda Item: Citizen Comments at First Public Meeting on the Clean Air Plan Conducted January 22, 2003 2-26-03 Agenda Item: Citizen Comments at Second Public Meeting on the Clean Air Plan Conducted February 22, 2003 3-26-03 Agenda Item: Citizen Comments at Third Public Meeting on the Clean Air Plan Conducted March 19, 2003 3-26-03 Agenda Item: Clean Air Plan Update – Business and Industry Outreach 4-23-03 Agenda Item: Citizen Comments at the Fourth Public Meeting on the Clean Air Plan Conducted April 12, 2003 4-23-03 Agenda Item: Discussion of Issues of Public Participation and the Early Action Compact 4-23-03 Agenda Item: Clean Air Plan Update – Biannual Progress Report 5-28-03 Agenda Item: Citizen Comments at the Fifth Public Meeting on the Clean Air Plan Conducted May 20, 2003 5-28-03 Agenda Item: Clean Air Plan Update – Review of First Biannual Progress Report

Milestone	Date of Air Improvement Resources (AIR) Public Meeting in which Progress was Assessed/Reported
Public Involvement Milestones (continued)	6-18-03 Agenda Item: Citizen Comments at the Sixth Clean Air Plan Workshop of 2003 Conducted on June 14, 2003 6-18-03 Agenda Item: Clean Air Plan Update – Approval of First Biannual Progress Report 7-23-03 Agenda Item: Citizen Comments at the Seventh Clean Air Plan Workshop of 2003 Conducted July 16, 2003 8-27-03 Agenda Item: Milestones and Timelines in the Clean Air Plan – Ongoing Local Efforts 10-1-03 Agenda Item: Other Issues For Discussion – Public Presentation of Clean Air Strategies 10-29-03 Agenda Item: Other Issues – Clean Air for Central Texas Public Presentation/Workshop for Clean Air Strategies Scheduled for November 5, 2003 12-22-03 Agenda Item: Clean Air Plan – *Action Item* EAC Milestone Approval: 2nd Biannual Progress Report

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CHAPTER 2: EMISSIONS INVENTORY

2.1 OVERVIEW

The 1990 Amendments to the federal Clean Air Act (FCAA) and 40 CFR, §51.322 require that emissions inventories (EI) be prepared statewide, particularly for ozone nonattainment areas. The chemical species that form ozone include volatile organic compounds (VOC), nitrogen oxides (NOx), and to a more limited degree, carbon monoxide (CO). Because ground-level ozone forms photochemically (i.e., in the presence of sunlight) as the result of VOC, NOx and CO chemical reactions, it is critical that planners identify and quantify these precursor pollutants. The EI describes sources of precursors within a region as well as the amount of each pollutant emitted and any processes and control devices in use.

EI data are used in support of a variety of air quality planning tasks, including establishing baseline emission levels, calculating reduction targets, developing control strategies, developing emission inputs for air quality simulation models, and tracking actual emission reductions against the established emissions growth and control budgets. This chapter focuses on the development of EI data used in the development of a photochemical model that simulates an elevated ozone episode that occurred in September 1999. This San Antonio area base case EI includes VOC, NO_x, and CO emissions for the September 1999 episode for five general categories of emissions sources, as described below.

2.2 POINT SOURCES

Major point sources include industrial, commercial, or institutional sources that emit criteria pollutants at or above thresholds established by the FCAA. For nonattainment areas, this threshold varies from 10 tons per year (tpy) to 100 tpy depending on the pollutant in question and the seriousness of the nonattainment problem. For the attainment areas of the state, any source that emits a minimum of 100 tpy of a regulated pollutant must complete an inventory. Additionally, any source that generates or has the potential to generate at least 10 tpy of any single hazardous air pollutant (HAP) or 25 tpy of aggregate HAPs is also required to report emissions to the Texas Commission on Environmental Quality (TCEQ).

To collect emissions and industrial process operating data for these plants, the TCEQ mails Emissions Inventory questionnaires (EIQ) to all sources identified as having emissions that trigger the reporting requirements. Companies must report the type of emissions from all emission-generating units and emission points, as well as the amount of materials used in the processes that result in emissions. The EIQ also requests information on process equipment, operation schedules, emissions control devices, abatement device control efficiency, and stack parameters such as location, height, and exhaust gas flow rate. All data submitted via the EIQ are subjected to rigorous quality assurance procedures by the technical staff of the Industrial Emissions Assessment Section, and are then entered into the Point Source Data Base (PSDB) by the Data Services Section.

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2.3 AREA SOURCES

Area sources are defined as emission sources that fall below the point source reporting levels, and are too numerous or too small to identify individually. Area sources include commercial, small-scale industrial, and residential sources that use materials or operate processes generating VOC, NOx, or CO emissions. Area sources can be divided into two groups – hydrocarbon evaporative emissions or fuel combustion emissions – depending on the emission mechanism. Examples of activities that generate evaporative losses include printing, application of industrial coatings, use of degreasing solvents, house painting, leaking underground storage tanks, gasoline service station underground tank filling, and vehicle refueling operations. Fuel combustion sources include stationary source fossil fuel combustion at residences and businesses, as well as outdoor burning, structural fires, and wildfires. These emissions, with some exceptions, may be calculated by multiplication of an established emission factor (emissions per unit of activity) times the appropriate activity. If the activity level is difficult to obtain or measure, surrogate data may be used to develop emissions estimates. Population is the most commonly used surrogate for many area source categories, while other activity data include amount of gasoline sold in an area, employment by industry type, and acres of cropland.

2.4 ON-ROAD MOBILE SOURCES

On-road mobile sources consist of automobiles, trucks, motorcycles, and other motor vehicles traveling a region's roadways. Combustion-related emissions are estimated for vehicle engine exhaust, and evaporative hydrocarbon emissions are estimated for the fuel tank and other sources of leaks from vehicles. Emission factors were developed using the EPA's mobile emission factor model, MOBILE6. Model inputs were developed specifically for the San Antonio area. These inputs include such parameters as vehicle speeds by roadway type, vehicle registration by vehicle type and age, percentage of miles traveled by vehicle type, and gasoline vapor pressure. All of these inputs have an impact on the emission factor calculated by the MOBILE model, and every effort is made to use parameters reflecting local conditions. To complete the emissions estimate, the emission factors calculated by the MOBILE model must be multiplied by a measure of vehicle activity: vehicle miles traveled (VMT). The level of vehicle travel activity is developed from the federal Highway Performance Monitoring System (HPMS) data compiled by the Texas Department of Transportation for each county. Finally, roadway speeds, which are required for the MOBILE model's input, are obtained from an analysis for several roadway types performed by the Texas Transportation Institute (TTI).

2.5 NON-ROAD MOBILE SOURCES

Non-road mobile sources include aircraft operations, recreational boats, residential and commercial lawn maintenance equipment, railroad locomotives, and a wide range of off-highway equipment. Methods for calculating emissions from non-road engine sources are based on information about equipment populations, engine horsepower, load factor, emission factor, and annual usage. With the exception of aircraft and locomotives, non-road emissions were estimated using EPA's NONROAD model. Aircraft emissions were estimated using the Emissions and Dispersion Modeling System (EDMS) aircraft emissions model. Model inputs were obtained from airport documents containing landing and takeoff data. Locomotive emissions were developed from fuel usage and track mileage data obtained from individual railroads.

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2.6 BIOGENIC SOURCES

Biogenics refers to natural sources of emissions, primarily vegetation (e.g., crops, lawn, and forests). Vegetation emits VOCs such as isoprenes, monoterpenes, and alpha-pinenes. Natural processes in soil also contribute to ozone by emitting a small amount of NOx. The biogenic emission inventory for the San Antonio region was developed by ENVIRON International Corporation, under contract with the TCEQ, using version 2.2 of the GloBEIS biogenic emissions model. Emissions were calculated at the county level for an ozone season day in 1999 by using weather conditions typical of the September 1999 timeframe as model input. The model was further enhanced through the use of the TCEQ's landuse/landcover (LULC) database.

Emissions from biogenic sources are natural; therefore controls on biogenic sources are not appropriate. Nevertheless, biogenic emissions are part of the ozone chemistry and must be included in both the base and future case photochemical modeling to ensure that the overall chemical profile is correct. Only anthropogenic emissions are included in control strategy testing, however.

2.7 EMISSIONS SUMMARY

The base case EI for the four SAER counties are summarized in figures 2-1 (VOC) and 2-2 (NOx). These numbers represent emission estimations for September 15, 1999 (Wednesday), chosen to represent an average weekday.

The percent contributions from VOC sources in the September 15, 1999 base case inventory include the following: 53.8% from biogenic, 26.6% from area/non-road, 18.2% from on-road, and 1.5% from point sources. The percent contributions from NOx sources for the September 15, 1999 EI include: 45.7% from on-road, 32.3% from point sources, 15.3% from area/non-road, and 6.7% from biogenic.

Natural sources (biogenics) are included in the summary. However, control strategies are limited to the reduction of anthropogenic emissions.

In addition to creating a 1999 base case EI, a 2007 future base EI was developed to facilitate attainment demonstration modeling. The 2007 EI was projected from 1999 emissions using growth factors and control factors. Figures 2-3 (VOC) and 2-4 (NOx) summarize the 2007 future base EI for the four San Antonio EAC counties. The percent contributions from VOC sources in the September 2007 (Wednesday) future case inventory include the following: 59.5% from biogenic, 26.0% from area/non-road, 11.5% from on-road, and 3.1% from point sources. The percent contributions from NOx sources for the September 2007 EI include: 36.5% from on-road category, 33.3% from point sources, 21.0% from area/non-road, and 9.3% from biogenic.

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Figure 2-1. September 15, 1999 (Wednesday) VOC Emissions Inventory for the San Antonio EAC Counties.

	Tons/Day	Percent
On-road	88.8	18.2%
Area/Non-road	130.2	26.6%
Point	7.2	1.5%
Biogenic	263.0	53.8%
Total	489.2	100.0%

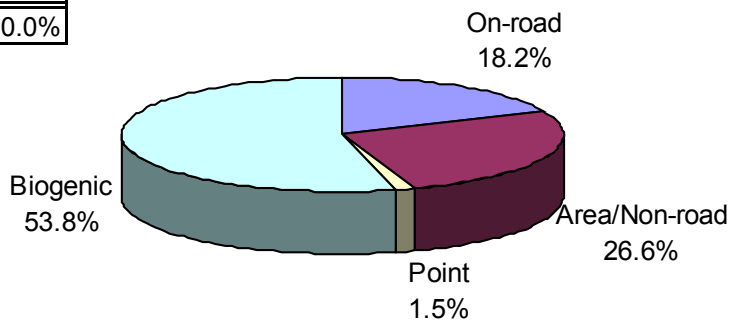

Figure 2-2. September 15, 1999 (Wednesday) NOx Emissions Inventory for the San Antonio EAC Counties.

	Tons/Day	Percent
On-road	143.6	45.7%
Area/Non-road	48.1	15.3%
Point	101.3	32.3%
Biogenic	21.0	6.7%
Total	314.0	100.0%

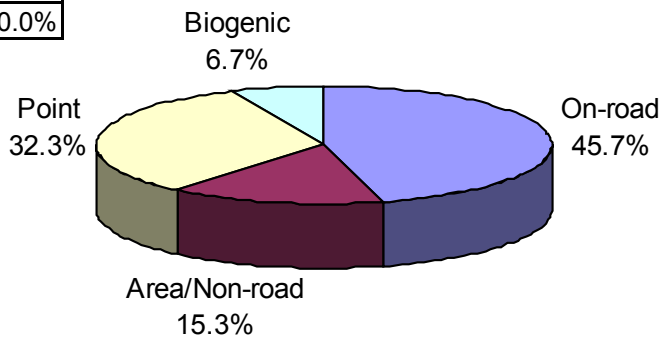

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Figure 2-3. Estimated Wednesday, September 2007 VOC Emissions Inventory for the San Antonio EAC Counties.

	Tons/Day	Percent
On-road	50.7	11.5%
Area/Non-road	114.8	26.0%
Point	13.5	3.1%
Biogenic	263.0	59.5%
Total	441.9	100.0%

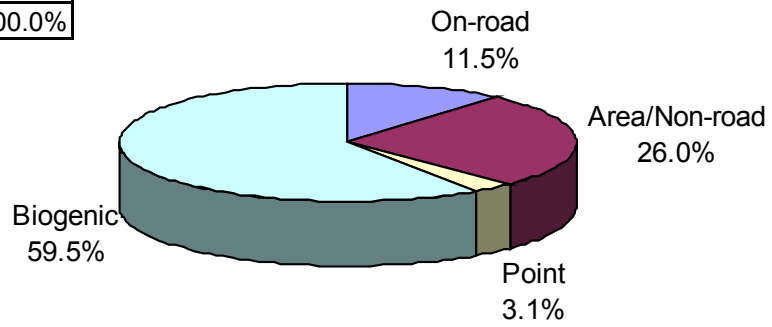
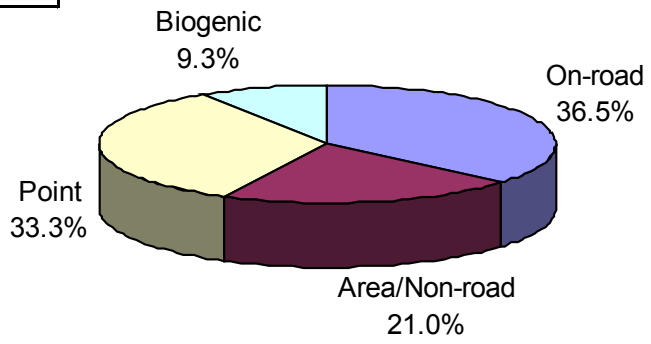


Figure 2-4. Estimated Wednesday, September 2007 NOx Emissions Inventory for the San Antonio EAC Counties.

	Tons/Day	Percent
On-road	82.3	36.5%
Area/Non-road	47.3	21.0%
Point	75.1	33.3%
Biogenic	21.0	9.3%
Total	225.7	100.0%



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CHAPTER 3: PHOTOCHEMICAL MODELING

3.1 INTRODUCTION

The Natural Resources staff of the Alamo Area Council of Governments has supported the development of and made refinements to two discrete photochemical models suitable for attainment demonstrations in the San Antonio EAC region. The first was a 1995 episode simulation developed to establish a base case for an attainment demonstration in the region's Early Implementation Plan and O3 Flex Plan. These plans were forerunners to the current Clean Air Plan developed under the TCEQ's and EPA's Early Action Compact protocol. The 1995 model simulation was presented to EPA Region 6 and TCEQ representatives in 2002 and was found adequate for attainment work.

AACOG staff also refined, with the assistance of other agencies[2], a 1999 episode that is used to demonstrate attainment in the SAER's Early Action Compact SIP. Development of the September 15th through 20th, 1999 episode model was sponsored by four South-central Texas near nonattainment areas[3] (NNA) and TCEQ. During this time span, monitors in the San Antonio region recorded 8-hour ambient ozone levels as high as 96 parts per billion (ppb)[4] as shown in figure 3-1. This exceeds the 85-ppb threshold established by the "eight-hour average ozone standard" in the 1997 amendments to the Clean Air Act. Similarly, other urban areas of South and Central Texas also experienced elevated ozone concentrations.

The intent of developing the 1999 simulation was to provide a base case as the first step in projecting air quality conditions to the year 2007 so that clean air measures could be modeled and analyzed for their effectiveness in that future time period. The year 2007 was chosen because it coincides with the attainment dates for the largest metropolitan areas of Texas including Dallas-Fort Worth and Houston. By that date, three of the four Texas nonattainment areas should have control strategies in place. Since ambient ozone levels in San Antonio can be affected by transport of pollution from Houston and other areas, selecting a date in which control strategies are in place for other large urban areas is an important modeling consideration. Furthermore, the Early Action Compacts for two Texas regions (Austin and San Antonio) require attainment by 2007. As a result, the Texas non-attainment and EAC areas benefit from the use of coordinated timelines and coordinated planning of control strategy programs.

3.2 EPISODE SELECTION

An initial step in the attainment demonstration model process entailed developing a conceptual description of the SA area's ozone problem. The conceptual model of ozone formation provided a basis for determining subsequent steps in the model development process including those related to episode selection. One of the intents of the conceptual model was to summarize both the local meteorological conditions and associated synoptic weather patterns typically experienced during periods of elevated ozone concentrations. This process was facilitated by assembling and reviewing all available ambient air quality data, meteorological data, and previous photochemical

[2] Other entities involved in refining the 1999 base case included the TCEQ, The University of Texas at Austin, and ENVIRON International Corporation.
[3] The regions of Austin, Corpus Christi, San Antonio and Victoria.
[4] Measured at the Camp Bullis monitor on September 18, 1999.

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modeling efforts. Appendix A provides a description of the conceptual model developed for the San Antonio region.

Ozone formation in the San Antonio region is influenced by many of the same factors as in other areas of Texas. These factors include sunny skies, high pressure, and low wind speeds. Ozone formation peaks during the warm weather that predominates in the San Antonio region from April through October.

In their draft guidance (1999), EPA recommends using four criteria, at a minimum, to select episodes appropriate for modeling. The minimum criteria include: 1) reviewing a mix of episodes that represent a variety of meteorological conditions associated with observed 8-hour daily maxima in excess of 84 ppb; 2) selecting periods in which observed 8-hour daily maxima approximate the average fourth highest 8-hour ozone concentrations; 3) reviewing periods for which extensive air quality/meteorological data exist; and 4) modeling a sufficient number of days to represent a complete ozone cycle.

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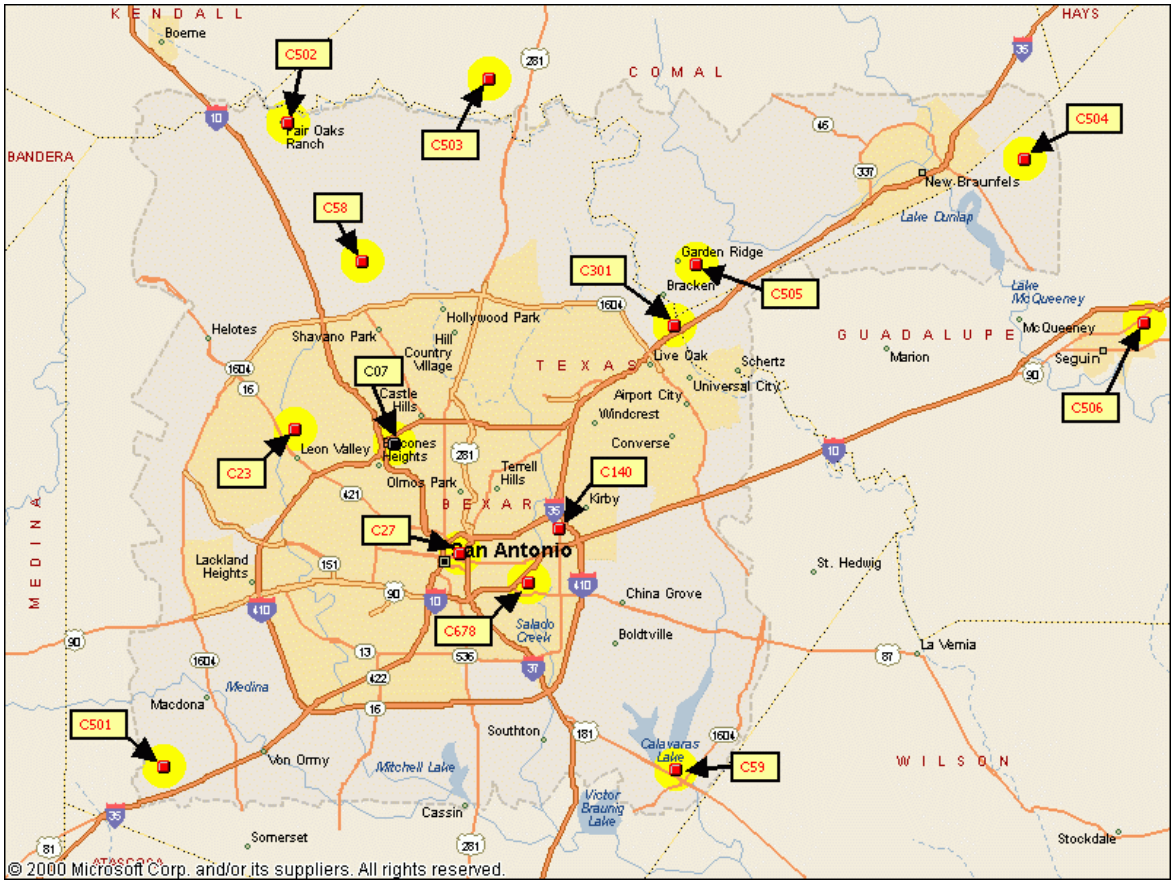
Figure 3-1. Eight-hour Average Daily Maxima during the Ramp-up Period and Modeling Episode, September 13 - 20, 1999, Recorded by Monitors in the San Antonio Region.



Monitoring Site	13	14	15	16	17	18	19	20
San Antonio Northwest C23	57	66	82	**85**	75	**92**	**89**	84
Camp Bullis C58	57	63	79	78	74	**96**	**91**	81
CPS Pecan Valley C678	56	57	74	74	64	76	84	**86**
Calaveras Lake C59	64	64	81	81	76	80	**89**	84

Numbers in red represent exceedances of the 8-hour average threshold.

Work conducted during the summer of 2000 on the Conceptual Model helped staff identify five candidate episodes for modeling purposes: June 21-23, 1995, August 28 – September 3, 1998, August 16 –21, 1999, August 30 – September 1, 1999, and September 16 – 20, 1999. However, the June 21-23, 1995, August 16- 21, 1999, and August 30 – September 1, 1999 episodes were eliminated from consideration because of a lack of meteorological data (8/30 – 9/1/99 episode), an insufficient number of exceedance days (8/16 – 8/21/99 episode), or because the episode occurred prior to the design value period (6/21 – 6/23/95 episode) – a secondary criterion.

Ultimately, the September 13 – 20, 1999 high ozone episode was chosen for the most recent modeling effort. Both the August-September 1998 and September 1999 episodes met the primary selection criteria recommended by the EPA. In addition, both episodes

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met some secondary criteria, such as inclusion of weekend days and correspondence with the current (as of Conceptual Model development in September 2000) design value. However, the decision to model the September 1999 episode was based on another secondary selection criterion; i.e., the 1999 time period represented an elevated ozone episode for multiple regions of Texas. The benefits of developing a regional model covering four near non-attainment areas included cost-sharing and a consistent, Central Texas base case on which to model clean air strategies.

The September episode consists of two model initialization days, September 13th and 14th, and five primary episode days, September 15 – 20, 1999. Although these days (15th- 20th) were chosen because they represent a period in which elevated ozone levels occurred in South-central Texas, the modeling domain covers a much larger geographical area than South-central Texas alone. The larger domain is necessary to simulate the effects of meteorological and atmospheric processes including transport of precursors and background concentrations of ozone to the San Antonio region. The 32-hour back trajectories for the 1999 episode originated in southeastern Missouri. Consequently, the 36-km coarse grid used in the model simulation extends throughout much of the South and Central U.S. including the Ohio River Valley to the north and Atlanta to the east, as shown in Figure 3-2. Furthermore, this matches the TCEQ standard modeling domain. The grid formulation includes two nested grids: a 12-km grid domain that incorporates eastern Texas including the nonattainment areas of Dallas/Fort Worth, Houston/Galveston, and Beaumont/Port Arthur, and an urban scale 4-km grid that covers the four NNAs in South-central Texas.

The EAC requires development of other episodes, as necessary, to fully represent the variety of situations that typically contribute to local ozone production. The San Antonio region agreed in the Early Action Compact signed December 2002, to investigate further episode development based on Conceptual Model updates. Updates are scheduled for completion by AACOG by April 30, 2003 and April 30, 2005. Based on the April 2003 update of the Conceptual Model, in an analysis agreed upon by TCEQ, no candidate episodes were revealed.

The 2003 Conceptual Model update was comprehensive of all potential episodes from 1995 through 2002. Although there was one candidate episode in 2002, the meteorological conditions resemble the meteorological patterns in the September 1999 episode. Also, this 2002 episode was potentially useful to Austin and San Antonio; whereas the 1999 episode was useful to Austin, Corpus Christi, San Antonio, and Victoria. As a consequence, the 2002 episode is not a particularly strong candidate. However, if the region is required to perform 2002 modeling, as is currently the case for traditional 8-hour non-attainment areas, then this episode may be revisited and developed. Ongoing research will attempt to identify new, viable episodes.

3.3 MODELING/ANALYSIS PROTOCOL

Many stakeholders were involved in the modeling/analysis protocol process. Decisions as to which modeling episode, air quality simulation model, and modeling consultant(s) to use were made by staff of the TCEQ and representatives of four Texas NNAs: Austin (Capital Area Planning Council and Central Texas Clean Air Force), Corpus Christi (City of Corpus Christi), San Antonio (Alamo Area Council of Governments), and Victoria (City of Victoria). Modeling decisions were reviewed within the SAER by the Air Improvement Resources Technical Committee which is composed of technical staff representing local

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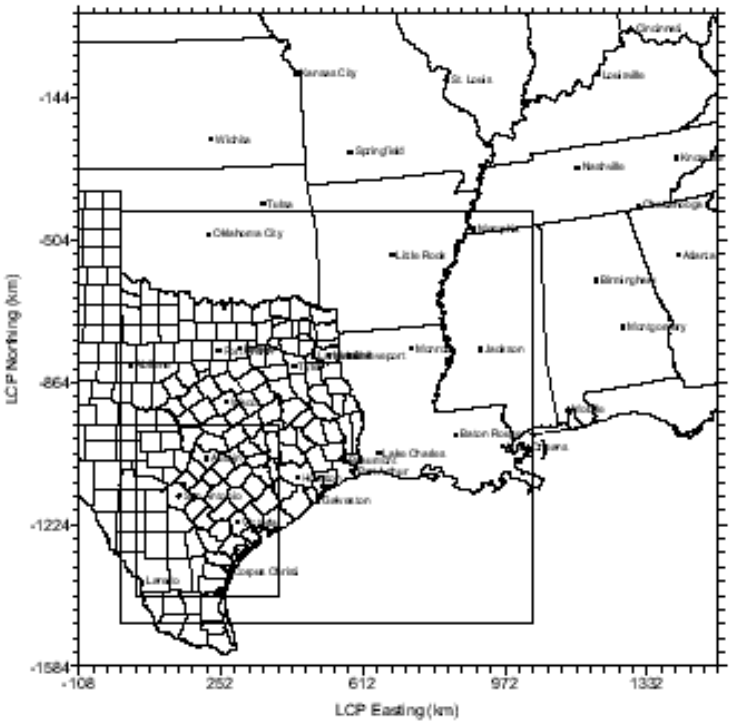
governments. Recommendations from the Technical Committee were forwarded to the Air Improvement Resources (AIR) Executive/Advisory Committee during regularly-scheduled public meetings for final approval at the local level. For example, the decision to use the September 13 – 20, 1999 episode for modeling purposes was approved during the August 23, 2000 AIR Executive/Advisory Committee meeting by voting members of the AIR Committee.

Voting members (Executive members) of the AIR Committee include one representative each from Bexar County, Comal County, City of Floresville, Guadalupe County, City of New Braunfels, City of San Antonio, City of Seguin, Wilson County, The Alamo Area Council of Governments Board of Directors, Greater Bexar County Council of Cities (GBCCC) and the San Antonio-Bexar County Metropolitan Planning Organization (MPO).

The Advisory committee, although not consisting of voting members, includes representatives of other governmental entities, numerous industries, and private citizens. Appendix J provides additional information regarding the modeling/analysis protocol for the SAER.

Figure 3-2. Modeling Domain used to Simulate the September 13 – 20, 1999 High Ozone Episode. Source: ENVIRON International Corporation.



CAMx Grid Dimensions

LCP Grid with reference origin at (40 N, 100 W)

36 km Grid: 45 x 46 cells from (-108, -1584) to (1512, 72)
12 km Grid: 87 x 87 cells from (0, -1476) to (1044, -432)
4 km Grid: 90 x 108 cells from (36, -1404) to (396, -972)
(nested grid dimensions do not include buffer cells)

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3.4 1999 METEOROLOGICAL MODEL

The September 1999 ozone model was developed using the Mesoscale Model (MM5), the standard meteorological model used by TCEQ and recommended by EPA. The original September 13 – 20, 1999 meteorological model was developed using version 3.4 of the MM5 model. However, statistical summaries of modeling results indicated certain performance problems. These included consistent over prediction of wind speed at night and under predictions during the daytime; over prediction of early morning temperatures; and marginal performance for both humidity and the overall pressure pattern covering the south-central U.S.

It was assumed that the deficiencies in performance were the result of a combination of errors associated with model inputs and the choice of internal model algorithms. Based on results of sensitivity tests, numerous additional iterations of the model were conducted to incorporate new information and improve known deficiencies. These subsequent runs were conducted on the newly-released version 3.5 of MM5; and so, took advantage of the additional modeling capabilities of the refined meteorological model. The new runs also incorporated improvements to the boundary layer scheme, radiation scheme, soil moisture scheme, and observational analyses and FDDA techniques.

The final MM5 configuration, referred to as “Met Run 5g,” exhibited improved simulation capabilities of surface temperature and pressure gradients over Texas, and improved temperature and humidity performance at the surface. In addition, the EDAS analysis field utilized for large-scale grid nudging on Met Run 5g more closely resembled observations than the EDAS initialization package used for other meteorological runs. As a result, the Met Run 5g configuration is the basis for the meteorological fields used in development of the September 13 –20, 1999 photochemical model for the San Antonio, area, as well as three other NNA regions. Met Run 5g incorporates the following model physics and options (CAPCO 2004):

- 28 sigma levels
- Two-way interactive 108/36/12/4-km grids
  - Three-dimensional analysis nudging – MM5 was lightly nudged toward 3 hourly gridded EDAS analysis of winds (in the boundary layer and aloft) and temperature and humidity (only above the boundary layer), which were improved by the blending of routine surface and upper-air observational data
  - Two-dimensional surface analysis nudging – MM5 was lightly nudged toward 3 hourly gridded surface analyses of winds, temperature and humidity
- Observation nudging on the 12/4-km grids – MM5 was strongly nudged toward discrete hourly wind observations from routine and special measurement networks operating in Texas during the episode
- Medium Range Forecast (MRF) planetary boundary layer scheme
- Simple ice cloud microphysics
- Kain-Fritsch cumulus parameterization, except on 4-km grid
- Five-layer soil model
- RRTM radiation scheme
- Reduced soil moisture and thermal inertia to account for drier conditions

Table 3-1 provides Met Run 5g performance statistics for several regions within the 4-km domain. These 4-km grid subdomains include Austin / San Antonio, Corpus Christi / Victoria, and Houston / Galveston / Beaumont / Port Arthur. A fourth column lists performance benchmarks for comparison purposes. The benchmarks represent performance goals that were established as the result of comparing statistical summaries of nearly thirty regional meteorological models developed for various areas of the country. The goals reflect the results of meteorological models that were accepted and used in support of regulatory air quality photochemical modeling efforts (CAPCO, 2004).

The subdomain performance statistics listed in table 3-1are based on comparisons between observations obtained from ground-level monitoring stations and Met Run 5g predictions. As indicated by the results, Met Run 5g demonstrated excellent performance for wind speed and direction and good performance for temperature and humidity within the 4-km domain. Since the most important variables passed to the ozone model are wind speed and direction, MM5 performance on other variables is secondary.

Table 3-1. Comparisons of Mean Daily Statistics with Performance Benchmarks for Selected Urban Regions. Values in red denote statistics outside the performance goals (CAPCO, January 2004).

Parameter	Benchmark	Episode Mean		
		Austin/ San Antonio	Corpus Christi/ Victoria	Houston/ Galveston/ Beaumont/ Port Arthur
Wind Speed RMSE*	<2.0 m/s	1.2	1.3	1.3
Wind Speed Bias	± 0.5 m/s	0.0	0.5	0.4
Wind Speed IOA**	>0.60	0.68	0.81	0.63
Wind Direction Gross Error	<30 deg	36	23	30
Wind Direction Bias	± 10 deg	-6	-5	2
Temperature Gross Error	<2.0 K	2.1	1.3	1.5
Temperature Bias	± 0.5 K	-1.3	0.4	-0.6
Temperature IOA**	>0.80	0.92	0.92	0.95
Humidity Gross Error	<2.0 g/kg	1.4	2.4	1.1
Humidity Bias	± 1.0 g/kg	-0.3	-1.6	-0.3
Humidity IOA**	>0.60	0.47	0.53	0.61

*RMSE: root mean square error
**IOA: index of agreement

Development, analysis, and subsequent refinement of the September 13-20, 1999 meteorological model are explained in more detail in appendix B. Appendix B also provides descriptions of the statistical measurements used to evaluate the meteorological model's performance.

3.5 1999 MODELING EMISSIONS INVENTORY

In addition to meteorological inputs, photochemical models require emissions inputs that are day- and hour-specific to the modeled time period. For the September 1999 ozone

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episode, this required identifying and quantifying sources of VOC, NOx and CO emissions, as ozone forms as the result of chemical reactions between these chemical precursors. In order to prepare emissions for use in an air quality model, the emissions were temporally allocated to account for seasonal differences in emission rates or activity and to apportion emissions to a particular day or hour, in accordance with EPA policy (EPA April 1999). Furthermore, the emissions were spatially allocated among each grid cell in the modeling domain, both horizontally and vertically.

As described previously, the original September 1999 photochemical simulation failed to meet certain EPA-established acceptance criteria for photochemical simulations. Efforts to improve model performance focused on refining the meteorological inputs (see section 3.3) and the emissions inputs. As a result, the emission inventory for the September 13-20, 1999 episode underwent extensive scrutiny and refinement since development of the original 1999 model simulation. The final mobile on-road, area/non-road, and point source (anthropogenic) VOC and NOx emission inventories developed for the four-county SAER are summarized in tables 3-2 and 3-3, respectively.

Table 3-2. Average Weekday (Wednesday) Anthropogenic VOC Emissions in the Four-county SAER Calculated for the September 1999 Episode.

County	On-Road (tpd)	Area / Non-road (tpd)	Point (tpd)	Total (tpd)
Bexar	75.52	111.98	6.30	193.80
Comal	6.15	6.70	0.34	13.20
Guadalupe	5.57	7.77	0.45	13.78
Wilson	1.57	3.73	0.07	5.37
Total (tpd)	88.81	130.18	7.17	226.15

Table 3-3. Average Weekday (Wednesday) Anthropogenic NOx Emissions in the Four-county SAER Calculated for the September 1999 Episode.

County	On-Road (tpd)	Area / Non-road (tpd)	Point (tpd)	Total (tpd)
Bexar	119.57	39.39	88.59	247.55
Comal	11.64	3.57	12.16	27.38
Guadalupe	10.47	4.24	0.51	15.21
Wilson	1.89	0.93	0.00	2.82
Total (tpd)	143.58	48.12	101.26	292.96

3.5.1 Local Emissions Inventory

TCEQ provided staff with local biogenic and point source emissions inventories for the 12-county AACOG region. Area and non-road inventories were developed by staff using guidance from such documents as EPA's Air Chief and AP-42. Whenever possible, emission calculation methodologies were supplemented with data obtained from surveys. Specific sources that were surveyed in development of the local 1999 EI included quarry operations; power plants; operators of construction, commercial, industrial, railroad, and agricultural equipment; bakeries; wineries; breweries; wastewater treatment plants; and asphalt paving operations.

One of the most significant refinements made to the modeling EI was the use of traffic demand modeling and EPA's MOBILE6 model to develop link-based on-road inventories

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for some urban areas of Texas including the 4-county SAER. The original 1999 SAER on-road EI was created using a previous version of the model, MOBILE5a_h. Texas Transportation Institute, under contract with the TCEQ, developed MOBILE6 on-road emission estimates for 18 Texas NNA counties. This MOBILE6 EI file, labeled version 1, continued to undergo review during the QA/QC process.

As a product of their review, an enhanced MOBILE6 on-road file, version 2, was developed by TTI to account for an improved methodology for allocating vehicle miles traveled (VMT) for heavy-duty diesel vehicles (HDDV). The Bexar County MOBILE6 version 2 on-road file was provided to AACOG by TCEQ modeling staff on August 29, 2003 and incorporated into the September 1999 photochemical model labeled "CAMx Run 18." Although AACOG eventually received MOBILE6 on-road inventories for surrounding SAER counties (Comal, Guadalupe, and Wilson), the file was not received in time to incorporate into the photochemical model.

To account for the anticipated difference between MOBILE5a_h and MOBILE6 emission estimations in Comal, Guadalupe, and Wilson counties, an emissions factor was applied to the counties' on-road emission data using a software adjustment. This "cntlem" software program was provided to staff by UT Austin.

The on-road inventories were developed by TTI for a September 17 – 20, 1999 timeframe. TTI's documentation on development of NNA on-road emission inventories is included as appendix C of this SIP. The process of converting TTI's emissions inventory from an abbreviated episode, September 17-20, 1999, to the complete episode including ramp-up period (September 13 – 20, 1999), is presented in appendix D.

3.5.2 Texas and Regional Emissions Inventories

September 1999 area and non-road modeling EIs were developed for three other urban areas within the 4-km subdomain (the NNA partners participating in the joint modeling project - Austin, Corpus Christi, and Victoria) for inclusion in the photochemical model. Area/non-road files for the remainder of Texas were obtained from the TCEQ and based on the TEXAQS 2000 data set. In order to use this data set for modeling a September 1999 ozone episode, the data were backcast to 1999 using the ratio of 1999/2000 emissions as determined by the Economic Growth Analysis System (EGAS) 4.0 and NONROAD 2000 models.

Non-electric generating unit (NEGU) point source emissions were obtained from the TCEQ's point source database (PSDB). Electric generating unit (EGU) point source emissions were provided by the TCEQ from a September 1999 TCEQ emissions package that was updated with data from the 1999 Acid Rain Program Data Base (ARPDB). This data set applied to all of Texas with the exception of Houston. The 11-county Houston point source file was based on a 2000 NEGU and EGU emissions inventory.

On-road mobile EI data for Texas were developed by TTI and provided to staff by TCEQ. MOBILE6, version 1 was used to develop on-road emissions for the Houston area, Gregg County and Smith County. On-road EI files for the remainder of the state were developed using MOBILE5a_h.

In some cases the Texas area, non-road, and mobile EI data provided by the TCEQ required additional refinement. The modeling EI for the Houston area, for example, was

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developed for an August 2000 ozone episode. Therefore, the emissions data were backcast from August 2000 to September 1999 using appropriate modeling software such as the EGAS, MOBILE6 and NONROAD models.

Regional EI data for states outside of Texas were provided by the TCEQ. Other than point sources for the State of Louisiana, the TCEQ based the emission rates on EPA's 1999 National Emission Inventory (NEI v.2). The point source EI for Louisiana was obtained from the Louisiana Department of Environmental Quality, quality assured by the TCEQ, and updated with September data from the ARPDB.

3.5.3 QA/QC Methodology and Preparation of EI Data for Photochemical Modeling

Several quality assurance/quality control methodologies were used to assess the reliability of the EI calculations. These included "reality checks" in which calculations were evaluated for reasonableness, peer review of the EI by TCEQ, replication of calculations for some emissions sources, statistical checks, and computerized checks. To conduct computerized checks, staff evaluated computer-generated graphics using PAVE software to identify possible problems and make comparisons (1999 EI versus 2007 EI for example). This type of check provided an additional benefit; i.e., it allowed analysts to evaluate the spatial allocation of emissions. Examples of these types of comparisons can be found in figures G-1 through G-6 of appendix G.

In addition to checking data for accuracy in terms of calculation methodologies and geographical allocation, data were also evaluated in terms of temporal allocation. This step involved reviewing data distribution by hour of the day, day of the week, and season.

Although the original September 1999 model was developed by ENVIRON and further refined by collaboration between ENVIRON and UT Austin (meteorological model and air quality input refinements), the model was eventually provided to the NNA partners (or their contractors) for further modifications. These modifications included refinement of the emissions inventory inputs, development of the future case, and clean air strategy analyses. Because the model was modified by more than one agency during this process, there was a concern that the various agencies' models would be dissimilar and provide different predictions for the base case, future case, and control strategy runs.

As part of the QA/QC process, a great amount of effort was spent ensuring that the Austin and San Antonio base and future cases contained identical input. Often this involved discussions between the two agencies, as well as TCEQ, regarding the most appropriate model procedures and EI data for local and regional areas. Discrepancies in emissions inputs were corrected prior to the final AACOG and UT Austin runs.

As a result of this effort, the base and future cases refined/developed by AACOG and UT are nearly identical. An analysis of predictions made by the two models reveals that there is an insignificant difference in the models' predictions at the two Austin monitors. The average differences, during the six-day episode, between peak predictions at the Murchison and Audubon monitors when comparing the AACOG and UT base cases were 0.00 ppb and 0.05 ppb, respectively. For the 2007 future cases, the average differences in peak concentrations were –0.06 ppb (Murchison) and –0.04 ppb (Audubon). Daily differences in peak predictions by the two models are provided in the Summary of appendix E.

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Upon completion of the QA/QC process, the emissions were formatted for the CAMx photochemical model using EPA's Emissions Preprocessor System 2.0 (EPS2). The EPS2 computer program performs the data manipulations required to incorporate spatial, temporal, and chemical resolution into the emissions inventory used by photochemical models. At the end of the spatial and temporal allocation process, data totals were checked to ensure no emissions were lost during the allocation process.

3.6 1999 PHOTOCHEMICAL MODEL BASE CASE AND PERFORMANCE EVALUATION

In addition to extensive refinement of the meteorological and emissions inputs, other model configurations were reviewed for suitability during an on-going test and evaluation process. This step entailed performing sensitivity analyses on various model parameters including dry deposition algorithms, chemistry data, and boundary/initial conditions. As a result of these studies, changes were made to some model settings including dry deposition algorithms (to account for mild drought conditions occurring in eastern Texas during September 1999) and boundary condition data. Sources of refined boundary/initial condition data included U.S. EPA's guidance on UAM modeling, measurements of rural oxidants collected during the Southern Oxidants Study (SOS), and data collected during the Gulf of Mexico Air Quality Study sponsored by the Minerals Management Service. Appendix E provides a more extensive description of 1999 photochemical model development including the modifications made to the dry deposition algorithms, chemistry data, and boundary/initial conditions.

3.6.1 Evaluation Methodology

In accordance with EPA's draft 8-hour guidance (May 1999), the September 1999 photochemical simulation was subjected to a variety of 1-hour and 8-hour performance analyses. Many of the tests conducted, including scatter plots, Q-Q plots, and ozone metrics, were used to measure the differences between predictions and their paired observations. Due to some uncertainty as to the most appropriate method of implementing the EPA's 8-hour statistics, and in recognition that model performance for 8-hour averaged ozone attainment demonstrations is currently being applied for the first time, statistical metrics were calculated using three different methodologies. These included:

1) The predicted daily maximum ozone concentration within grid cells near a monitor;
2) The predicted daily maximum ozone concentration within grid cells near a monitor that is closest in magnitude to the observed daily maximum at the monitor; and
3) A bilinear interpolation of predicted daily maximum ozone concentration around the monitor location.

EPA's draft guidance provides default recommendations for delineating the area "near a monitor." The defaults are based on the size of the grid cells used in the photochemical model. Since the 1999 episode was modeled using a 4-km grid, "near a monitor" was determined to be the 7 x 7 array of cells surrounding each monitor. The 7 x 7 arrays surrounding the Central Texas monitors are represented by dashed red lines in figure 3-3. The Central Texas monitors include four CAMS sites located in the 10-county Capital Area Planning Council (CAPCO) region and four monitors located in the 12-county AACOG region.

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The 1999 base case was also evaluated using a second type of performance analysis: sensitivity tests. These tests were used to determine how accurately the model responds to changes in emissions. Diagnostic, or sensitivity, tests were conducted throughout the model development process. The type of sensitivity test applied to the model depended on the stage of model development. During the performance evaluation stage, sensitivity analysis efforts focused on testing the impacts of precursor species on ozone concentrations. These tests and test results are provided in Section 3.5.2.

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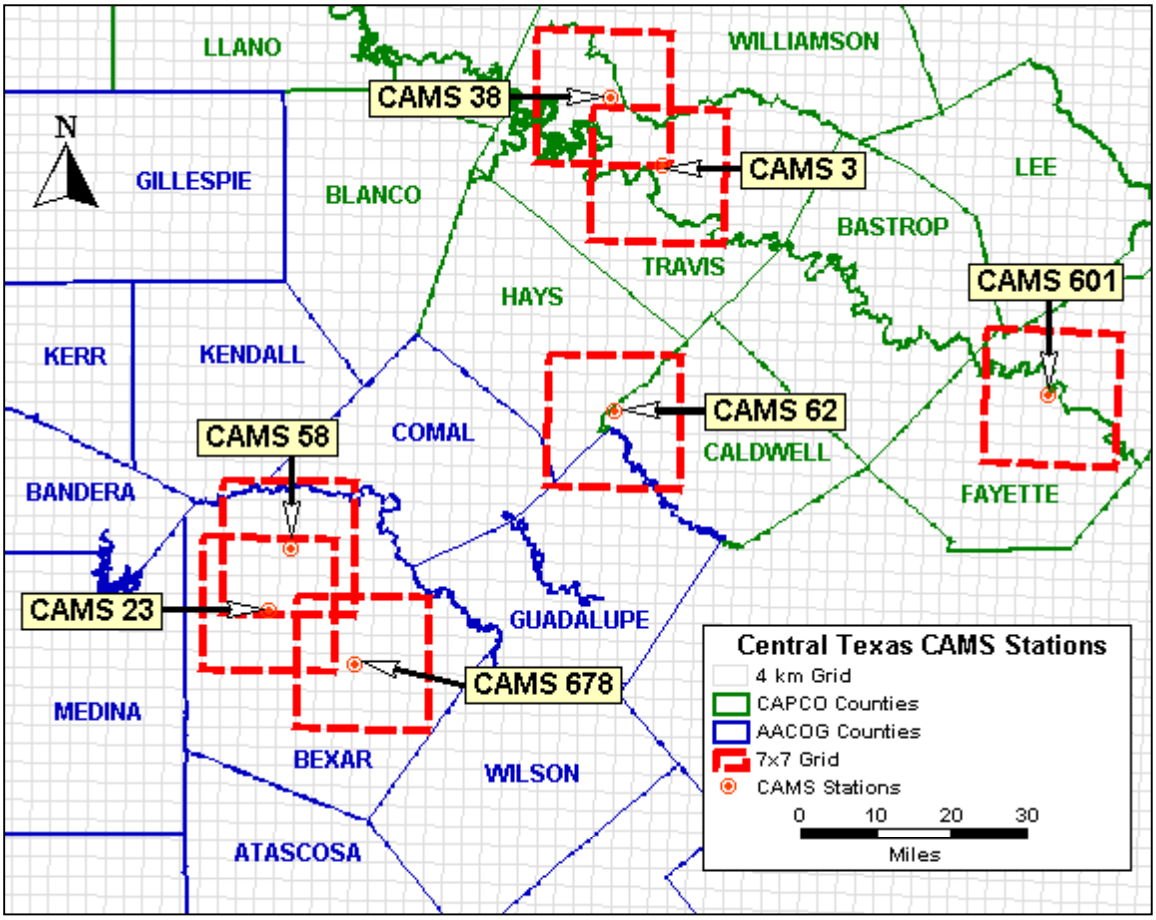
Figure 3-3. Locations of Central Texas Air Quality Monitors in the Model's 4-km Grid System. Dashed red lines represent the 7 x 7 array of cells surrounding each monitor.



3.6.2 Ozone Metrics

EPA recommends calculating ozone metrics to produce numerical comparisons between observed (measured) ozone concentrations and the model's predicted concentrations. The recommended metrics include calculations of bias, error, and correlation coefficients.

In addition to conducting the metrics calculations for individual monitors, the EPA recommends "pooling" data by monitor location, i.e., developing average statistics for downwind, city center, and upwind groups of monitors. Both the San Antonio and Austin areas have relatively sparse monitoring networks. Although, bias, error, and other metrics were calculated for monitoring groups when possible, the two EAC regions, based on recommendations from the TCEQ and U.S. EPA Region 6, evaluated performance based on the averaged statistics for all stations in Central Texas. The ozone metrics calculated for the pooled eight Central Texas monitors are provided in this section. Metrics for individual monitors and monitor groups are provided in appendix E.

In their draft guidance (EPA, May 1999), the EPA recommends specific goals for each of the ozone metrics tests. These goals include the following:

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Test	Goal
Bias between predicted/observed mean 8-hour (and 1-hour) daily maxima near each monitor	20% most monitors (8-hr comparisons only)
Fractional bias between predicted/ Observed mean 8-hour (and 1-hour) daily maxima near each monitor	20% most monitors (8-hr comparisons only)
Correlation coefficients, all data, temporally paired means, spatially paired means	Moderate to large positive correlation
Bias (8-hour daily maxima and 1-hour observed/predicted), all monitors	5 – 15%
Gross error (8-hour daily maxima and 1-hour observed/predicted), all monitors	30 – 35%

Statistical metrics averaged for the eight Central Texas monitors, using each of the three methodologies described in Section 3.5.1, are presented in tables 3-4 through 3-6. Likewise, scatter plots with correlation coefficients and Q-Q results, using each of the three methodologies, are provided in figures 3-4 through 3-6. These statistical and graphical metrics were performed on the final photochemical model run, CAMx Run 18, which incorporated the refined meteorological model (Met Run 5g), refined emissions inventories, modified dry deposition algorithms to account for vegetation moisture stress, and the modified boundary/initial conditions described in appendix E.

Although EPA does not require calculating performance statistics for the model initialization period, these metrics are included in tables 3-4 through 3-6 for comparison purposes. Metrics for the initialization days are highlighted in yellow.

As demonstrated, all bias and error metrics averaged for the eight Central Texas monitors fall within the goals established for the EPA. Furthermore, the goals are not only met on primary episode days (September 15 – 20, 1999), but also on the initialization days.

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Table 3-4. Statistical Metrics (%), Based on the Predicted Daily Maximum Ozone Concentration within a 7x7 Array of Grid Cells Near Each Monitor, used to Assess 8-hour Performance of the September 13-20, 1999 Photochemical Model in Central Texas.

Date	Maximum Observed 8-Hour Ozone Concentration (ppb)	Maximum Predicted 8-Hour Ozone Concentration (ppb)	Average Normalized Bias (±15%)	Average Fractional Bias (±15%)	Average Normalized Error (35%)	Average Fractional Error (35%)
9/13/99	55.74	52.87	-4.54	-5.01	8.63	8.94
9/14/99	60.03	59.56	-0.13	-0.70	7.51	7.39
9/15/99	75.41	74.09	-1.28	-1.67	6.80	6.92
9/16/99	76.19	75.04	-0.80	-1.13	7.46	7.50
9/17/99	82.12	80.75	-0.79	-1.16	7.66	7.74
9/18/99	85.53	83.59	-2.13	-2.40	5.96	6.15
9/19/99	88.76	89.58	1.16	0.82	7.07	7.01
9/20/99	82.24	86.20	4.68	4.43	6.40	6.21

Table 3-5. Statistical Metrics (%), Based on the Predicted Daily Maximum Ozone Concentration within a 7x7 Array of Grid Cells Near Each Monitor that is Closest in Magnitude to the Observed Daily Maximum, used to Assess 8-hour Performance of the September 13-20, 1999 Photochemical Model in Central Texas.

Date	Maximum Observed 8-hour Ozone Concentration (ppb)	Maximum Predicted 8-hour Ozone Concentration (ppb)	Average Normalized Bias (±15%)	Average Fractional Bias (±15%)	Average Normalized Error (35%)	Average Fractional Error (35%)
9/13/99	55.74	51.92	-6.45	-6.84	6.74	7.13
9/14/99	60.03	57.59	-3.84	-4.07	3.84	4.07
9/15/99	75.41	72.15	-4.09	-4.34	4.11	4.36
9/1699	76.19	72.77	-4.13	-4.32	4.13	4.32
9/17/99	82.12	78.25	-4.24	-4.47	4.32	4.55
9/18/99	85.53	81.83	-4.20	-4.43	4.26	4.49
9/19/99	88.76	86.02	-2.88	-3.02	3.15	3.30
9/20/99	82.24	81.61	-0.85	-0.88	1.01	1.04

Table 3-6. Statistical Metrics (%), Based on a Bilinear Interpolation of Predicted Daily Maximum Ozone Concentration, used to Assess 8-hour Performance of the September 13-20, 1999 Photochemical Model in Central Texas.

Date	Maximum Observed 8-hour Ozone Concentration (ppb)	Maximum Predicted 8-hour Ozone Concentration (ppb)	Average Normalized Bias (±15%)	Average Fractional Bias (±15%)	Average Normalized Error (35%)	Average Fractional Error (35%)
9/13/99	55.74	50.49	-8.82	-9.61	9.87	10.65
9/14/99	60.03	55.17	-7.55	-8.17	9.23	9.81
9/15/99	75.41	68.04	-9.37	-10.07	9.73	10.43
9/16/99	76.19	70.04	-7.43	-8.07	9.37	9.96
9/17/99	82.12	73.97	-9.22	-9.92	10.22	10.90
9/18/99	85.53	76.44	-10.52	-11.34	10.52	11.34
9/19/99	88.76	82.97	-6.30	-6.82	8.41	8.85
9/20/99	82.24	78.36	-4.69	-5.20	6.68	7.16

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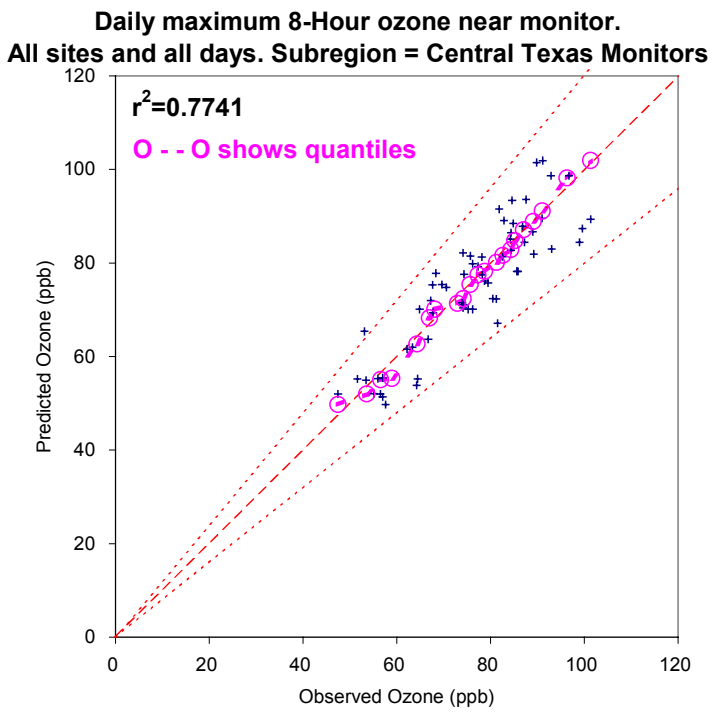
Observed and predicted 8-hour maxima were compared graphically using scatter plots and Q-Q plots.[5] Figures 3-4 through 3-6 provide combined scatter/Q-Q data pairs determined for the pooled Central Texas monitors using the three methodologies described previously. Only the third methodology (figure 3-6) yields observed/predicted data pairs (indicated by blue "+" signs) outside the ±20 indicator lines. Q-Q points, designated by magenta circles, follow the 1:1 reference line closely in each graph, particularly for methods 1 and 2. Furthermore, each methodology yields moderate to high correlation coefficients. Therefore the graphics tests indicate a high degree of correlation between peak 8-hour ozone concentrations measured during the September 1999 episode and the predicted 8-hour maximums predicted by the model for the same period.

Figure 3-4. Observed and Predicted (within 7x7 array of grid cells near each monitor) Daily Maximum 8-hour Ozone Concentrations at Central Texas Monitors.



[5] Q-Q plots are used to determine whether two data sets, observed and predicted values in this case, come from populations with a common distribution. A quantile is the percentage of points below a given value; thus the 60% quantile is the point at which 60% of the data are below and 40% are above that value. The closer the Q-Q points follow the 1:1 reference line, the greater the evidence that the two data sets come from populations with similar distributions.

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Figure 3-5. Observed and Predicted (within 7x7 array of grid cells near each monitor that is closest in magnitude to the observed daily maximum) Daily Maximum 8-hour Ozone Concentrations at Central Texas Monitors.

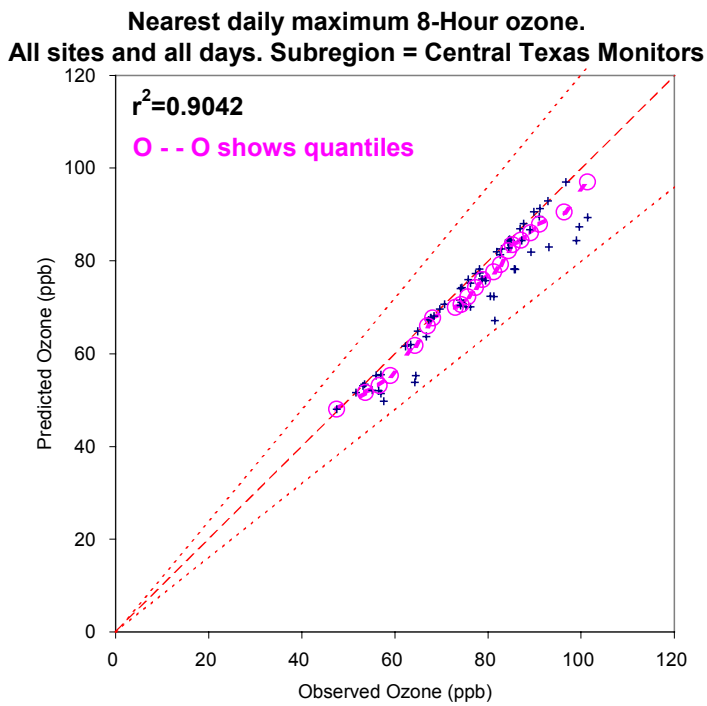
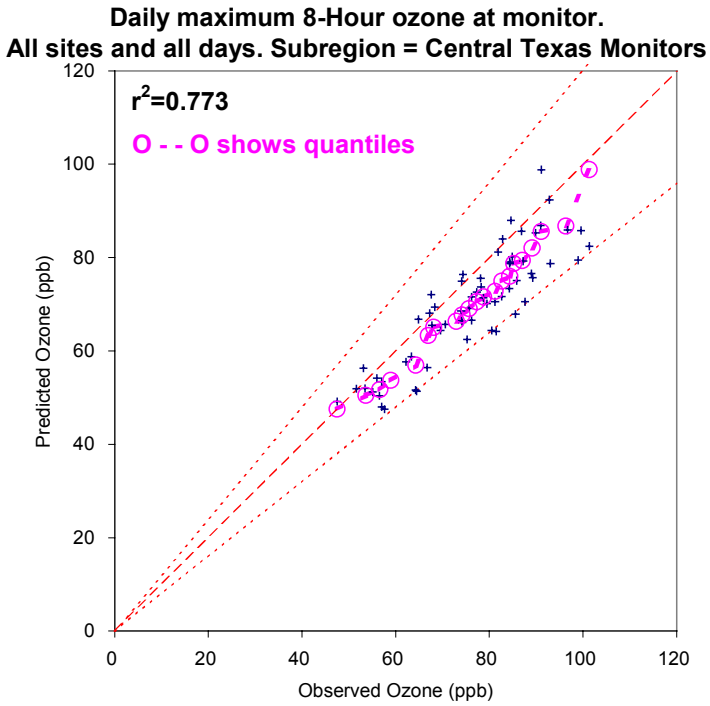


Figure 3-6. Observed and Predicted (based on a bilinear interpolation of daily maximum ozone concentrations around each monitor) Daily Maximum 8-hour Ozone Concentrations at Central Texas Monitors.



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Regardless of the methodology used to determine the predicted maximum concentration within Central Texas, the results of applying metrics tests to Run 18 for each day of the September 13 – 20, 1999 episode fell well within EPA's guidelines. In addition, 1-hour metrics and 8-hour metrics conducted on individual monitors and groups of monitors yielded excellent results. These tests and test results are described in appendix E.

3.6.3 Predictions of Precursor Concentrations

Models may also be assessed by how well the simulation replicates observed VOC, CO, NOy and NO_2, whenever data permits. There are no criteria for evaluating precursor concentrations, but comparing the modeled results to monitored data where precursor data exists can assist in resolving performance issues. When the two data sets track closely, the comparison provides additional assurance that the model is performing well and "getting the right answer for the right reasons."

Currently, the sole ozone precursor monitored by San Antonio area CAMS stations is NOx. Figures 3-7 through 3-9 provide a comparison of observed and predicted NOx concentrations at three monitoring sites: CAMS 27 located in downtown San Antonio, CAMS 59 located at Calaveras Lake in southeastern Bexar County, and CAMS 62 located northeast of San Antonio in Caldwell County.

The predicted/observed NOx comparisons were particularly important for evaluating earlier versions of the model, as the earlier base case runs tended to predict moderate to severe NOx reduction disbenefits on some episode days. Refinements to subsequent runs attenuated much of the NOx disbenefit problem. These graphs depicting CAMx Run 18 results indicate a high degree of correlation between paired predicted and observed data. A notable exception occurs on September 20th when predicted NOx concentrations are significantly higher than observed data at all three monitors.

Figure 3-7. Comparison of Observed and Predicted (Run 18) NOx Concentrations at CAMS 27 (San Antonio-downtown) during the September 13-20, 1999 Episode.
NOx values represent maximum concentrations within the 3x3 grid surrounding the monitor.

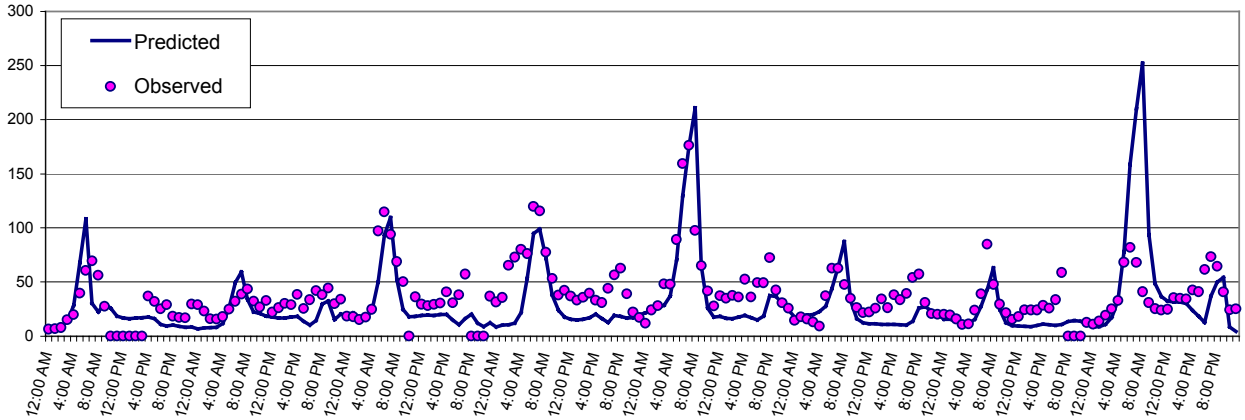

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Figure 3-8. Comparison of Observed and Predicted (Run 18) NOx Concentrations at CAMS 59 (Calaveras Lake) during the September 13-20, 1999 Episode.
NOx values represent maximum concentrations within the 3x3 grid surrounding the monitor.

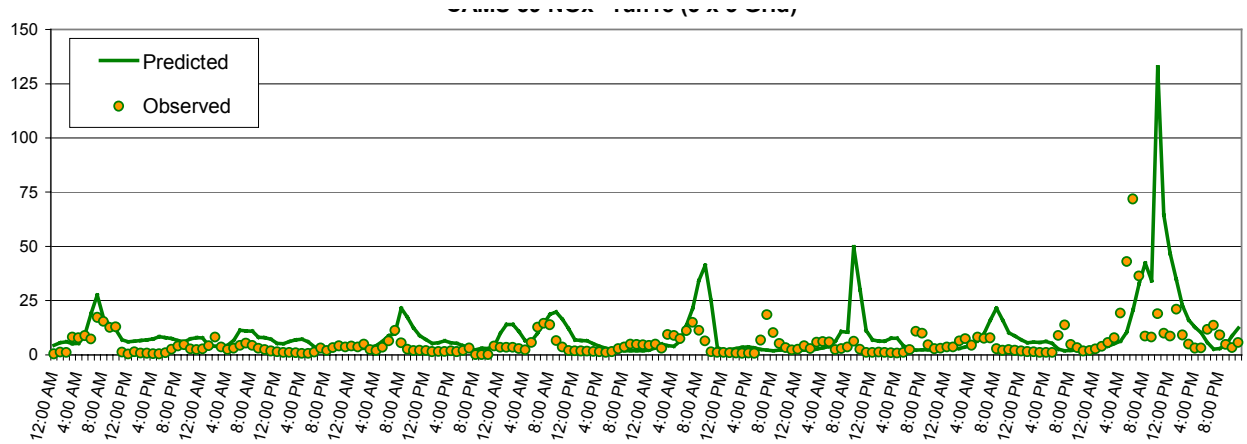
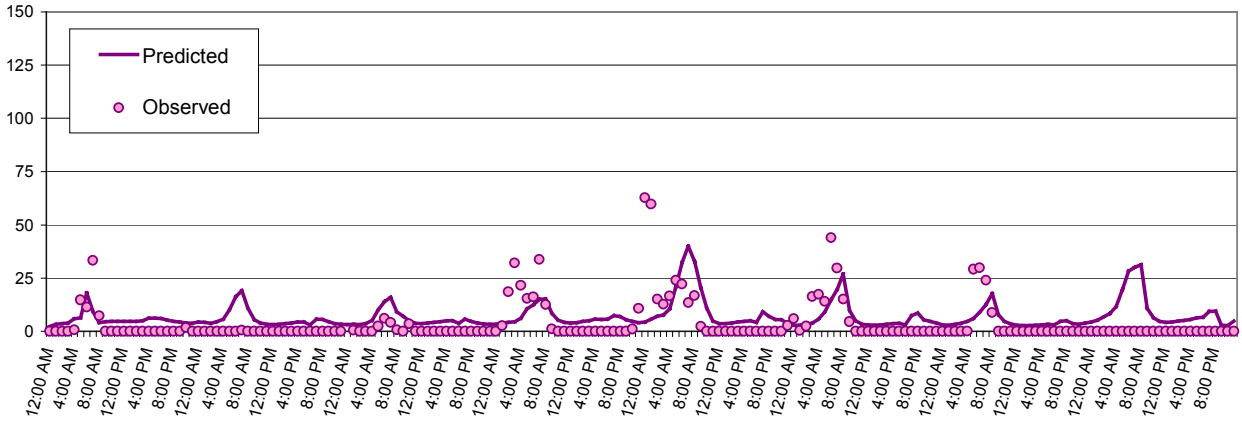


Figure 3-9. Comparison of Observed and Predicted (Run 18) NOx Concentrations at CAMS 62 (San Marcos) during the September 13-20, 1999 Episode.
NOx values represent maximum concentrations within the 3x3 grid surrounding the monitor.



3.6.4 Precursor Sensitivity Studies

During the base case performance evaluation process, two types of analyses were conducted on the model: (1) the metrics tests described above that measure how accurately the model predicts observed concentrations, and (2) sensitivity analyses that are useful for diagnostic or predictive purposes depending on how and when the tests are applied. Sensitivity tests were conducted throughout the model development process to identify sources of uncertainty and opportunities for model improvement. The sensitivity tests applied during the base case evaluation phase of model development involved reducing VOC, NOx, and combinations of VOC and NOx to determine the model's sensitivity to precursor emissions. Precursor sensitivity studies are useful for identifying the types of emissions and sources of emissions on which to focus strategy analyses.

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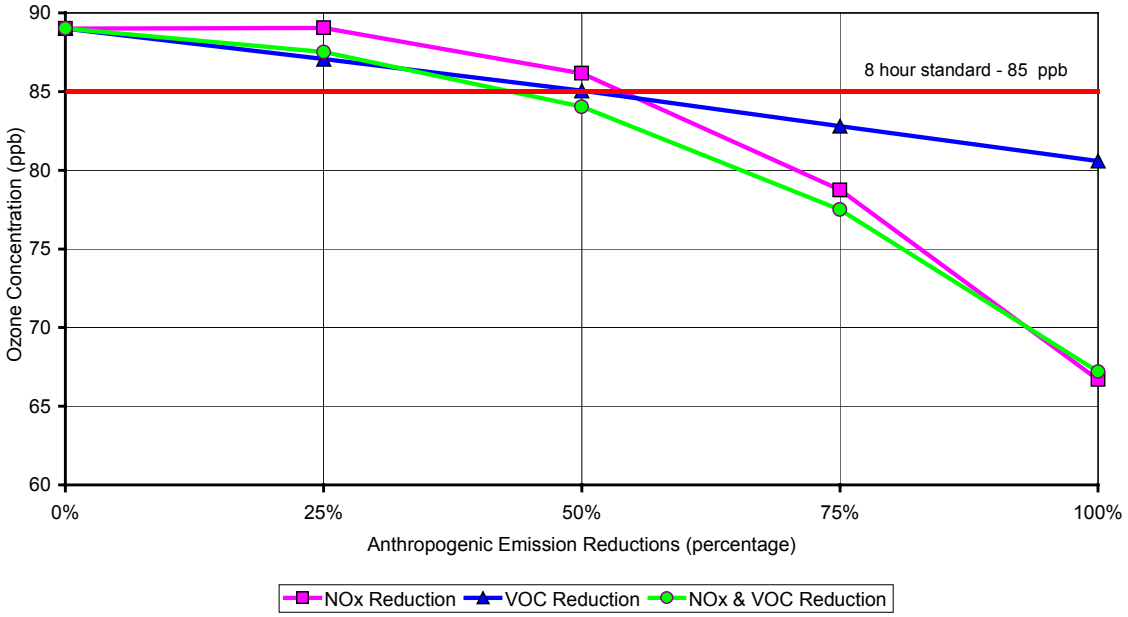
Across-the-board sensitivity runs were conducted by removing 25%, 50%, 75%, and 100% of the local (4-county SAER) NOx emissions, VOC emissions, and combinations of the two, from the CAMx Run 17b model. Figures 3-10 and 3-11 provide the results of the across-the-board reduction runs for CAMS 23 and CAMS 58, averaged over the six day modeling period. In general, VOC reductions were more effective than NOx reductions over the range of controls required to demonstrate attainment.

Due to time constraints, VOC/NOx reduction analyses were not conducted on CAMx Run 18. However, several precursor sensitivity runs were conducted on a prior version of the September 1999 model, CAMx Run 17b. The primary difference between CAMx Run 17b and CAMx Run 18, for the 1999 base cases,[6] was the use of a refined MOBILE6 on-road EI in the latter model, as described in section 3.4. Rerunning all the sensitivity tests again on Run 18 would have added an enormous amount of work. Based upon experience, it was assumed that the general findings and directional guidance determined from previous runs would remain stable with relatively small emissions adjustments.

Figure 3-10. Predicted Ozone Concentrations at CAMS 23 after Removing Local (4-county SAER) NOx and VOC Emissions, average from September 15 – 20, 1999.



[6] The 2007 projection developed from CAMx Run 18 incorporates a refined regional EI (described in Section 3.6); however, the regional EIs for Runs 17b and 18 1999 base cases are identical.

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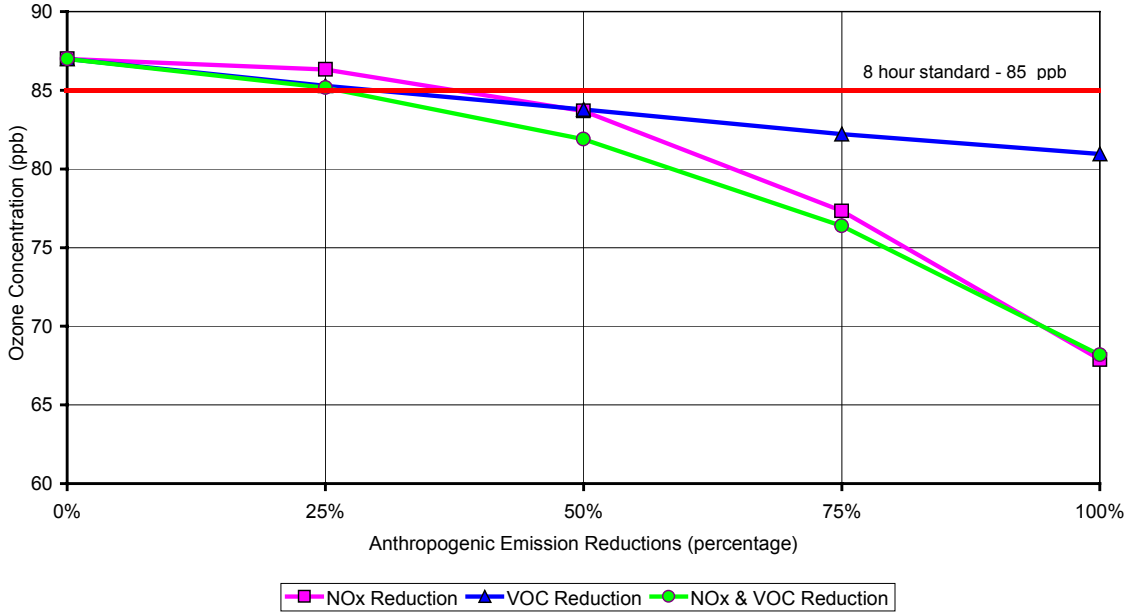
Figure 3-11. Predicted Ozone Concentrations at CAMS 58 after Removing Local (4-county SAER) NOx and VOC Emissions, average from September 15 – 20, 1999.



3.7 2007 FUTURE CASE MODELING EMISSIONS INVENTORY

Based on the positive outcome of performance evaluations conducted on the September 1999 episode simulation (Run 18), the model was subjected to a subsequent step in the attainment demonstration process: development of an attainment year base case.
In order to create a future base case for the SAER, emissions inventory inputs were developed for the attainment year of 2007. This step required adjusting the modeling EI calculated for the 1999 base case to the projection year using both control and growth factors. Growth factors accounted for anticipated increases or decreases in emission-generating activities as the result of growth / decline in employment, population, and transportation. Control factors were applied to emission projections to account for state and federal control regulations that are already mandated and expected to be in place by the attainment year. Such control factors are expected to impact local emissions through changes in technology, fuel formulations, fuel use, energy efficiency, and other emission reduction programs.

One exception to "growing" emissions to a projection year was the estimation of future biogenic emissions. In accordance with EPA recommendations, the biogenic inventory for 2007 was identical to that used in the 1999 base case. Biogenic sources were estimated to release 263 tons per day (tpd) of VOC and 21 tpd of NOx in the SAER during the September 1999 episode. Therefore, the 2007 biogenic emission input file contains these same values. Likewise, the biogenic EI for the remainder for the modeling domain remains consistent between base and future cases.

Emission projection procedures are specific to the source category – on-road mobile, area/non-road, and point – and are discussed in more detail in appendix F. As part of the on-road emission estimation project referenced in section 3.4, TTI also developed 2007 attainment year mobile emissions for the NNA regions. The methodology TTI used to project on-road emissions for the San Antonio area is described in their report, *San Antonio Metropolitan Statistical Area On-Road Mobile Source Modeling Emissions*

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Inventories: 1999, 2007, and 2012 (TTI, 2003), included as appendix C. The results of projecting the VOC and NOx EI to 2007 for all anthropogenic sources in the four-county SAER are summarized in tables 3-7 and 3-8, respectively.

Table 3-7. Estimated 2007 Average Weekday (Wednesday) VOC Emissions from Anthropogenic Sources in the Four-county SAER.

County	On-Road (tpd)	Area / Non-road (tpd)	Point (tpd)	Total (tpd)
Bexar	42.42	98.55	11.82	152.79
Comal	3.85	5.53	0.52	9.90
Guadalupe	3.42	6.98	1.10	11.50
Wilson	0.98	3.68	0.07	4.74
Total (tpd)	50.67	114.75	13.50	178.93

Table 3-8. Estimated 2007 Average Weekday (Wednesday) NOx Emissions from Anthropogenic Sources in the Four-county SAER.

County	On-Road (tpd)	Area / Non-road (tpd)	Point (tpd)	Total (tpd)
Bexar	67.45	39.18	53.24	159.86
Comal	7.07	3.70	13.77	24.53
Guadalupe	6.47	3.40	8.07	17.95
Wilson	1.34	1.04	0.00	2.39
Total (tpd)	82.34	47.32	75.08	204.74

For most anthropogenic source categories, the emission estimates decreased between 1999 and 2007, as shown in tables 3-9 and 3-10. Exceptions include an estimated increase in VOC emissions from point sources in Bexar, Comal, and Guadalupe counties. The increases in Bexar and Guadalupe counties are primarily attributed to a new Toyota manufacturing plant scheduled for completion by 2006 in Bexar County and two gas-fired power plants (online between 1999 and 2007) in Guadalupe County. The increase in NOx emissions in Guadalupe County for 2007 is based on projected effluent from the new power plants as well. In addition, area/non-road NOx emissions are estimated to increase in Comal and Wilson Counties by 2007. Overall, VOC emissions are expected to decrease by 20.88% between 1999 and 2007 in the four-county SAER and NOx emissions are expected to decrease by 30.11% during the same timeframe.

Table 3-9. Percent Difference between Estimated Weekday VOC Emissions for 1999 and 2007 in the Four-county SAER.

County	On-Road (tpd)	Area / Non-road (tpd)	Point (tpd)	Total (tpd)
Bexar	-43.83%	-11.99%	87.47%	-21.16%
Comal	-37.42%	-17.45%	50.94%	-24.98%
Guadalupe	-38.63%	-10.08%	145.00%	-16.58%
Wilson	-37.42%	-1.31%	0.00%	-11.82%
Total (tpd)	-42.95%	-11.85%	88.44%	-20.88%

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Table 3-10. Percent Difference between Estimated Weekday NOx Emissions for 1999 and 2007 in the Four-county SAER.

County	On-Road (tpd)	Area / Non-road (tpd)	Point (tpd)	Total (tpd)
Bexar	-43.59%	-0.53%	-39.90%	-35.42%
Comal	-39.30%	3.46%	13.22%	-10.39%
Guadalupe	-38.15%	-19.65%	1492.19%	17.99%
Wilson	-29.00%	12.17%	0.00%	-15.44%
Total (tpd)	-42.65%	-1.67%	-25.85%	-30.11%

3.8 2007 PHOTOCHEMICAL MODEL BASE CASE AND SENSITIVITY ANALYSES

The effects of modifying emissions inputs to the model in order to develop a 2007 future base are provided in table 3-11. This table lists the average daily (September 15 – 20) maximum 8-hour ozone concentrations within the 7x7 array of cells surrounding the SAER monitors, as predicted by the 2007 future case, and compares those values to those predicted for 1999. For each monitoring site, ozone concentrations are predicted to decrease between 1999 and 2007. The difference in the 1999 and 2007 predictions ranges from -3.3% at CAMS 678 to -5.7% at CAMS 59. Both CAMS 59 and CAMS 678 are upwind monitors located southeast of downtown San Antonio.

Table 3-11. Comparison of 1999 and 2007 Predicted Ozone Concentrations by Monitor.

CAMS Station	1999 Predicted 8-hr Max. Ozone	2007 Predicted 8-hr Max. Ozone	1999-2007 Percent Change
CAMS 23	89.0 ppb	84.5 ppb	-5.0%
CAMS 58	87.8 ppb	82.8 ppb	-5.6%
CAMS 59	78.1 ppb	73.6 ppb	-5.7%
CAMS 678	80.1 ppb	77.4 ppb	-3.3%

The 1999-2007 predicted ozone concentration results are compared graphically in figure 3-12. This comparison represents the maximum 8-hour concentrations within the entire 4-km subdomain for a typical episode weekday – Wednesday, September 15th. As shown, predicted ozone levels fell significantly between 1999 and 2007 throughout the 4-km subdomain and the area with exceedances was completely eliminated. Moreover, the peak predicted 8-hour maximum concentration for the domain decreased from 90 ppb to 81 ppb in the September 15th simulation. Comparisons of 1999 and 2007 peak ozone concentration predictions for each episode day are provided in appendix G, *2007 Base Case and Sensitivity Analyses*.

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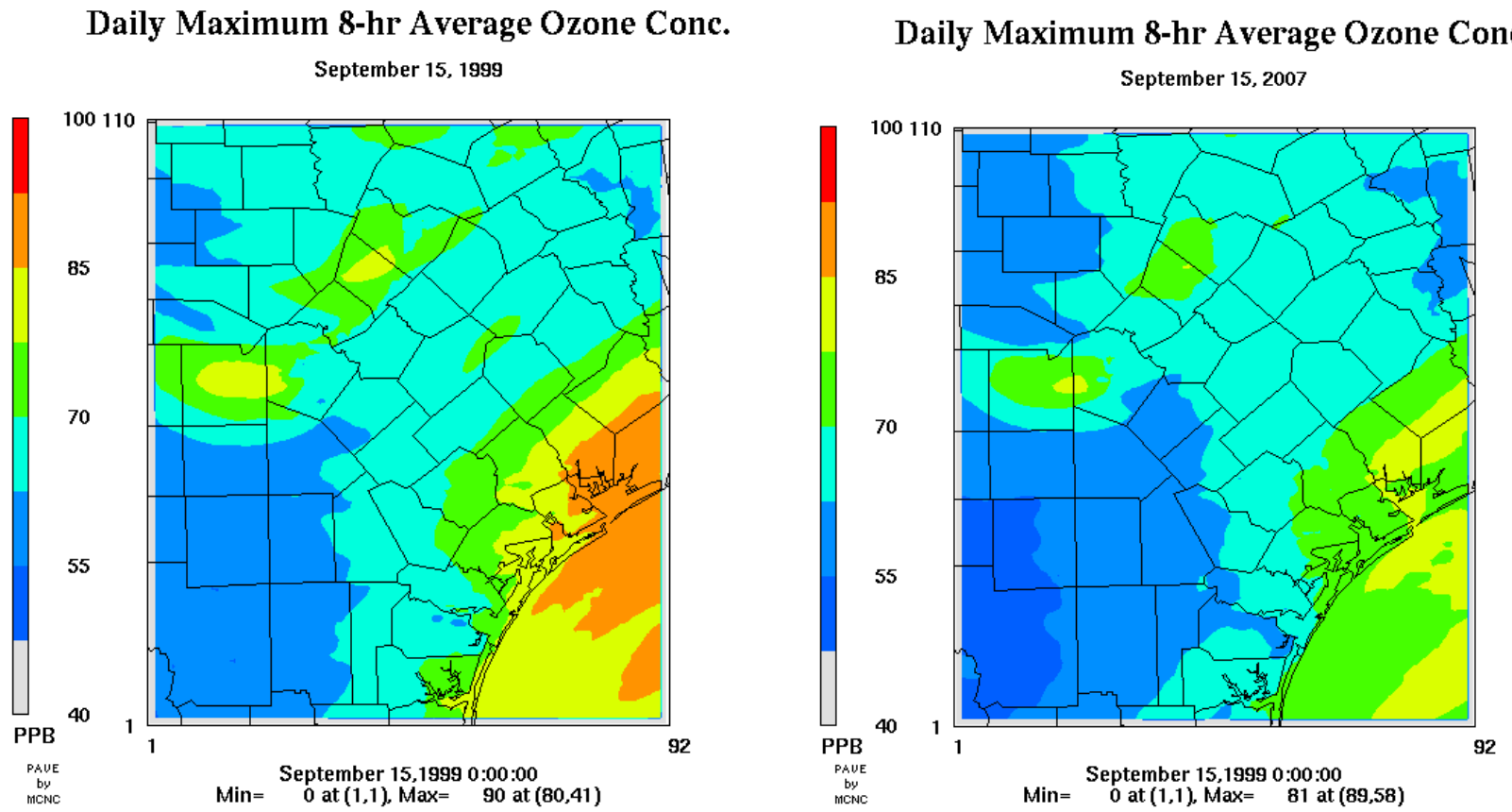
Figure 3-12. Comparison of 1999 and 2007 Predicted Daily Maximum 8-hour Ozone Concentrations within the 4-km Subdomain for a Typical Weekday (Wednesday, September 15th).

1999 **2007**



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Once the photochemical model was modified using the projected 2007 EI, several additional sensitivity runs were conducted on the simulation to assess the robustness of the 2007 base case simulation. The 2007 base case included an updated 2007 regional EI that was originally used by ENVIRON to model an ozone episode for northeast Texas. Much of the regional emission rate file was based on an EPA study which analyzed the impacts of implementing federal rules pertaining to heavy-duty diesel engines and fuels in the on-road and off-road source categories. The study was documented in the federal agency's report *Procedures for Developing Base Year and Future Year Mass and Modeling Inventories for the Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel (HDD) Rulemaking.*[7]

After the sensitivity tests were completed on the CAMx Run 18 base case (or 1999 base case A), AACOG received additional EI data and performed other modifications to incorporate into the 1999 base and 2007 future cases. Modifications incorporated into the 1999 base case included:

- refined 1999 VOC emission rates from a San Antonio-based water utility for wastewater treatment plants
- EI data file from ENVIRON International Corporation (via TCEQ) for states outside of Texas
- updated area and non-road source temporal profiles for regional Texas that matches 2007 temporal profiles
- updated point source cut off point from 20m to 50m for the 4km grid
- updated Victoria's mobile EI
- updated chemical and temporal profiles for Texas area and non-road emissions
- updated Victoria's point sources
- updated Texas NEGU and EGU point sources outside of Houston
- updated Louisiana point source emissions
- updated San Antonio asphalt emissions
- updated tanker truck unloading emissions
- updated tanker trucks in transit emissions
- updated emissions for other gasoline distribution activities

Additional modifications incorporated into the 2007 base case included:

- updated regional EI non-road HDD provided by TCEQ
- updated Austin Point Source Control database (several revisions)
- new wastewater estimates
- new regional temporal profile for point sources
- updated Austin CO on-road EI (3 County)
- stage1 (125k) file
- removed tank truck unloading on Sunday
- updated area source temporal profiles
- updated Texas regional area and non-road emissions
- updated Texas point sources (besides CPS),
- new Lehigh cement kiln controls
- updated point source cut off point from 20m to 50m for the 4km grid
- updated Victoria's emissions
- updated chemical and temporal profiles for Texas area and non-road emissions
- updated San Antonio asphalt emissions

[7] The report , dated October 2000, was prepared for EPA by E.H. Pechan & Associates, Inc. and is available on-line at: http://www.epa.gov/otaq/models/hd2007/r00020.pdf

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- updated tanker truck unloading emissions
- updated tanker trucks in transit emissions
- updated emissions for other gasoline distribution activities
- updated emissions for rate of progress controls

As a consequence of receiving and incorporating revised local and regional EI data files for the base case and future case, additional sensitivity runs were conducted on the refined base runs. The final run, 1999 Base Case G (CAMX Run 18.f) incorporates all refinements listed above. Tables 3-12 through 3-15 list the results (by ppb) of sensitivity runs conducted for 2007 based on predictions of ozone concentrations within the 7 x 7 grids surrounding each of four CAMS stations in the San Antonio area. The tables also provide comparisons between 1999 and 2007 predicted average ozone concentrations and between 1999 and 2007 design values for both A and G versions of the CAMx Run 18 simulations.

As demonstrated in these tables, the future case "zero out" runs (removal of power plants and other sources), show that SAER sources will contribute from ~12 – 21% of the ambient ozone, depending on the CAMS station being evaluated. These sensitivity runs also indicate that emissions added by the Toyota plant and the various power plants make small changes in total ozone concentrations in the SAER. Furthermore, the predicted 2007 design values (see section 3.9 for methodology used to calculate design values) at each CAMS location in the San Antonio region are reduced below the 85 ppb threshold for both A and G versions of the future cases. This holds true even for CAMS 23, which has the highest current design value: 89 ppb.

Table 3-12. Results of Sensitivity Runs Conducted at CAMS 23 (San Antonio Northwest – Marshall High School).

Sensitivity Run	Year	Design Value (ppb)	Change (ppb)
Base Case A	1999	89	---
Base Case G	1999	89	---
No City Public Service Plants	2007	83.32	-1.21
No Spruce Power Plant (5.93 tons/day NOx)	2007	84.42	-0.10
No Toyota Manufacturing Plant	2007	84.51	-0.01
No San Antonio (4-county area) 2007	2007	63.09	-21.43
Base Case A	2007	84.56	---
Base Case G	2007	84.52	---

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Table 3-13. Results of Sensitivity Runs Conducted at CAMS 58 (Camp Bullis)

Sensitivity Run	Year	Design Value (ppb)	Change (ppb)
Base Case A	1999	87	---
Base Case G	1999	87	---
No City Public Service Plants	2007	81.15	-0.97
No Spruce Power Plant	2007	82.04	-0.08
No Toyota Manufacturing Plant	2007	82.11	-0.01
No San Antonio (4-county area) 2007	2007	63.42	-18.69
Base Case A	2007	82.19	---
Base Case G	2007	82.12	---

Table 3-14. Results of Sensitivity Runs Conducted at CAMS 59 (Calaveras Lake)

Sensitivity Run	Year	Design Value (ppb)	Change (ppb)
Base Case A	1999	79	---
Base Case G	1999	79	---
No City Public Service Plants	2007	71.07	-3.42
No Spruce Power Plant	2007	74.46	0.03
No Toyota Manufacturing Plant	2007	74.46	-0.02
No San Antonio (4-county area) 2007	2007	64.51	-9.97
Base Case A	2007	74.96*	---
Base Case G	2007	74.48	---

*averaged over one more day (Sept 17th) because the value was above 70 ppb requirement (EPA 1999 , p. 41) to be included in the RRF

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Table 3-15. Results of Sensitivity Runs Conducted at CAMS 678 (CPS Pecan Valley)

Sensitivity Run	Year	Design Value (ppb)	Change (ppb)
Base Case A	1999	77	---
Base Case G (includes refined wastewater VOCs)	1999	77	---
No City Public Service Plants	2007	72.17	-2.29
No Spruce Power Plant	2007	74.35	-0.11
No Toyota Manufacturing Plant	2007	74.48	-0.02
No San Antonio (4-county area) 2007	2007	61.29	-13.17
Base Case A*	2007	74.71	---
Base Case G	2007	74.46	---

*averaged over one more day (Sept 17th) because the value was above the 70 ppb requirement (EPA 1999 , p. 41) to be included in the RRF

3.9 ATTAINMENT DEMONSTRATION PROCESS

An attainment demonstration compares predicted ozone concentrations with the thresholds established by the ozone NAAQS. The NAAQSare met if the fourth highest 8-hour daily maximum ozone concentration averaged over three consecutive years is less than or equal to 0.08 ppm. Therefore, the modeled attainment test is passed when the predicted future design values near all monitoring sites are less than or equal to 84 ppb. The EPA has specified a procedure for calculating the future design values. In order to determine the level of reductions needed to reach attainment by 2007, staff calculated the future design values for the San Antonio region in accordance with EPA guidance.

3.9.1 Design Values and Relative Reduction Factors

As recommended by the EPA, attainment demonstrations for the 8-hour ozone NAAQS should be based on the results of modeled attainment tests, screening tests, and, when appropriate, weight-of-evidence determinations. Key components of these tests are the predicted and observed design values.

The “current” design value for the SAER was determined using EPA guidelines. This step entailed reviewing the three-year period straddling the year represented by the most recently available emissions inventory (1998 – 2000) and the three-year period that is anticipated to be used to designate the area nonattainment (2001 – 2003). The current monitored design values were selected based on the higher of the two estimates at each monitor, as shown in table3-16. Based on this procedure, the area-wide “current” design value for the San Antonio area is 89 ppb at CAMS 23.

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Table 3-16. Selection of Current Monitored Design Values based on Comparison of 1998 – 2000 Values with 2001 – 2003 Values.

Monitor	1998-2000 Design Value	2001-2003 Design Value	Current Monitored Design Value Used in the Modeled Attainment Test
CAMS 23	85 ppb	89 ppb	89 ppb
CAMS 58	84 ppb	87 ppb	87 ppb
CAMS 59	79 ppb	78 ppb	79 ppb
CAMS 678	77 ppb	76 ppb	77 ppb

3.9.2 Modeled Attainment Test

The modeled attainment test predicts whether or not all observed future design values will be less than or equal to the 8-hour ozone NAAQS under the same meteorological conditions as those simulated for the base case (EPA, May 1999). The future design value is calculated by multiplying the "current" design value by a "Relative Reduction Factor," which is the relative change in modeled values between the base and future case. The test was performed by solving the following equation for each monitoring site within the San Antonio region.

$$(DVF)_I = (RRF)_I(DVC)_I$$

where

$(DVC)_I$ = the current design value at monitoring site I

$(RRF)_I$ = the relative reduction calculated near site I (ratio of the future 8-hour daily maximum concentration predicted near a monitor (within the 7 x 7 grid) to the current 8-hour daily maximum concentration predicted near a monitor

$(DVF)_I$ = the estimated future design value for the time attainment is required

The modeled attainment test is passed if all resulting predicted future design values are ≤ 84 ppb. Table 3-17 provides the results of the modeled attainment test at each SAER monitor. As indicated, the test was passed at all the monitors used to determine attainment.

Table 3-17. Modeled Attainment Test Results at SAER Monitors.

Monitor	Modeled Average Daily Maximum Ozone Concentration – 1999	Modeled Average Daily Maximum Ozone Concentration - 2007	RRF	Current Design Value	Future Design Value	Pass / Fail Status
CAMS 23	88 ppb	84 ppb	0.95	89 ppb	84 ppb	Pass
CAMS 58	87 ppb	82 ppb	0.94	87 ppb	82 ppb	Pass
CAMS 59	78 ppb	73 ppb	0.95	79 ppb	74 ppb	Pass
CAMS 678	80 ppb	77 ppb	0.97	77 ppb	74 ppb	Pass

While the future design values listed in table 3-17 indicate the region would be in compliance with the 8-hour ozone NAAQS by the attainment year without implementing local clean air controls, the results for CAMS 23 are very close to the 85-ppb threshold. Chapter 5 describes additional local controls that were evaluated as a means of further

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reducing ozone concentrations in the SAER by the attainment year. One strategy, Stage I vapor recovery, is creditable, enforceable, and permanent in terms required for credit taken in the SIP.

Table 3-18 provides the future design values, by monitor, calculated from a 2007 control strategy run that incorporated the impacts of Stage I vapor recovery technology in the SAER. The table provides a comparison between these values and the future design values calculated from the 2007 future case (without local controls). Although EPA guidance (May 1999) suggests truncating design value calculations, decimal places are provided in table 3-18 to allow for comparisons. These results indicate that implementation of Stage I vapor recovery systems in the SAER is expected to reduce ozone concentrations at all SAER monitors. More information on clean air strategies and calculation of design values is provided in chapter 5 of this attainment document and appendix H.

Table 3-18. Modeled Attainment Test Results that Account for Implementation of Stage I Vapor Recovery.

Monitor	Future Design Value (ppb)	RRF	Future Design Value with Stage I (ppb)	Pass/Fail Status
CAMS 23	84.52	0.950	84.40	Pass
CAMS 58	82.12	0.944	82.03	Pass
CAMS 59	74.48	0.943	74.44	Pass
CAMS 678	74.46	0.967	74.39	Pass

3.9.3 Screening Test

Since the modeled attainment test provides no indication of future ozone concentrations at locations without monitors, the EPA recommends a supplementary screening analysis to support an attainment demonstration. The screening test is particularly important in areas such as Central Texas where monitoring networks are relatively sparse. The screening test requires identifying areas in the domain where absolute predicted 8-hour daily maximum ozone concentrations are consistently greater than any predicted in the vicinity of a monitoring site. The final step in the screening test requires estimating the future design value for each identified area.

The default criterion recommended by EPA for defining areas with consistently high predictions of 8-hour daily maximum ozone concentrations requires identifying 8-hour concentration predictions that are >5% higher than any near a monitored location on 50% or more of the modeled days. Table 3-19 provides a list of the daily maximum 8-hour concentrations predicted within the San Antonio region for the September episode model and compares the data to daily maximum 8-hour concentrations in the vicinity of a monitoring site. As shown, the predicted 8-hour daily maximum for the SA region exceeded the highest predicted 8-hour daily maximum near a monitor by more than 5% on only two day of the episode (16th and 17th). Since the 5% threshold was not exceeded on “50% or more modeled days,” a screening test is unnecessary for demonstration purposes.

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Table 3-19. Screening Cell Design Value Scaling Results*

Date	8-hr Daily Maximum				Maximum Screened Cell Value	Percent difference compared to Peak CAMS Value
	CAMS 23	CAMS 58	CAMS 59	CAMS 679		
15th	81.14	75.59	66.89	70.16	83.22	2.56%
16th	78.08	77.26	72.38	71.51	**84.67**	8.43%
17th	81.36	82.01	69.90	69.90	**86.13**	5.03%
18th	98.57	98.57	72.12	79.63	98.57	0.00%
19th	101.40	101.83	81.75	91.49	101.83	0.00%
20th	93.20	91.30	86.26	87.65	93.20	0.00%

*Bold type indicates > 5% of modeled daily maximum value

3.10 SUMMARY AND RECOMMENDATIONS

The extensive QA/QC process performed on and subsequent refinements made to the September 1999 photochemical simulation have produced a model that replicates observed trends very well. A variety of performance tests, including 1-hour and 8-hour metrics, precursor observations, and diagnostic tests, were conducted on the simulation with encouraging results. In particular, the final iteration labeled Run 18, replicated observations quite accurately and passed all performance tests. Extensive model analyses, testing, and performance evaluation provided all four South and Central Texas urban areas with the confidence to use the simulation for modeling purposes. Furthermore, model performance lent credence for basing attainment demonstrations for two cities on the September episode simulation: the SAER attainment demonstration described here and the Austin / Round Rock MSA Clean Air Plan.

Following EPA guidance, modeled attainment tests and screening tests were conducted on the model to determine the reductions necessary to meet NAAQS thresholds by the attainment year. Although these tests indicated the San Antonio region would reach attainment by 2007 with no additional local controls, it was recognized that the attainment tests were passed with very little margin for error. Therefore, it was deemed prudent to proceed with modeling the effects of controlling local sources of emissions.

Results of the precursor sensitivity analyses described in Section 3.5.3 indicate that, at the 25% reduction level, decreases in either VOC or NOx effectively reduce ozone levels in the San Antonio region. However, VOC reductions were generally more effective at lowering ozone concentrations at the 25% reduction level than comparable reductions of NOx. Based on these precursor tests, it was recommended that a variety of local controls be modeled that target reductions of NOx, VOC, or both NOx and VOC.

References

Capital Area Planning Council (January 2004). Development of the September 13-20, 1999 Base Case Photochemical Model for Austin's Early Action Compact, Report submitted to the U.S. EPA and TCEQ by CAPCO with contractors from The University of Texas at Austin and ENVIRON International Corporation. Austin, TX.

Environmental Protection Agency (April 1999). Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations (EPA-454/R-99-006). Research Triangle Park, NC: Office of Air Quality Planning and Standards.

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Environmental Protection Agency (May 1999). Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS (EPA-454/R-99-004). Research Triangle Park, NC: Office of Air Quality Planning and Standards.

Texas Transportation Institute (June 2003). San Antonio Metropolitan Statistical Area On-Road Mobile Source Modeling Emissions Inventories: 1999, 2007, and 2012. College Station, TX: TTI – The Texas A&M University System

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CHAPTER 4: DATA ANALYSIS

4.1 INTRODUCTION

A great amount of data must be accumulated and reviewed in preparation for photochemical modeling. This not only includes the data used to develop meteorological, precursor emissions, and air quality inputs to the model, but data used to understand and define the conditions that contribute to elevated ozone concentrations in a region. Data analysis entails assessing and characterizing these environmental conditions to develop an understanding of their impact on ozone formation, transport, and deposition. Further, these analyses enhance the decision-making process for clean air strategy selection.

Ozone data analysis focuses on the underlying causes of ozone level exceedances. Such studies include a review of ozone trends to identify patterns of peak ozone formation; meteorological conditions that are conducive to exceedances; and the impacts of transport, as well as contribution of local sources, on ozone levels. The following sections summarize the results and conclusions of these analyses. Detailed information on these topics is provided in appendices A and M.

4.2 LEVELS AND TRENDS IN OZONE CONCENTRATIONS

The SAER region continues to meet the 1-hour ozone NAAQS. However, since promulgation of the 8-hour ozone standard in 1997, the region has exceeded the 8-hour standard during several averaging periods.

Figure 4-1 identifies the annual peak 1-hour and 8-hour ozone concentrations measured by any SAER monitor between 1995 and 2002. Of note is the relative rarity of 1-hour ozone exceedances in the region. From 1995-2003, the region has recorded a total of five one-hour ozone readings at or above 125 ppb. One of these, May 7, 1998, was associated with a Mexican smoke event and is not a regulatory reading. This graph also indicates the highest 8-hour average measured in the region varies from year to year. Due to the limited information this graph provides (annual peak values), and the relatively short (8 years) study period, no conclusions are drawn regarding ozone concentration trends.

Figure 4-1. Annual Peak 1-hour and 8-hour Ozone Measurements within SAER.

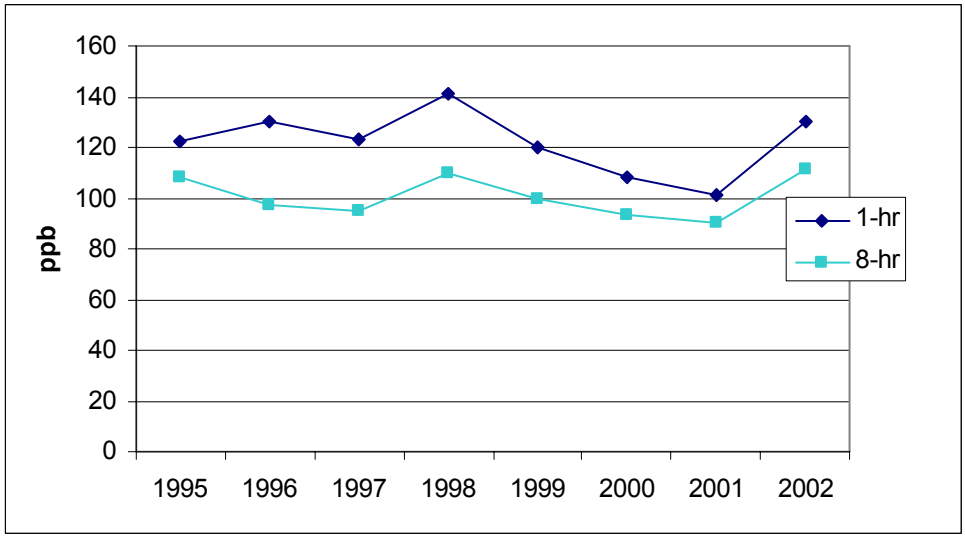

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Figure 4-2 displays the eight-hour ozone design value trends, by site, between the years 1980 and 2003. Although this graph provides a much wider data range than figure 4-1, there is little indication of ozone trends in this graph, as the values tend to vary from year to year. The lowest 8-hour design values generally occurred during the early 1990s. However, beginning in 1995, the design values began to rise and the 85-ppb design was exceeded multiple times. Only the design values for CAMS 59 (Calaveras Lake) and CAMS 678 (CPS Pecan Valley) consistently remained below 85 ppb. During the ozone season, these monitors are historically upwind. Since CAMS 59 and 678 typically measure background concentrations, these monitors are expected to have lower design values than San Antonio's downwind monitors, CAMS 23 and 58.

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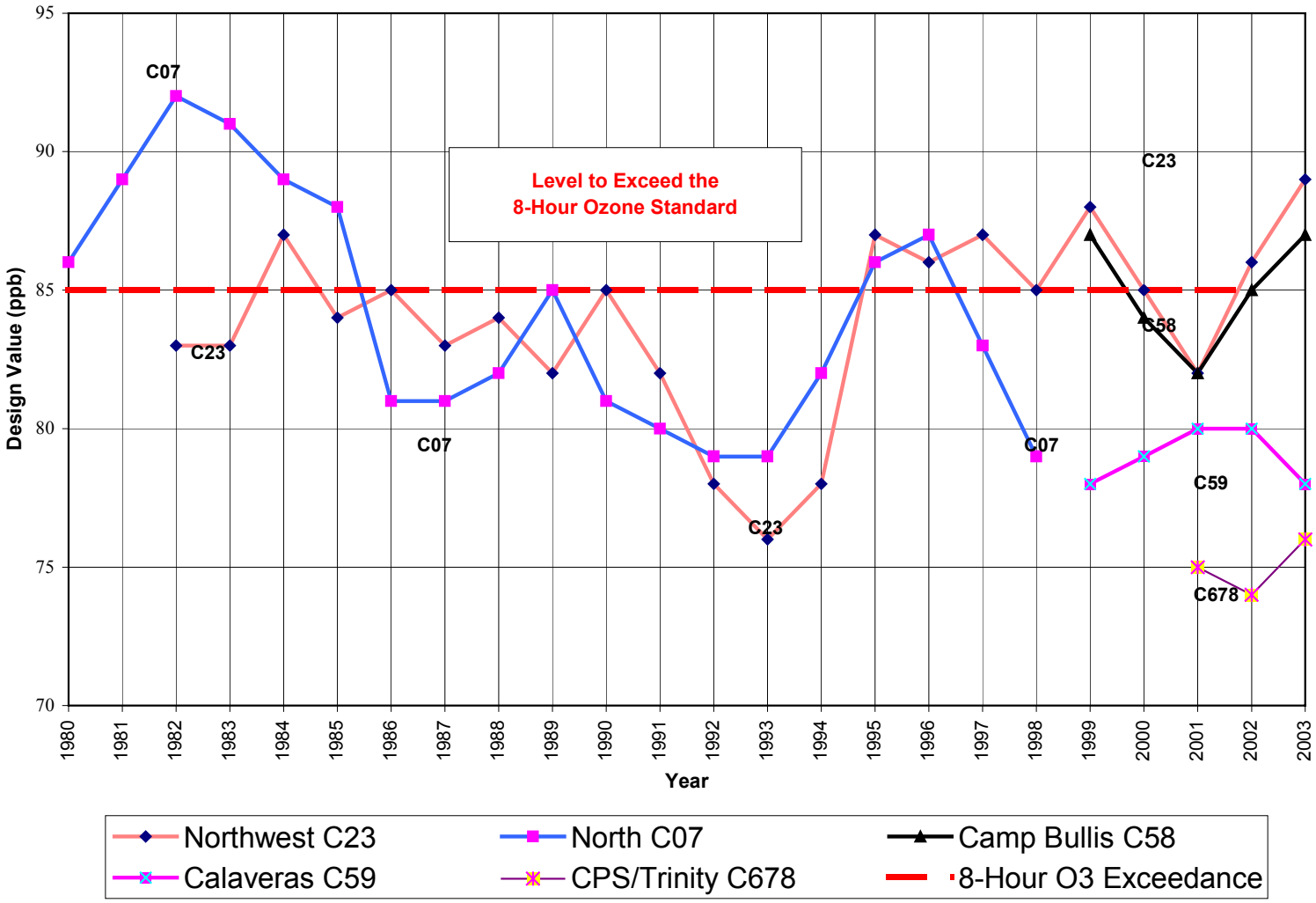
Figure 4-2. San Antonio Eight-hour Ozone Design Value Trends by Site.*



*Each plotted value covers a 3-year period ending with the year indicated.

Figure 4-3 provides an indication of the frequency of 8-hour threshold exceedances. This graph identifies, on an annual basis, the number of days the 85-ppb threshold was exceeded between 1995 and 2002. The annual values range from one exceedance day in 2001 to 17 exceedance days the following year, 2002. As with annual peak concentrations, this comparison shows a great deal of variability between 1995 and 2002, with no obvious conclusions regarding trends.

Figure 4-3. Annual Number of Days in which Measured 8-hour Averages Met or Exceeded 85 ppb at SAER Monitors.

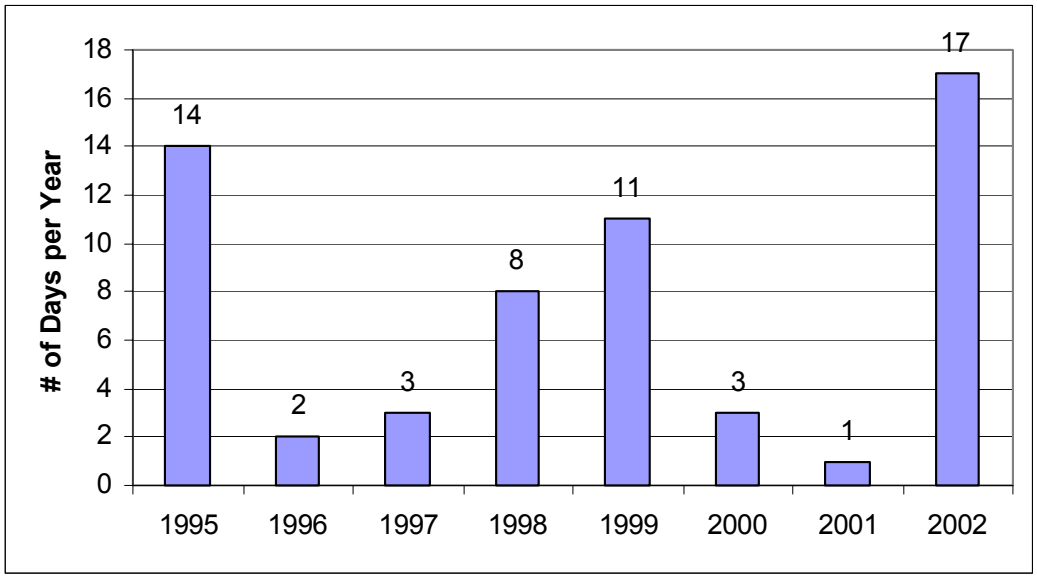
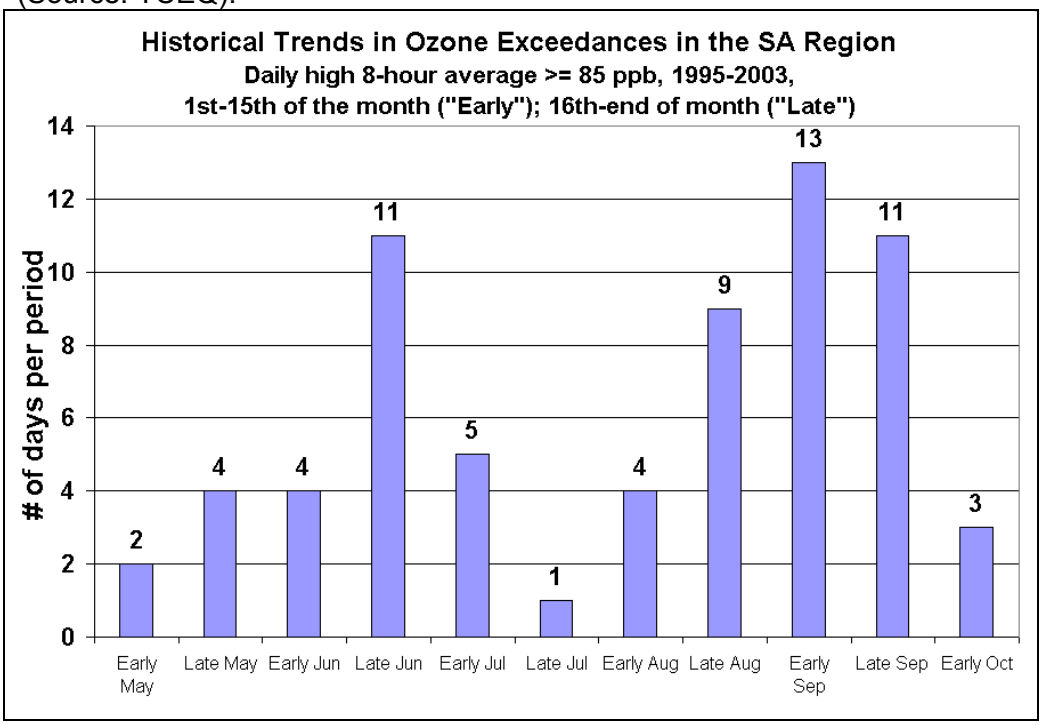


Figure 4-4. High Ozone Readings by Two-week Period for San Antonio Region. (Source: TCEQ).



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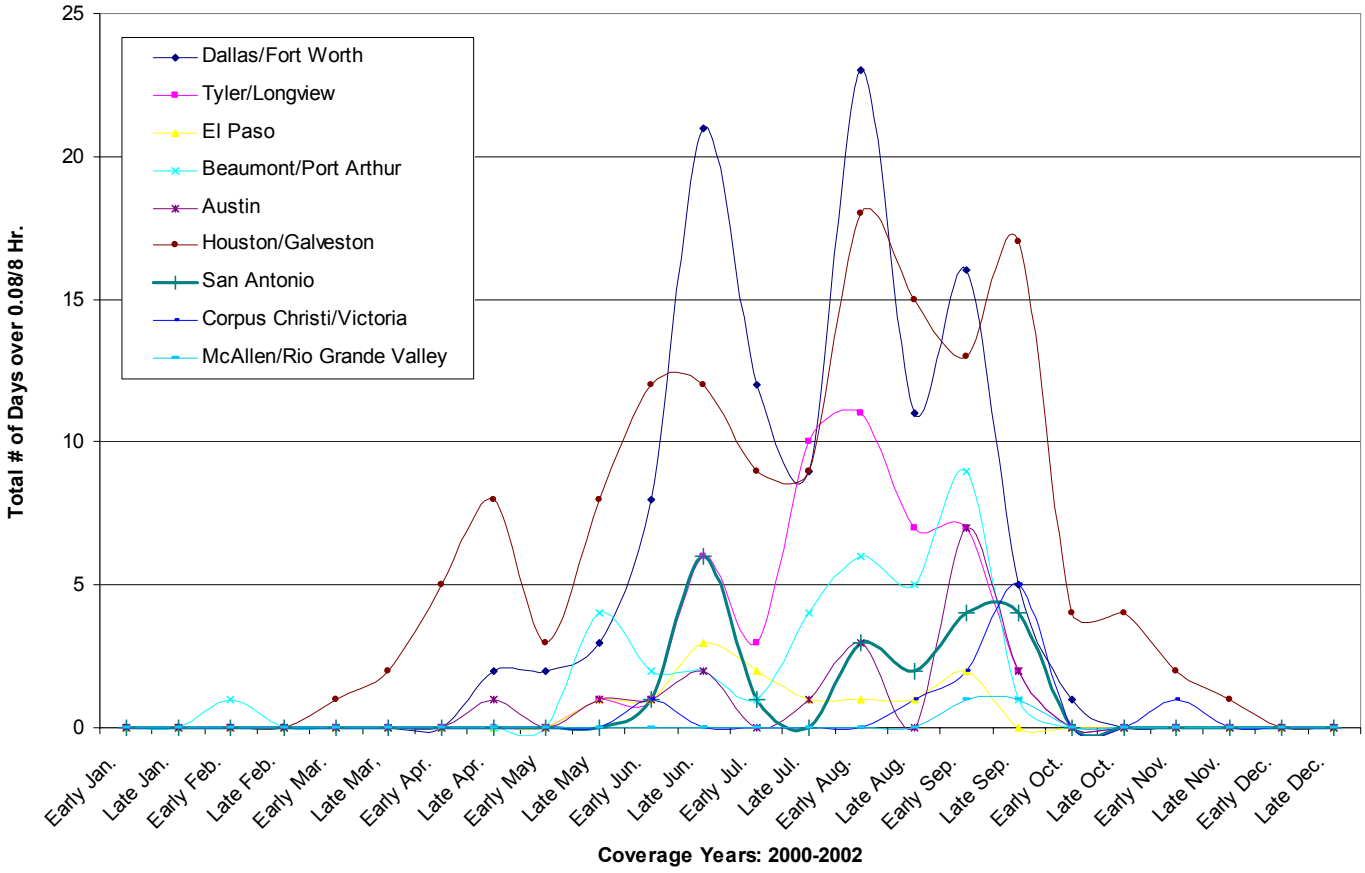
While few conclusions can be drawn regarding annual trends in ozone data as demonstrated above, aggregated annual data may be more useful. The previous graph (figure 4-4) shows ozone exceedance counts by two-week bin for San Antonio. The following graph (figure 4-5) provided by TCEQ compares high ozone measurements, by two-week period, for the combined years of 2000-2002. The curve for the SAER is similar to several other Texas urban areas (also displayed) in which peak measurements are typically recorded in June, August, and September. These peaks indicate the influence of seasonal weather patterns on regional ozone concentrations, given that exceedance frequency occurs in patterns when averaged.

Figure 4-5. High Ozone Readings by Two-week Period for Major Texas Urban Areas. (Source: TCEQ).



4.3 ANALYSIS OF METEOROLOGICAL DATA

The TCEQ conducts periodic studies to determine air quality/meteorological conditions, both at the surface and aloft, throughout Texas. Several of these studies have involved the use of aircraft for collecting air samples. For example, the Baylor University Aviation Sciences Department, under contract with the TCEQ, has been collecting airborne air quality data in Texas for several years. Sonoma Technology, Inc. analyzed air quality data collected by the Baylor Airborne sampling program during the years 1997 and 1998 and concluded that, in the San Antonio region, elevated ozone levels were associated

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with high pressure systems, clear skies, light flow aloft, and peak mixing heights at approximately 1500 meters (MacDonald et al., 1999).

Additional meteorological analyses have been conducted by AACOG. Staff analyzed the relationship of regional ozone concentrations to several meteorological parameters: temperature, wind speed, and solar radiation. Results of these analyses are provided in figures 4-6 through 4-8.

The average daily peak temperature on ozone exceedance days (8-hour average ≥ 85 ppb) during the study period of 1998-2002 was 91.2^{o} F. As shown in figure 4-6, 95% of the exceedances occurred on days when peak daily temperatures were greater than 84° F. Although 8-hour ozone exceedances in the SAER typically occur when peak temperatures are > 84° F., the figure also makes it clear that peak temperatures do not necessarily produce ozone exceedances. The majority of high temperature days are associated with ozone levels below the 85 ppb threshold. The temperature data indicate that other factors, or combinations of factors, are of greater influence on concentrations than temperature alone.

Analysis of 1997 – 2002 wind speed data indicate no exceedances occurred on days when wind speeds surpassed 6 mph. In addition, only 15% of the exceedance days occurred on days when wind speeds were between 5-6 mph. Therefore, stagnation is an important factor in ozone exceedances. Figure 4-7 also indicates that on the majority of days with little or no wind, there were no exceedances of the 85-ppb threshold.

Since ozone forms as the result of photochemical reactions between precursor emissions, the amount of solar radiation reaching the lower atmosphere is another meteorological condition that influences the chemical's formation. Figure 4-8 shows that below 1 langley/minute, there were only two days between 1999 and 2002 in which 8-hour ozone levels exceeded 85 ppb. Below 0.9 langleys/minute there were no exceedances. As with temperature and wind speed however, certain solar radiation levels may be conducive to, but by no means guarantee, ozone exceedances.

Local ozone exceedances are typically associated with certain meteorological conditions: high pressure systems and stagnation, high ambient temperatures, and low wind speeds. As demonstrated, these conditions do not always produce excessive ozone concentrations in SAER. Other factors also influence ozone buildup. Such conditions include background ozone concentrations and transport. These issues are discussed in more detail in the following section.

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Figure 4-6. Daily 8-hour Ozone Maxima Measured at CAMS 23 v. Peak Temperature, 1998 –2002

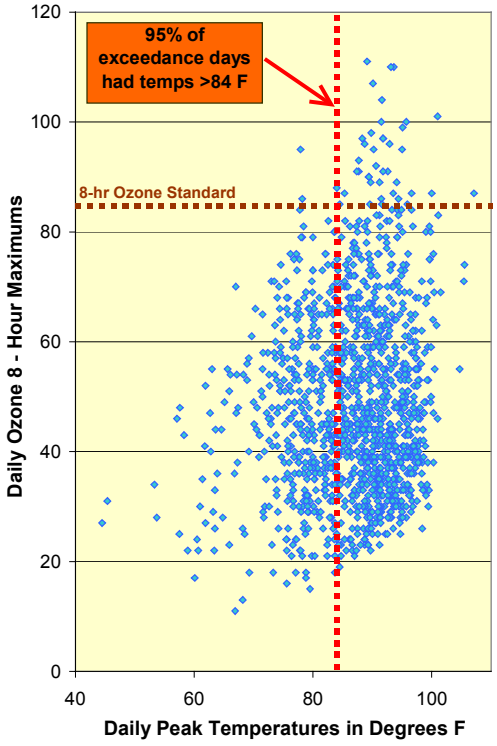


Figure 4-7. Daily 8-hour Ozone Maxima v. Average Wind Speeds, 1997 - 2002

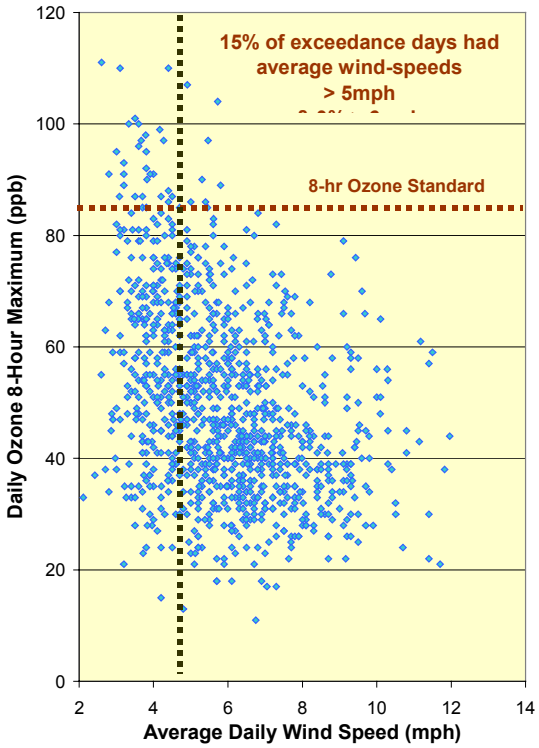
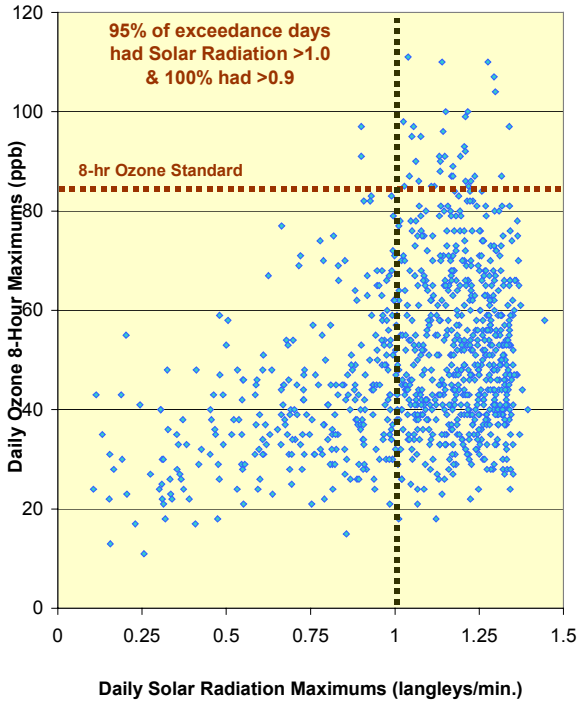


Figure 4-8. Comparison of Daily 8-hr Maxima & Daily Solar Radiation Maxima, 1999-2002



4.4 TRANSPORT AND LOCAL CONTRIBUTIONS TO OZONE CONCENTRATIONS

It is generally recognized that transport is a more significant issue under the 8-hour ozone standard than under the 1-hour standard. Since transport is a primary contributor to the local ozone problem, the SAER has less control over local ambient air quality.

As is shown extensively in Appendix M, photochemical modeling runs in which the entire anthropogenic emissions inventory for the four-county San Antonio region is removed lowers the peak ozone levels by less than 25% in the 1999 base case. This result intimates that transport and background ozone levels heavily influence the ozone levels recorded on area ozone monitors. Clearly, local governments in the San Antonio region have no jurisdiction over the background concentrations or the external sources giving rise to transport.

Based on the modeled results of implementing clean air measures locally, it is predicted that many strategies which significantly reduce ambient ozone concentrations in one-hour nonattainment areas would be considerably less effective in the SA region. (See Chapter 5 for results of modeled clean air strategies in the SAER). As a consequence, the San Antonio regional Early Action Compact signatories must rely on state and federal partners to ensure that the clean air strategies and controls they have proposed and promulgated are installed and effective.

In specific terms, the future case model assumes that the Houston SIP controls will be in place and effective by 2007, the attainment year for the San Antonio area. If the controls are not in place early enough, Houston's emissions will continue to affect San Antonio during 2005, 2006 and 2007, the three years that will be used to calculate the attainment year design value. Since attainment year modeling predicts that San Antonio will be below the 8-hour ozone standard by less than one part per billion, any weakening or delay in the implementation of Houston controls will affect San Antonio, as well as Austin and the rest of Central Texas.

Nevertheless, the San Antonio region is going beyond the attainment analysis requirements and is petitioning the state and federal partners to enact further local clean air strategies to control its own sources and lower ozone levels still further. These actions are consistent with the goals and letter of the Early Action Compact protocol.

Some of the transport determinations described in Appendix M are based strictly on modeling results for a specific time period; however, there is a variety of additional evidence that indicates SAER ozone levels are significantly impacted by transport. These include smoke and haze events tracked by the Navy Aerosol Analysis and Prediction System and other agencies' monitoring programs, as described in appendix M.

4.5 CONCLUSION

1-hour average ozone readings at or above 125 ppb are relatively rare, at five since 1995. One of these was disqualified for regulatory purposes as associated with the May 1998 Mexican smoke event. The eight-hour design value, from 1980 to 2003, has exceed the 8-hour average ozone standard seventeen times, yet this design value has only exceeded 88 ppb once (1982).

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These ozone average values, while relatively mild, are frequently at or above the 8-hour average ozone standard. Many of the factors conducive to ozone production, including daily temperatures above 95º F, low wind speeds, high solar radiation, and wind patterns conducive to transport (see Appendices A and M) are present in San Antonio during the ozone season.

In all, San Antonio is a region that has typical conditions for moderate to high ambient ozone levels. The trend indicated by the 1980-2003 design value is simply one of sustained levels as read on this graph. The data analysis contained throughout this document reinforces the predictability of these readings.

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CHAPTER 5: CLEAN AIR STRATEGIES

Table 5-1. SAER VOC Emission Reduction Estimates for an Average Weekday (Wednesday).

September 1999 Base Case Emissions Inventory	1999 Base Case (tpd)	Percent of 1999 Total	2007 Future Base	2007 Future Control Strategy (tpd)	Percent of 2007 Total
Area and Non-road sources	130	27%	115	109	26%
Point sources	7	1%	13	14	3%
On-road mobile sources	89	18%	51	52	11%
Biogenic sources	263	54%	263	263	60%
TOTALS	489	100%	442	437	100%

Table 5-2. SAER NOx Emission Reduction Estimates for an Average Weekday (Wednesday).

September 1999 Base Case Emissions Inventory	1999 Base Case (tpd)	Percent of 1999 Total	2007 Future Base	2007 Future Control Strategy (tpd)	Percent of 2007 Total
Area and Non-road sources	48	15%	47	47	21%
Point sources	101	32%	75	75	33%
On-road mobile sources	144	46%	82	82	37%
Biogenic sources	21	7%	21	21	9%
TOTALS	314	100%	225	225	100%

5.1 INTRODUCTION

The Clean Air Plan, which incorporates the Early Action Compact, was designed to develop and implement control strategies, account for growth, and achieve and maintain the 8-hour ozone standard. The EAC requires that clean air strategies, or methodologies for lowering ozone concentrations to acceptable levels, be developed to meet the region's clean air challenge. The technical analysis of the photochemical modeling used to demonstrate the effectiveness of the control strategies is performed by the staff of AACOG and has been reviewed and approved by the AIR Committee, the staff of AACOG, the TCEQ, and the EPA. (AACOG, 2002 pgs.3, 6)

Section d) of Chapter 4 in the Clean Air Plan for the San Antonio region lists the requirements for clean air strategies development once the base case and future case modeling is complete. The future and base case accounts for all Federal, State, and local controls that have been or will be adopted by 2007. The base and future case

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modeling has been developed based on AACOG's September 1999 photochemical model. Tables 5-1 and 5-2 detail VOC and NOx emissions that are inputs in the base case and future case. The tables also contain the emission reductions by the selected clean air measures.

The requirements for clean air strategy development and selection are listed below:

- After all adopted Federal and State controls that have been or will be implemented by the attainment date of December 31, 2007, are accounted for in the modeling, the area will identify additional local controls, as necessary, to demonstrate attainment of the 8-hour standard on or before December 31, 2007. These local controls will be specific, quantified, permanent, and enforceable control strategies. All controls will include specific implementation dates, as well as detailed documentation and reporting processes.
- Controls will be implemented as soon as practicable, but not later than December 31, 2005.
- Controls will be designed and implemented by the community with full stakeholder participation.
- All control measures will be incorporated by the state into the State Implementation Plan, which will be submitted to the EPA for review and approval. In the event that areas wish to add or substitute measures after SIP submittal, plan modifications will be treated as SIP revisions and facilitated by the state. (AACOG, 2002 pg. 18)

Following the guidance provided by the EAC assures that the selection of the Clean Air Strategies are EPA and TCEQ compliant. This chapter will detail the strategies implemented on the federal, state, and local level as well as the emission reductions and effects the strategies will have on regional ozone levels.

The AIR Committee recommended three Clean Air Strategies for inclusion in the Clean Air Plan to local Early Action Compact signatory governments for their final approval. The strategies were:

- Reid Vapor Pressure lowered to 7.2 pounds per square inch during the ozone season for the San Antonio region;
- Degreasing Equipment Operation Controls, described in TAC, Title 30, Ch. 115; and
- Stage I Vapor Recovery required of service stations of 25,000 gallons throughput of gasoline or more per month.

The eight local governments which are signatories to the Early Action Compact for the San Antonio region deliberated these strategies during regularly scheduled meetings of their representatives (i.e., during City Council meetings or during Commissioners' Court sessions). These meetings are open to the public and have meeting schedules published according to the Texas Open Meetings Act. All eight governments approved each of the three strategies specified above. Copies of their signed resolutions to this effect are attached to this Clean Air Plan document set.

The San Antonio EAC Region, acting through the AIR Committee, has incorporated these three strategies into the Clean Air Plan and requests that the Texas Commission on Environmental Quality take the necessary actions, including development of enforcement provisions, to implement these Clean Air Strategies. However, challenges to promulgation of these strategies have changed the amount and manner that credit can be taken for these strategies.

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5.1.1 Challenges to Local Clean Air Strategies

During the Clean Air Strategy ratification phase, TCEQ and EPA notified AACOG staff of possible "challenges" to several of the clean air strategies that were under consideration by the EAC signatory governments. The challenges concerned the Clean Air Strategies requesting seasonal RVP 7.2 gasoline as well as the strategy requiring Degreasing Equipment controls.

Understanding a brief history of these challenges is important since the credit for these two locally enacted Clean Air Strategies was originally envisioned as SIP creditable.

Challenges: RVP

Mayor Howard Peak of San Antonio requested a lower RVP level for all gasoline shipped into the San Antonio metropolitan region for the ozone season of 1999. His success brought seasonal 7.8 RVP gasoline to the area before that requirement became a regional law enacted by the state in the following year.[8]

Lowering RVP from 7.8 to 7.2 has consistently been considered a potential new Clean Air Strategy for the San Antonio region since that success. It has remained under review by the AIR Technical Committee during the Early Action Compact strategy refinement process. Consideration of lower RVP received special prominence after AACOG staff announced, in December 2003,[9] tentative agreement by EPA, AACOG and TCEQ technical staff that the 2007 design value for the San Antonio region was below 85 parts per billion. This was one of the results of a long process of review and verification regarding the performance of the September 13-10, 1999 photochemical model episode and its corresponding 2007 projection.

On the one hand, the determination that the 2007 design value for the region was below 85 ppb was a simple technical result that followed from the refinement of the photochemical model. On the other, the fact that the 2007 design value is below 85 ppb means, as a straightforward corollary, that no additional local controls (beyond all adopted Federal and State controls that have been or will be implemented by the attainment date of December 31, 2007) are required to model attainment.

Despite the fact that the model showed attainment in 2007 without recourse to enactment of further Clean Air Strategies, the AIR Committee continued to support lower RVP as a locally enacted Clean Air Strategy.

On January 27, 2004, AACOG received communication from EPA's Region 6 office regarding Section 211 of the Clean Air Act. At that time, it was not clear whether Section 211 would apply to a lower RVP request by a region acting under the Early Action Compact. This was the first notification to AACOG that there might perhaps be existing law affecting some conditions of the request by the San Antonio area for lower RVP.

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[8] The current Texas State Regional Low RVP Gasoline program began May 1, 2000. It requires that all gasoline sold in 95 central and eastern Texas counties, including the San Antonio EAC region, have a maximum RVP of 7.8 psi from June 1 through October 1 of each year. http://www.tnrcc.state.tx.us/air/ms/fuelprograms.html

[9] Modeled attainment in 2007 was first publicly announced during the December 15, 2003 meeting of the AIR Technical Committee. See the AIR Technical Committee meeting minutes of Dec. 15, 2003: <http://www.aacog.com/board/comm_agendas/12-15-03_AIR_TechMin_Approved.pdf>

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During a regularly scheduled meeting of the AIR Executive/Advisory Committees the following day, January 28, lower RVP received the formal endorsement by the committee as a strategy selected for ratification by the local EAC signatory governments. Prior to that endorsement, Cindy Morphew, Vice-President for Environmental Affairs with the Texas Oil & Gas Association (TxOGA) spoke before the AIR Executive/Advisory Committees during the same meeting.[10] In effect, the general TxOGA membership was not supportive of developing further new fuel blends in our area, according to Ms. Morphew.[11]

The eight local Early Action Compact signatory governments took up the formal endorsement of RVP as one of three Clean Air Strategies for their approval. The first government to consider this Clean Air Strategy set was the City of Seguin on February 3, 2004. The final government to consider them was Guadalupe Commissioners' Court on February 24, 2004. All eight local governments approved resolutions requesting the three strategies during that February 3 - 24 period.

On February 13, 2004, TCEQ provided AACOG some clarification[12] regarding the circumstances allowing such a measure to be implemented in the local EAC SIP. According to EPA and TCEQ preliminary investigations, Section 211(c)(4)(A) of the federal CAA prohibits state and federal governments from enforcing RVP as it was being requested. Such a measure can only be implemented in an EAC SIP if there are special circumstances. Detailed descriptions regarding Section 211 and its effect on the promulgation of lower RVP rules are provided in Appendix K. On February 17, 2004, an EPA Working Group confirmed their earlier interpretation of this provision, supporting TCEQ's opinion.

Resolution of Challenges: RVP

- Given the formal approval of the EAC signatory governments, the San Antonio EAC region is committed to requesting that the state implement a 4-county EAC regional rule requiring gasoline stations to dispense gasoline with an RVP 7.2 during the months of March to October.
- Given also the apparent enforcement prohibitions described above, the emissions reduction credits which would be expected through such a rule are not being placed in the SIP-creditable section of this document, nor in the Attainment Demonstration model.
- Specifically, the credits which would be available due to seasonal 7.2 RVP and the technical details of such credit estimation methodology are relegated to Appendix K, which is the Analysis of Additional Evidence appendix of this document set. The credits are also listed in the Additional Evidence section of this chapter (Chapter 5.5).
- If a resolution is reached such that lower RVP is supplied to the San Antonio region as approved by local governments on a permanent, enforceable basis, appropriate SIP credit will be taken for the measure as a successful local Clean Air Strategy.

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[10] Email from Ms. Morphew on this subject and voicing the same opinion, received by AACOG on January 12, was circulated to the AIR Technical Committee on January 18th.
[11] The Austin region has also asked their elected officials to support a reduced RVP strategy as well. They asked for an ozone season RVP level of 7.0 pounds per square inch, a lower level than requested in the San Antonio area.
[12] Email from Candy Garrett, dated February 13, 2004 to Peter Bella of AACOG. Ms. Garrett is Director, Environmental Planning and Implementation for TCEQ.

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5.1.2 Challenges: Degreasing Equipment Controls

On October 14, 2003, Eastern Research Group (ERG) completed a technical memorandum under a consultant contract with the Capital Area Planning Council (CAPCO)[13]. In their memorandum, ERG identified Degreasing/Solvent Surface Cleaning as a strategy for the Austin region. They noted[14] as a potential control option that the region could "establish an equipment based VOC standard, such as the one in effect in the Beaumont/Port Arthur, Dallas/Fort Worth, El Paso, and Houston/Galveston areas of Texas."

Since that time, both Austin[15] and San Antonio proposed the Chapter 115[16] (Texas Administrative Code, or TAC) application of the Degreasing Equipment Control Standard noted as a candidate Clean Air Strategy. Both regions estimated reductions based on the methodologies noted in the memorandum. Degreasing Equipment controls, as prescribed in Chapter 115, were projected to provide VOC emission reductions of 12.83 tons per day in the San Antonio region. This reduction total assumes no existing state degreasing controls of this type. This reduction total was presented to the elected officials and technical staff as the reductions available through local enactment of a Chapter 115 Degreasing Controls rule as identified in the ERG report.

The eight local Early Action Compact signatory governments took up the formal endorsement of Degreasing Controls as one of three Clean Air Strategies for their approval. The first government to consider this Clean Air Strategy set was the City of Seguin on February 3, 2004. The final government to consider them was Guadalupe Commissioners' Court on February 24, 2004. All eight local governments approved resolutions requesting the three strategies during that February 3 - 24 period.

In early February 2004, TCEQ staff from the Region 13 office informed AACOG staff that Chapter 106 of the TAC contained a requirement to implement Chapter 115-compliant degreasing controls statewide. Subsequent investigations revealed that subchapter T of Chapter 106 requires Permit By Rule degreasing units, regardless of the county in which they are located, to meet the requirements of §115.412 and §115.415. Following the realization that much of the credit previously calculated for degreasing controls as a voluntary Clean Air Strategy might no longer be available due to Chapter 106, AACOG staff proceeded to analyze Chapter 106 and Chapter 115 and assess how emission reductions should be properly determined and allocated.

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[13] CAPCO is the council of governments for the Austin region and is responsible for the technical planning for that area's Early Action Compact, much as AACOG is responsible for the technical planning in the San Antonio region.

[14] ERG Technical Memorandum dated October 14, 2003, to CAPCO. Subject: Area Source VOC Control Options.

[15] The Austin region's Clean Air Action Plan was written to fulfill their requirements under their Early Action Compact. The Degreasing Control strategy proposed in their Clean Air Action Plan is available online. Visit page 38 of <http://www.cleanairforce.org/Draft CAAP 1-04.pdf>.

[16] The Degreasing Processes strategy in the TAC advised by the AIR Committee is available through http://www.tnrcc.state.tx.us/oprd/rules/index.html. Click on the "30 TAC Administrative Code in HTML Format" hotlink on that page and then click on the following series of hotlinks: Title 30; Part I; Chapter 115; Subchapter E (Solvent-Using Processes); Division I (Degreasing Processes).

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The Chapter 115 degreaser requirements have been in place since early in the 1980's for certain other regions of the state. Permit by rule (PBR) stipulations in Chapter 106 (§106.454) require compliance with the Chapter 115 degreaser requirements, regardless of location. Such compliance with Chapter 115 through 106 regardless of location has only been in place since May 1994.[17]

Hence, the initial 2007 degreasing emission reductions estimated through local Chapter 115 promulgation, which assumed that no such state rule was in place, were clearly overestimated. On the other hand, since promulgation of Chapter 106 predates 1999, then both the 1999 and 2007 "uncontrolled" degreasing emissions inventories, which heretofore had also assumed no effective degreasing controls of this type, were also likely to be too large.

Note that Chapters 106/115 as existing state rules guarantee that reduction credits are available, not as voluntary credits available to the region as Local Clean Air Strategy enactment, but in both the 1999 and 2007 base case as is true for other existing state and federal rules.

Reductions in degreasing emissions due to both local implementation of Chapter 115 in the Clean Air Plan and due to Chapter 106 are described in two categories.

1. Reductions in emissions based on the growth of degreasing emission between 1999 and 2007, and
2. Reductions in degreasing emissions in the 1999 (and hence, in the 2007) base case.

As reported in Appendix F, area source emission projections were generally calculated for 2007 using the Economic Growth Analysis System (E-GAS) model. The EGAS model supplied growth factors for projecting of all area source emissions[18]. Thus growth in degreasing emissions to 2007 was calculated based on the 1999 emissions inventory for this category.

Because Chapter 106 was in effect from 1999 to 2007, the *growth* in degreasing emissions during that period was in fact limited by the same factor as promulgation of the effective rule limited *emissions* in the degreasing operations themselves. That is, reduction credits due to the effective state rule can be taken on earlier calculations for growth in the degreasing emissions category from 1999-2007. This is both a first approximation correction to the 2007 base case degreasing emissions inventory and a source of modeling credit identified under applicable state and federal rules. As mentioned earlier, these reductions are not categorized as voluntary credits available to the region as Local Clean Air Strategy enactment.

Correcting the 1999 EI to account for the promulgation of Chapter 106, which was effective in 1994 and hence prior to 1999, is challenging. The 1999 EI should be corrected to account for the effects of Chapter 106, just as the 1999-2007 growth has been corrected. The preferred approach in taking credit for Chapter 106/115 emission reductions for 1999 involves using available information and data regarding compliance to the rules in 1999. Information regarding Safety-Kleen, a Texas based company which provides various environmental services throughout the nation, was utilized in this approach.

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[17] Email from Eddie Mack, TCEQ, February 13, 2004.
[18] With the exception of Architectural Surface Coatings and Consumer/Commercial Solvents

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Documentation provided by TCEQ shows that Safety-Kleen 1) provides degreasing equipment and solvents for approximately 50% of the San Antonio market; 2) Safety-Kleen products are Chapter 115 compliant; 3) Safety-Kleen provided these products to their customers in the San Antonio region consistent with the promulgation of Chapter 106. Hence, the 85% reduction effective through Chapter 106/115 should act as a first approximation correction to 50% of the degreasing emissions in the 1999 EI. Since these emission reductions are tentative, they are not reflected in the 1999 base case, but are treated as potential credit and are documented in Appendix K, Additional Evidence.

Resolution of Challenges: Degreasing Equipment Controls

- Given the formal approval of the EAC signatory governments, the San Antonio EAC region is committed to requesting that the state implement a 4-county EAC regional rule requiring compliance with Degreasing Equipment Operation Controls, described in TAC, Title 30, Ch. 115.
- Given Chapter 106, reductions in earlier estimates of the growth of degreasing emissions between 1999 and 2007 have been approximated and are treated uniquely as creditable reductions achieved through current State rule. These credits are listed in this chapter in the Federal and State reductions strategies section (Chapter 5.2), and treated in greater depth in Appendix I, Federal and State reductions.
- Reductions in the 1999 (and 2007) base case degreasing emissions inventories have been calculated based on Safety-Kleen's participation in the regional market. These reductions are treated as tentative and unconfirmed. An overview of these reductions is given in this chapter in the Additional Evidence section (Chapter 5.5). These reductions are discussed in greater depth in Appendix K, Additional Evidence.
- Chapter 106 of the TAC was adopted in 1994, thus applying to degreasing facilities that were constructed or scheduled to be constructed on and after 1994. This potentially leaves degreasing facilities that were in existence prior to 1994 exempt from Chapter 106. Such uncontrolled facilities would be subject to Chapter 115 due to the passage of the rule requested by local governments. In this case, enactment of Chapter 115 as a local Clean Air Strategy would be a source of additional emission reductions. This potential reduction source is discussed in Appendix K.

5.1.3 Conclusion

The San Antonio EAC Region has committed to pursue three Clean Air Strategies requested by the local governments. The EAC signatory governments passed resolutions requesting the clean air measures in table 5.4 be implemented in the SAER. These commitments involve requesting lower RVP gasoline implementation, Stage I Vapor recovery systems, and Degreasing Equipment Controls. Details regarding emission reductions due to gasoline having an RVP of 7.2 can be found in Appendix K, Additional Evidence. Stage I Vapor Recovery for retailers that dispense no less than 25,000 gallons per month is SIP creditable and is discussed in Appendix I. Degreasing controls, through consideration of Chapter 106 and Chapter 115, have various degrees of creditability. Emission reductions achieved by Chapter 106 on growth in degreasing emission between 1999 and 2007 are accounted for as emission reductions due to state rule and discussed in Appendix I. Reductions in the 1999 base case due to Chapter 106 are treated as additional evidence and discussed in Appendix K. Additional reductions to

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degreasing units that were in existence prior to 1999, possibly achieved through local implementation of Chapter 115, are described in Appendix K.

5.2 FEDERAL AND STATE REDUCTION STRATEGIES

Various state and federal strategies are scheduled to be promulgated and enforced by the TCEQ and EPA by 2007. These strategies will provide emission reductions in the SAER in future years. Detailed descriptions of the federal and state reduction strategies can be found in Appendix I - Clean Air Strategy Development. The reduction estimations listed in the table below are calculated for the four county Early Action Compact region of Bexar, Comal, Guadalupe and Wilson Counties.

Table 5-3. State and Federal Issued Rules

FEDERAL ISSUED RULES	Estimated NOx Reductions in 2007 (tpd)	Estimated VOC Reductions in 2007 (tpd)
Federal area measures: On-board Refueling Vapor Recovery	0.00	8.20
Federal on-road measures: Federal Phase II Reformulated Gasoline National Low Emission Vehicle (NLEV) Program Tier II Vehicle Emission Standards Federal Regulation of On-road Diesel Engines	22.39	12.43
Federal non road measures: Standards for Compression-ignition Vehicles and Equipment Standards for Spark-ignition Off-road Vehicles and Equipment Tier III Heavy Diesel Equipment Lawn and Garden Equipment Recreational Marine Standards Locomotives	1.10	10.97
STATE ISSUED RULES	Estimated NOx Reductions in 2007 (tpd)	Estimated VOC Reductions in 2007 (tpd)
State area measures: Stage I Vapor Recovery (throughput ≥ 125,000 gal / month)[19] TAC Chapter 106 Degreasing Controls	0.00	7.61
State point measures: Senate Bill 766 – Grandfathered Power Plants Senate Bill 7 – Grandfathered Power Plants	39.51	1.06

[19] Gasoline stations that dispense more than 125,000 gallons per month are subject to stage I vapor recovery requirements: TAC Chapter 115.227. Available online: http://www.tnrcc.state.tx.us/oprd/rules/pdflib/115c.pdf

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5.3 LOCAL CLEAN AIR STRATEGIES

Signatories of the Clean Air Plan for the San Antonio region are committed to early planning and early actions that will benefit the region's air quality. These actions were accomplished through cooperative relations between the representatives of the affected region, state and federal officials in assessing the region's air quality situation and in developing the best available approach to reach and maintain the 8-hour ozone NAAQS. Since the EAC was created to enable early local actions, it is pertinent to implement strategies locally that will improve air quality most effectively.

Lower Reid Vapor Pressure (RVP)

- Reid Vapor Pressure lowered to 7.2 pounds per square inch during the ozone season for the San Antonio region.

The requested rule, as approved by the AIR Committee and all Early Action Compact signatory governments, would lower the ozone seasonal RVP to 7.2.

Stage I Vapor Recovery at Stations Dispensing > 25,000 gallons/month

- Stage I Vapor Recovery required of service stations of 25,000 gallons throughput of gasoline or more per month.

Stage I Vapor Recovery systems are designed to control the escape of gasoline vapors from gasoline storage tanks. The uncontrolled vapors escape from storage tanks when displaced by liquid gasoline unloaded from refueling trucks. With installation of Stage I equipment, the storage tank vapors are captured by a vapor return hose and are returned to the refueling truck. Texas currently enforces the requirement of Stage I Vapor Recovery systems at gasoline stations that dispense no less than 125,000 gallons of gasoline per month. This strategy proposes Stage I Vapor Recovery systems at gasoline stations that dispense no less than 25,000 gallons per month.

- ➢ Stage I Vapor Recovery for service stations of 25,000 gallons throughput of gasoline or more per month will be implemented and operational no later than December 31, 2005. Implementation of this control strategy comes as a formal request of the eight local governments who are signatories to the Early Action Compact. Their support for Stage I Vapor Recovery as a local clean air strategy, and their approval of this proposed local State Implementation Plan Revision, are attached as appendix N.

Reduction Calculations Methodology Overview

Evaluation of this strategy involved quantification of emission reductions resulting from potential strategy implementation. The estimated 2007 VOC tonnage from Source Classification Code 2501060053 (Tanker Truck Unloading) was multiplied by an emission factor provided by TCEQ. (TCEQ, 2004c) Further details regarding emission reduction calculations can be found in Appendix I.

Degreasing

- Degreasing Equipment Operation Controls, described in TAC, Title 30, Ch. 115.

The requested rule, as approved by the AIR Committee and all Early Action Compact signatory governments, would lower VOC emissions on degreasing operations.

The following table lists the strategies were formally approved for implementation by the EAC signatory governments along with their estimated emission reduction when implemented in the SAER.

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Table 5-4. Locally Issued Rules

Local Clean Air Strategies	Estimated NOx Reductions in 2007 (tpd)	Estimated VOC Reductions in 2007 (tpd)
Reid Vapor Pressure (RVP) lowered from 7.8 to 7.2 psi	*	*
Stage I Vapor Recovery for gas stations dispensing 25,000 to 125,000 gallons/month	0.00 tpd	5.81 tpd
Degreasing Controls	See State Rules; thru Ch. 106	See State Rules; thru Ch. 106
	*	*

* Potential Emissions Reductions are listed in Additional Evidence, Appendix K

5.4 STRATEGY TESTING

Various emission reducing strategies were scrutinized and analyzed for their effectiveness in reducing ozone precursors as well as reducing ambient ozone levels in the photochemical model. Local entities that were involved in the strategy selection were provided numerous control strategies that would have an effect on the ambient air quality. AACOG technical staff presented a preliminary list that detailed over 100 clean air strategies. The strategies on the list were then analyzed based on criteria that would be acceptable to the TCEQ and EPA. The criteria consisted of emission reducing strategies that were quantifiable (emissions can be quantified from such a strategy), enforceable (local or state jurisdiction can be applied to enforce the strategy), and permanent. Once the strategies that did not meet the criteria had been eliminated, the potential clean air strategies were analyzed based on feasibility, cost effectiveness, and emission reducing capacity. The strategies that met these criteria were then incorporated into the photochemical model so that their effect on ambient ozone levels could be observed. The strategies listed in Table 5-4 were selected as local initiatives that will assist the SAER reach 8-hour attainment standards. Table 5-5 lists the design values for the CAMs stations in the SAER. Table 5-6 depicts the emission reductions the selected strategies are projected to provide by 2007.

Table 5-5. Comparison of 1999 and 2007 Base Cases & Adopted Control Strategies

Model Run	Design Value at CAMS 23	Design Value at CAMS 58	Design Value at CAMS 59	Design Value at CAMS 678
1999 Base Case	89	87	79	77
2007 Base case	84.52	82.12	74.48	74.46
Control Strategies Included	84.40	82.03	74.44	74.39

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Table 5-6. Projected Ozone Reductions by Local Reduction Strategies

Strategy	Reduction in Ground-Level Ozone (ppb)	Implementing Entity
Degreasing Solvent	*	State
Stage I VR (25K)	0.12	State
RVP 7.2	*	Fuel distribution through local agreement

- Potential Emissions Reductions are listed in Additional Evidence, Appendix K

5.5 ADDITIONAL EVIDENCE

This section describes additional analyses performed, key assumptions and outcomes of each analysis, and justifies the conclusion that, viewed as a whole, the area will attain the NAAQS. In the following pages we introduce further local projects as well as additional studies and indicators supporting the likelihood of the results of our photochemical modeling in regard to the attainment of NAAQS ozone level by the year 2007. For some of the strategies presented in this chapter, additional comments and calculations are available beyond those given here. These comments and calculations are given in Appendix K – Additional Evidence.

5.5.1 Evidence Supporting Attainment Demonstration

The argument presented here consists of several corroboratory analyses, which together form a compelling argument that by the year 2007 attainment will be achieved. Table 5.6 shows the 1999 base case, the 2007 base case, and the impacts of adopted control strategies on design values for CAMS 23, 59, 678, and 58 where ozone levels are being recorded.

5.5.2 Degreasing Emissions

As described in section *5.1.1 Resolution of Challenges: Degreasing Equipment Controls*, degreasers in the SAER are subject to adherence of Chapter 115 controls through reference in Chapter 106. Chapter 106 of the TAC was adopted in 1994, thus applying to degreasing facilities that were constructed or scheduled to be constructed on and after 1994. This leaves degreasing facilities that were in existence prior to 1994 exempt from Chapter 106 rule. These uncontrolled facilities would be subjected to the regulations of Chapter 115 due to the passage of the rule by local governments, therefore be a source of additional emission reductions. Additional details regarding the emission reductions can be found in Appendix K.

Reduction Calculations Methodology Overview

TAC Chapter 115 addresses controlling emissions from degreasing facilities and providing a reduction in emissions by 85%. Documentation provided by TCEQ shows that Safety-Kleen 1) provides degreasing equipment and solvents for approximately 50% of the San Antonio market; 2) Safety-Kleen products are Chapter 115 compliant; 3) Safety-Kleen provided these products to their customers in the San Antonio region consistent with the promulgation of Chapter 106. Hence, the 85% reduction effective through Chapter 106/115 should act as a first approximation correction to 50% of the degreasing emissions in the 1999 EI. Projecting degreasing emission reductions for 2007 was calculated as follows:

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1999 Degreasing Emissions Inventory x 0.85 emission factor x 0.5 market share = Emission Reduction

Further details regarding emission reduction calculations can be found in Appendix I.

5.5.3 Pollution Transport

The evidence for transport can be demonstrated by conducting a series of special modeling runs in which all of the anthropogenic emissions from selected adjacent metropolitan areas are removed from the CAMx emission inventory for the modeled episode. Using the graphic capabilities of the CAMx model and applying some post processing techniques, attempts have been made to depict the results of this analysis at regional level, as well as at various CAMS in San Antonio area. These results, which are discussed in the Appendix M, specifically show the impacts of removing the anthropogenic emissions on the design value of the modeled episode at various CAMS.

The highest 8-hour ozone concentrations near this monitor, for each day of the 6 modeling days in the episode, were dependent on local (i.e., within Bexar, Comal, Guadalupe or Wilson Counties) ozone precursor production sources, on average, for less than 25% of the total ozone concentrations predicted. In addition, while the amount of emissions attributed to the San Antonio region is predicted to increase in 2007, this region's contribution to its design value for the Sept. 1999 episode will remain as 25% of the total design value, or 21.86 parts per billion of ozone. (AACOG, 2003a) Additional details regarding the effect of transport on San Antonio's air quality can be located in Appendix M.

5.5.4 Alternative Fuel Vehicles

A local alternative fuel survey was conducted in 2001, which inventoried the AFV fleet in the SA MSA. The survey provided information on the number of AFVs, specific fuel type, the percentage of time that they operate on alternative fuel, the number of days per week they typically operate, and an estimate on how many vehicle miles traveled (VMT) were accumulated by each vehicle for 2001.

The results indicated that there were 2,050 AFVs in the San Antonio region, and this number is expected to increase to 2,442 AFVs by 2006. Of the reported fleet, 1,755 vehicles were modeled as the September 2001 fleet and 2,147 vehicles modeled for the September 2007 fleet. Analysis of fleet indicated that this fleet is generated emission reductions of 62 lbs./day of VOC, 45 lbs./day of CO, and 689 lbs./day of NOx. By 2007, it is projected that this fleet could contribute emissions reductions of 72 lbs./day of VOCs, 45 lbs./day of CO, and 858 lbs./day of NOx for the year 2007.

5.5.5 Energy Efficiency / Renewable Energy Projects

The TCEQ revised the Houston-Galveston (HGA) SIP and the Dallas/Ft. Worth (DFW) SIP to include a protocol for implementing and calculating emission reductions from energy saving resulting from Senate Bill 5 (SB5) and Senate Bill 7 (SB7) measures. The revisions relied on assumptions about the level of commitment by political subdivisions to implement the 5% per year reduction within their facilities. SB5 only requires that a target of 5% reduction in energy usage per year be set, it remains the responsibility of each individual political subdivision to adopt ordinances, resolutions, procedures or plans to demonstrate its commitment. Since passing the bills, efforts have been underway both to implement the energy reductions required by the state and to quantify

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the associated ozone precursor reductions. Air quality planners in the San Antonio region currently benefit from a partnership created by the TCEQ between AACOG, the Energy Systems Laboratory (ESL) of Texas A&M University, the local Metropolitan Partnership for Energy, and the Brooks Energy Sustainability Laboratory (BESL) of the Texas Engineering Experiment Station.

5.5.6 Lawnmower Recycling Program

Gasoline-powered lawnmowers contribute a significant amount of NOx, VOCs, and particulate matter to the atmosphere. Not surprisingly, carbon dioxide (CO2) emissions, the major greenhouse gas, are spewed out in large quantities from gas-powered mowers too.

In San Antonio, City Public Service (CPS) initiated the "buy back" program in 1998. The City of San Antonio and the Alamo Area Council of Governments later partnered in promoting CPS' "buy back" events. Their first trade-in event was held on March 31, 2001 and is scheduled to start in 2004 on March 20 continuing through August 31. (CPS, 2004)

Since its inception, CPS's "Mow Down Smog" lawn mower rebate program has removed over 3,200 pieces of operating gasoline-powered lawn equipment and replaced them with virtually pollution-free electric lawn equipment. The emissions reductions attributed to this program have not been taken into account in the process of photochemical modeling task for the attainment forecast. The reductions for all VOC, CO, and NOx categories have been calculated for Bexar County and the procedure for calculation of these reductions is presented in the Appendix K of this document. The followings show the amount of these reductions.

Table 5-7. Reduced Emissions from "Mow Down Smog" Recycling Program

2003 Emission Reduction due to City Public Service "Mow Down Smog" Program *pound per ozone season day**						
Emission	Exhuast	Crank	Diurnal	Displ.	Spillage	Total
VOC	90.62	3.60	5.84	1.50	12.70	114.24
NOx	4.78					4.78
CO	1145.39					1145.39

**Ozone season in 1999 EI report consists 196 days*

5.5.7 Lower Reid Vapor Pressure

Fuel control measures are effective strategies for states to use to reduce ozone pollution. Such measures reduce volatile organic compounds but may differ on methods the state or federal government administers them, and the statutory provisions governing their adoption. Gasoline with an RVP of 7.2 was proposed for the San Antonio region after in depth modeling, cost-benefit analysis, and consideration of sentiments of the local communities and their elected officials. If allowed, adoption of this fuel during the ozone season is expected to help reduce emissions of VOCs and NOx by 2.1 and 0.05

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tons/day respectively. The requirement for gasoline refineries to provide such gasoline will only be during the months of March through October, which is usually the time of the year ozone levels exceed the national standard in San Antonio region.

Modeling scenarios with the MOBILE6 model[20] indicated that lowering the RVP in gasoline to 7.2 from 7.8 would reduce emissions from the on-road mobile fleet in the SAER counties. Table 5-_ lists the emission reduction percentages for each of the SAER counties. (AACOG, 2003b)

Table 5-8. Reductions for SAER Counties with RVP 7.2 Gasoline, Compared with RVP 7.8.

County	VOC % Reduction, 2007 On-Road Mobile Fleet	NOx % Reduction, 2007 On-Road Mobile Fleet
Bexar County	4.18	0.06
Comal County	3.73	0.05
Guadalupe County	3.69	0.05
Wilson County	3.14	0.06

The percentage reduction of precursor emissions was used to calculate actual reductions. The actual reduction was estimated by multiplying the 2007 daily on road emissions total for each county with the emission reduction percentage. The resulting number was then divided by 100 to provide the emission reduction total in tons per day.

(2007 tons/day VOC x emission reduction %) / 100 = 2007 tons/day of VOC reduced)
Further details regarding emission reduction calculations can be found in Appendix I.

5.5.8 Windshield Wiper Fluid

In 1998, the EPA promulgated rules pertaining to the VOC emission standards for certain consumer solvents. One solvent, windshield wiper fluid, is limited 35 weight-% VOC. EPA calculated VOC reductions from this national consumer products rule to be 20% and allowed states to take this emission reduction credit in their SIPs. Prior to EPA's issuance of its national rule, Texas adopted a consumer products rule that limits automotive windshield washer fluid to 23.5 weight-% VOC. Due to the difference between EPA's 35% requirement, the EPA allows Texas to take credit for the difference

Due to this limited reduction and that the photochemical model shows attainment in the 2007 base case, this reduction credit has not been fully estimated and included in the photochemical model since a VMT-based estimate of VOCs allowed in the San Antonio region is 60 lbs-per-day for this category. (TCEQ, 1999)

5.5.9 Gas-fired Water Heaters, Small Boilers, and Process Heaters

This statewide rule would reduce NOx emissions from new natural gas-fired water heaters, small boilers, and process heaters sold and installed in Texas beginning in 2002. It is estimated that this rule would help reduce area source NOx emissions by 5%

[20] MOBILE6 Vehicle Emissions Modeling Software developed by the USEPA. Available online: http://www.epa.gov/otaq/m6.htm

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to 10%. The rules would apply to each new water heater, boiler, or process heater with a maximum rated capacity of up to 2.0 MMBtu/hr. (TCEQ, 2004)

5.5.10 Transportation Demand Management

Transportation Demand Management (TDM) projects are transportation-related projects that attempt to reduce vehicle use, change traffic flow, or reduce congestion conditions.. Due to a survey conducted by AACOG in 2002, results indicated that TDMs are or will be implemented by government agencies and companies in the San Antonio area. These TDMs included: rideshare, telecommuting, flex time, compressed workweek, and staggered hours. Study results revealed that during the weekday peak hours, TDMs could help reduce on-road source emissions of VOC's and NOx by 3.3% and 2.4% respectively for the year 2007. (AACOG, 2002) These reduction rates however, have not been included in the photochemical modeling efforts for the year 2007 attainment demonstration.

5.5.11 Transportation Emission Reduction Measures

Transportation Emission Reduction Measures (TERMs) are strategies or actions that can be employed to offset increases in nitrogen oxide (NOx) and volatile organic compound emissions from mobile sources by reducing either the number of vehicle trips, vehicle miles traveled, or both. These strategies may include ridesharing, telecommuting programs, clean fuel vehicle programs, improved transit/ bicycling facilities, or other possible actions such as intersection improvement and signalization.

It is important to note that many of projects included in the San Antonio-Bexar County Metropolitan Planning Organization (SA-BC MPO) Transportation Improvement Programs (TIP)[21] can be quantified as creditable reductions. They are listed n the Appendix K as TERM projects since the projects target vehicle trip reduction and improvement of air quality. AACOG photochemical modeling for the attainment demonstration does not take into account any emission reductions due to the implementation of these projects.

While the quantity of available and appropriate reductions have not been calculated and included in the attainment demonstration of the San Antonio proposed revisions to the State Implementation Plan, local air quality planners are now researching measures to make the appropriate TERMS enforceable. The region is intent on making them enforceable and calculating SIP credit for them in coordination with the state and the SA-BC MPO. Even if credit is not taken here for the TERMS projects in the region, the benefits of the reductions accrue as Additional Evidence that the San Antonio region will reach attainment.

Intersection Improvement and Signalization

Traffic signalization projects can reduce carbon monoxide (CO) and hydrocarbon (HC) by reducing the number of vehicular stops and idling, which would reduce travel times and traffic delays. Reductions in fuel consumption have also been observed through traffic signal re-timing. Traffic flow at intersections can be improved in interconnection and coordination of signals.

[21] Available online: http://www.co.bexar.tx.us/mpo/pages/futureprojects/short/main.html

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Of many projects shown in the MPO's TIP in Appendix K, certain traffic signals for various intersections in the Bexar County were separately evaluated for their impacts on air quality. (AACOG, 2003b) The results can be considered as additional evidence indicating future lower ozone levels for the San Antonio area.

5.5.12 TransGuide

ITS projects have shown to be a crucial ingredient of traffic management in metropolitan areas throughout the nation. Studies have proved that ITS have a significant impact on reducing the delays due to accidents and congestion on freeway systems in metropolitan areas. (Henk, R., et.al., 1996), (Carter, M., et.al., 2000) Results indicate that the most effective stand-alone implementation is incident management, recording improvements in all impact measures assessed. VMS and arterial traffic signal control can provide additional improvement under many of these areas. For the particular corridor modeled during this study, optimum implementation of the integrated VMS and incident management result in a 5.7% decrease in delay, a 2.8% decrease in crashes, and a 1.2% decrease in fuel consumption annually. Integrated use of incident management, VMS and arterial traffic control can achieve an annual benefit of a 5.9% reduction in delay, a 2.0% decrease in crashes, and a 1.4% decrease in fuel consumption for travelers in the corridor.

AACOG staff, neither in the photochemical modeling process nor in applications of MOBILE6 for the analysis of control strategies, has taken the air quality impacts of TransGuide into account. Techniques could be developed to translate reductions in fuel consumption, due to the impacts of TransGuide, into reductions of ozone precursor emissions.

5.5.13 Public Education

A detailed description of the public outreach and education projects undertaken by AACOG staff, for the purpose of disseminating information on air quality and informing the public of seriousness of air pollution problem in the San Antonio area, is presented in the Appendix K.

The main goal is to familiarize the public with actions they can take to improve the air quality. There has been no attempt to quantify the air quality impacts of these public outreach projects.

5.6 SUMMARY AND RECOMMENDATIONS

Clean air strategy selection required various technical analyses. These analyses provided by local air quality planners enabled elected officials to select applicable and effective clean air measures that would best improve the region's air quality. The number of strategies was reduced by elimination based on creditability. Creditable strategies are strategies that are quantifiable, enforceable, and permanent. Strategies that did not reflect these qualities were eliminated from the list. The remaining creditable strategies were then analyzed for emission reducing capacity and cost effectiveness.

The strategies that were then deemed cost effective and reduced emissions sufficiently were then subject to additional analysis by way of ozone reductions in the photochemical model.

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Since the attainment demonstration predicted 8-hour ozone levels below the NAAQS, it was deemed that the addition of three strategies would be enough to maintain attainment. These strategies are gasoline with an RVP of 7.2, stage I vapor recovery implementation on service stations that throughput at least 25,000 gallons, and degreasing controls on manufacturing equipment. The San Antonio Early Action Compact Region will comply with attainment standards by 2007 with the federal and state issued rules, the strategies selected by local officials, and the strategies presented in the additional evidence section.

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CHAPTER 6: MAINTENANCE FOR GROWTH

6.1 BACKGROUND

The general elements required for the development of the Maintenance for Growth were stated in the *Protocol for Early Action Compacts Designed to Achieve and Maintain the 8-Hour Ozone Standard*.[22] The protocol states that the Maintenance for Growth plan must address emissions growth at least 5 years beyond December 31, 2007 to ensure the area will remain in attainment of the 8-hour standard. The component may include modeling analyses, annual review of growth, or the identification and quantification of federal, state, and local control measures that indicate sufficient emission reduction. A continuing planning process that includes modeling updates and modeling assumption verification must also be included. The modeling must consider and evaluate relevant new point sources, impacts from potential new source growth, and future transportation patterns.

If the review of growth indicates that the adopted control measures are inadequate to address growth in emissions, additional measures will be added to the plan.

6.2 MAINTENANCE ANALYSIS

The Clean Air Plan for the SAER is directed to achieve the 8-hour standard by December 2007. Maintaining the 8-hour standard five years beyond the attainment date will be achieved through an annual review of growth as required in the EAC protocol.

The Maintenance for Growth analysis performed by AACOG has several stages or components.

- **Current Analysis**: The current Maintenance for Growth analysis is an updated and expanded Trend Analysis, first published September 30, 2003 as an EAC milestone. The Maintenance for Growth section (Appendix L) analyzes the emissions inventories from 1996 and 1999 and projects emissions to 2007 and 2012. These future year projections encompass all relevant changes affecting future emissions, including revised or new federal, state, and local rules and any new practices that would result in changes to future year emissions inventories. As a separate document, the Trend Analysis itself is updated once more, and is due as an updated milestone / deliverable in the EAC by September 30, 2005.
- **Continuing Planning Process**: The assumptions underlying this analysis will be reviewed annually throughout the term of the EAC (through 2007). Changes in assumptions will be incorporated annually into an updated Maintenance for Growth analysis and reported as a component of the Semi-Annual Updates. The current analysis reported in this document set (Appendix L) will next be updated and reported in the December 2004 Semi-Annual Update.
- **New Strategy Requirements**: In the event the annual analysis of emission trends and control strategies fails to maintain attainment standards, appropriate planning and implementation of additional clean air measures will result.

Current Analysis

As part of the initial analysis of the region's air quality, emission projections were developed. These projections provided insight to future air quality scenarios with increases in population and emission sources along with control strategies that will be implemented by state and federal agencies in the years to come. In summary, table 6-4 lists emissions from various anthropogenic sources for 1996, 1999, 2007, and 2012.

[22] Available online: http://www.epa.gov/ttn/naaqs/ozone/eac/20020619_eac_protocol.pdf

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Methodologies: 2012 projections
The 2012 emission projections were developed using the same methodologies in the development of 2007 emissions, which are described in Appendix F, Future Year Modeling Emissions Inventory Development. However, there are some components in the methodologies, such as emission factors, that were altered to reflect predicted changes for 2012 different from 2007. These alterations are described in Appendix L, Maintenance for Growth.

New Point Sources, 2007-2012
The following section describes new point sources that are expected to come into existence between 2007 to 2012. Detailed descriptions of the new point sources in methods used to determine their projected emissions can be found in Appendix L – Maintenance for Growth.

Guadalupe County Power Plants
Two natural gas powered electrical generating facilities are slated for completion and operation prior to 2007. Both facilities are under construction in Guadalupe County. Two facilities are currently being constructed, each facility is projected to emit 3.79 tons of NOx and 0.24 tons of VOC per day.

Tessman Road Landfill Gas Power Station
The proposed Tessman Road power station is located in Bexar County near Converse, TX. The station will feature six Deutz TBG 620 V16 engines, producing electricity from methane and other landfill gases. According to our calculation, this project will release 0.179 ton of NOx and 0.049 ton of VOC in the air on a daily basis.

City Public Service Power Plant
City Public Service is currently developing plans to build an additional coal burning power plant in our study area. City Public Service plans estimate that the plant will emit 5.92 tons of NOx in the air by 2012 when the plant is fully operational. Also, CPS plans to have a natural gas plant on-line by September 2012 and its projected NOx emissions are estimated at 0.72 tons per day.

Toyota Motor Manufacturer North America
Toyota Motor Manufacturer North America (TMMNA) is currently negotiating the building of an auto-production assembly plant in south Bexar County. Toyota provided emissions estimates of the anticipated pollutants produced by this plant at the start of production. Detailed emission data can be found in Appendix L. Table 6-1 lists total emissions projected to be emitted from plant production along with the other point source projected emissions. These figures do not include emissions produced during the building of this plant; they contain only those emitted during operation of the plant, after the building is completed. Plant construction will be completed prior to 2012.

New Point Source Emission Total
Table 6-1 displays the accumulative VOC and NOx emissions due to the introduction new point source related emissions to San Antonio region.

Table 6-1. Point Source VOC & NOx Emissions of New Point Source Projects (tons/weekday)

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Point Source	1999		2007		2012	
	VOC	NOx	VOC	NOx	VOC	NOx
Emissions without new sources	7.3	96.6	8.0	67.1	8.3	49.8
CPS - New Coal Plant	0.0	0.0	0.0	0.0	0.0	5.9
CPS – New Gas Plant	0.0	0.0	0.0	0.0	0.0	0.7
Guadalupe Power Plants	0.0	0.0	0.4	7.5	0.4	7.5
Toyota	0.0	0.0	5.0	0.3	10.0	0.7
Tessman Road Power Station	0.0	0.0	0.0	0.2	0.0	0.2
Total	7.3	96.6	13.5	75.1	18.7	64.9

The VOC emissions will increase due to the contribution of the Toyota Manufacturing Plant to the 2007 emissions projection as well as the 2012 emissions projection. The remaining new point source projects such as the CPS power plant, the Tessman LFG Power Station, and the Guadalupe Power Plant are not expected to contribute as significant amount of VOC emissions as the Toyota Manufacturing Plant. NOx emissions decrease in the 2007 and 2012 projections.

Comparison of 2007-2012 Emissions by Major Category

Point

VOC emissions from point source are estimated to increase approximately 38.5% (13.5 TPD→18.7 TPD) from 2007 to 2012. The rise is attributed to the emergence of new point sources within the region. NOx emissions are expected to decrease by 13.6% (75.1 TPD→64.9 TPD). The drop in NOx is anticipated due to use of improved emission reducing technologies employed at the City Public Service power production facilities.

Non Road

The 17.6% drop in VOC (30 TPD→24.7 TPD) and the 8.2% drop in NOx emissions (44 TPD→40.4 TPD) across the four counties between 2007 and 2012 for this source category are based on various state and federal control strategies, which are reflected in input files for the photochemical model. These files are described in Appendix F.

Area

From 2007 to 2012, area source VOC emissions are projected to increase 3.2% (80.5 TPD→83.1 TPD) and NOx emissions by 5.6% (9 TPD→9.5 TPD). This can be attributed to various growth assumptions, such as population growth.

On Road

On road VOCs decreased by 25.5% (53.8 TPD→40.1 TPD) and NOx emissions dropped by 40% (84 TPD→50.4 TPD) from 2007 to 2012. State and federal control strategies that will be implemented by 2007 are reasons for the decrease in both ozone precursors and can be found in Appendix C – On-Road Mobile Emissions Inventory Development.

Airport

Airport and military emission data were compiled by AACOG staff. These emissions cannot be projected due to the uncertainty of future of airport and military bases in the region. Political influence or unusual circumstances, such as wartime situation, may increase emissions levels. In times of peace or poor economy, the military may cut back, causing a decrease in emissions. Thus, emissions for this category remain the same for 1999, 2007, and 2012. Table 6-2 details the emissions from airport and military

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sources. These emissions are accounted for in the non-road source emissions listed in Table 6-4.

Table 6-2. Airport/Military Emissions for the San Antonio EAC Region

		1996		1999		2007		2012	
		VOC	NOx	VOC	NOx	VOC	NOx	VOC	NOx
Airport Sources	Bexar	2.7	6.8	3.0	9.9	3.0	9.9	3.0	9.9
	Comal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Guadalupe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wilson	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	2.7	6.8	3.0	9.9	3.0	9.9	3.0	9.9

Biogenic
Biogenic emissions emissions were unchanged from 1999 for 2007 and 2012. Table 6-3 lists the biogenic emissions for the SAER region. Biogenic emissions were not included in table 6-4.

Table 6-3. Biogenic Emissions for the San Antonio EAC Region

		1996		1999		2007		2012	
		VOC	NOx	VOC	NOx	VOC	NOx	VOC	NOx
Biogenic Sources	Bexar	60.1	5.0	60.1	5.0	60.1	5.0	60.1	5.0
	Comal	56.5	1.5	56.5	1.5	56.5	1.5	56.5	1.5
	Guadalupe	83.6	7.5	83.6	7.5	83.6	7.5	83.6	7.5
	Wilson	62.8	6.5	62.8	6.5	62.8	6.5	62.8	6.5
	Total	**263.0**	**20.6**	**263.0**	**20.6**	**263.0**	**20.6**	**263.0**	**20.6**

Figure 6-3 illustrates the predicted emission trend from 1996 to 2012. This illustration further supports the SAER's projected maintenance of attainment of the NAAQS 8-hour ozone standard. Between 1999 and 2007, an overall reduction of 28% of NOx emissions and a 23% reduction in VOC emissions are predicted. Between 2007 and 2012, an additional 22% reduction in NOx emissions and 7% reduction in VOC emissions can be expected. These reductions are a result of the positive actions enforced by the USEPA and TCEQ and indicate improved air quality is in the future of the San Antonio EAC region.

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Table 6-4. Anthropogenic Emissions within the San Antonio Early Action Compact Region

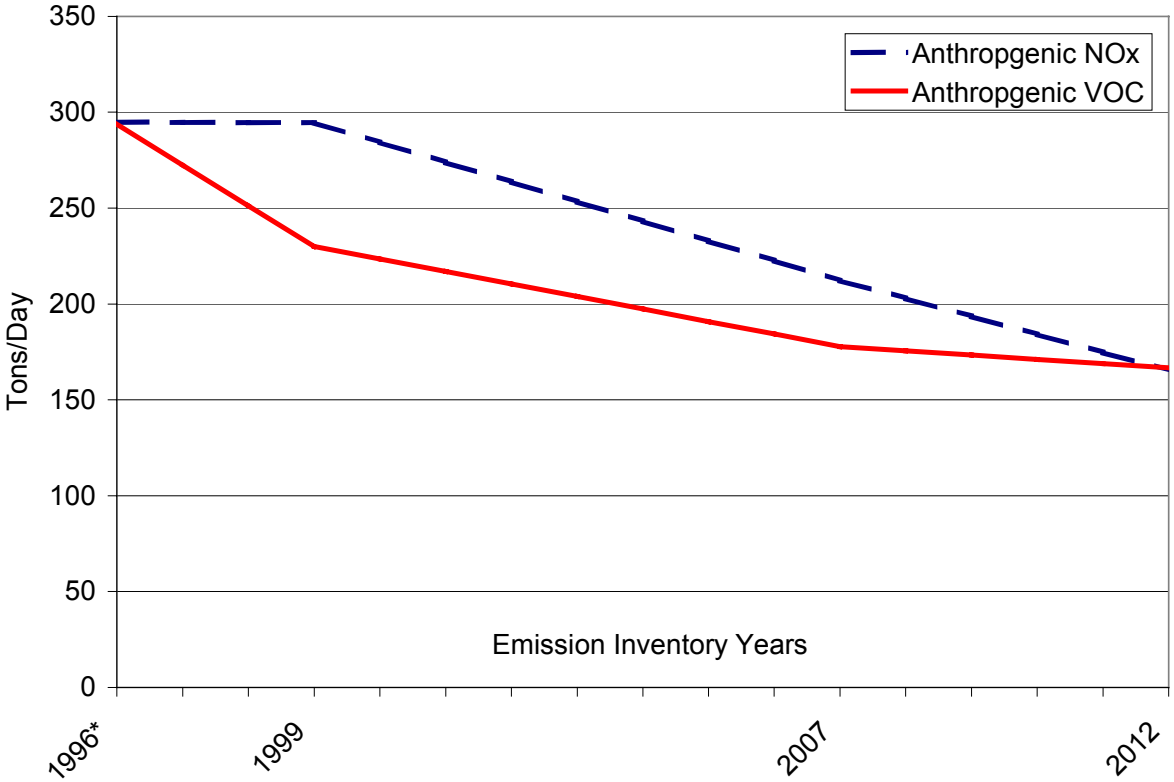
San Antonio Early Action Compact Region		Tons per Day Emission							
		1996		1999		2007		2012	
		VOC	NOx	VOC	NOx	VOC	NOx	VOC	NOx
Area Sources	Bexar	78.3	2.4	73.4	4.7	69.2	5.0	71.4	5.2
	Comal	4.4	0.1	3.7	0.3	3.4	0.5	3.6	0.5
	Guadalupe	6.1	0.3	5.4	0.9	5.2	1.7	5.4	1.8
	Wilson	2.6	0.4	2.7	0.9	2.7	1.8	2.7	2.0
	Total	91.4	3.3	85.2	6.8	80.5	9.0	83.1	9.5
Point Sources	Bexar	7.0	64.3	6.3	83.9	11.8	53.2	17.0	43.0
	Comal	0.4	8.2	0.5	12.2	0.5	13.8	0.5	13.8
	Guadalupe	0.4	0.3	0.5	0.5	1.1	8.1	1.1	8.1
	Wilson	0.0	0.0	0.01	0.004	0.1	0.004	0.1	0.004
	Total	7.8	72.8	7.3	96.6	13.5	75.1	18.7	64.9
On Road Sources	Bexar	106.6	122.39	82.1	121.87	45.5	69.1	33.7	41.4
	Comal	6.8	10.4	6.2	11.7	3.9	7.1	3	4.3
	Guadalupe	6.6	10	5.6	10.5	3.4	6.5	2.6	3.9
	Wilson	1.9	1.9	1.6	1.9	1	1.3	0.8	0.8
	Total	121.9	144.69	95.5	145.97	53.8	84	40.1	50.4
Non Road Sources	Bexar	54.3	55.2	36.3	36.4	25.6	36.3	21.0	32.9
	Comal	9.8	3.5	3.4	2.6	2.1	3.4	1.8	3.3
	Guadalupe	4.3	4.4	4.1	2.3	1.7	3.3	1.4	3.3
	Wilson	1.4	4.1	1.0	0.7	0.6	1.0	0.5	0.9
	Total	69.9	67.2	45.7	42.0	30.0	44.0	24.7	40.4

Table 6-5. Anthropogenic Emissions within the SAER, 2007-2012

SA Early Action Compact Region	Change VOC 2007→2012 (TPD)	Change VOC 2007→2012 (%)	Change NOx 2007→2012 (TPD)	Change NOx 2007→2012 (%)
Area Sources	80.5→83.1 + 2.6	+ 17.6%	9→9.5 + 0.5	+ 5.6%
Point Sources	13.5→18.7 + 5.2	+ 38.5%	75.1→64.9 - 10.2	- 13.6%
On-Road Sources	53.8→40.1 - 13.7	- 25.5%	84→50.4 - 23.6	- 40%
Non-Road Sources	30→24.7 - 5.3	- 17.7%	44→40.4 - 3.6	- 8.2%
Total	**177.8→166.6 - 11.2**	**- 6.3%**	**212.1→165.2 - 46.9**	**- 22.1%**

Table 6-5 is a synopsis of table 6-4. The trend in emissions changes between 2007 and 2012 shown is a downward trend, most significantly in NOx. The claim that the San Antonio region will be in attainment by 2007 is based on the results of the modeled attainment demonstration (Appendix H). The claim that the region will stay in attainment through 2012 is based centrally on this downward trend in locally produced precursors between attainment year 2007 and maintenance year 2012. Once the standard is achieved, the region should remain in attainment.

Figure 6-1 Trend of VOC and NOx Emissions in the SAER, 1996, 1999, 2007, 2012



*note 1996 estimates include version two of the 1995 Mobile6 inventory

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Emission reductions achieved through state and federal control measures will be further complemented by local clean air strategies enacted through the EAC, which are not shown in the 2007 baseline projections in table 6-4. Periodic trend analyses updates, which will take into account the clean air strategies enacted through the EAC and their schedules, will ensure that the reductions achieved through all measures are adequate to maintain attainment through 2012.

6.3 UPDATING THE PLANNING PROCESS

Various stages of planning and verification must be performed on a continual basis to ensure timely emission reductions for the region to maintain air quality standards. The impacts of new point source related emissions, economic and population growth, and the implementation of new control strategies are evaluated during the air quality modeling process. The modeling output allows for the air quality planners to identify the impacts of the new emission sources or control strategies on the air pollutants in the region. In the development of the State Implementation Plan for the San Antonio Early Action Compact Region, projected growth of emission sources in the area was integral in the air quality planning process. This preliminary trend analysis indicated that emissions for some sources were projected to increase while other sources would have a decrease in emissions. Besides the emission sources projected for their effect in 2012 using projected population statistics, models, or other methodologies, new point source emissions that come into existence between 1999 and 2012 will be accounted for in the analysis of emission growth. Analyzing their effect on ambient ozone levels will be essential in ensuring the maintenance of attainment.

6.3.1 Modeling Updates and Modeling Assumption Verification

AACOG staff will analyze air quality and related data and perform necessary modeling updates and modeling assumption verification annually. In the event that updated emission inventories, updates in any photochemical model inputs, or corrections to earlier modeling assumptions are created and available, the modeling scenarios used to demonstrate attainment for the SAER will be brought up to date. Modeling updates will be performed in accordance with state and federal guidelines.

Ongoing Updates

Gathering, updating, and verifying data is part of an ongoing process between the Texas Commission on Environmental Quality, the US Environmental Protection Agency, and the Alamo Area Council of Governments. The updating and verification process will continue to occur in the context of the Joint Near Nonattainment Area meetings held by air quality planning technical staff representing TCEQ, and the San Antonio, Victoria, Corpus Christi, Austin and the Tyler-Longview areas, or other appropriate venue (technical meetings with TCEQ and / or EPA, etc.). Joint Near Nonattainment Area meetings are held at least as often as every three months. They were established as a forum for discussion of new technology, new program and planning requirements under state programs, progress on and cooperation in attainment of air quality goals, as well as discussion of updates to modeling input and modeling technique. AACOG frequently attends other technical modeling meetings hosted by the TCEQ, EPA and other agencies, which provides greater opportunity for information update exchanges. In addition, AACOG staff attends regularly scheduled monthly technical meetings of the local San Antonio / Bexar County Metropolitan Planning Organization (MPO), allowing AACOG staff the most recent transportation planning information. AACOG provides all air quality analysis for the local MPO transportation projects. All local transportation

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planning updates to the modeling inputs will be incorporated as they occur, and their impacts analyzed.

Reporting of modeling updates and modeling assumption verification will be reported in the Semi-Annual Reports written by the AACOG. These reports are due on an ongoing six-month cycle ending December 31 and June 30 of each year of the Early Action Compact, ending December 31, 2007. These reports will specifically address, at a minimum,

- all relevant actual new point sources;
- impacts from potential new source growth; and
- future transportation patterns and their impact on air quality in a manner that is consistent with the most current adopted Long Term Transportation Plan and most current trend and projections of local motor vehicle emissions.

6.3.2 Transportation Patterns

The development of transportation patterns is influenced by many such as land use and urban planning. Transportation patterns directly effect emissions originating from on-road sources, therefore they must be evaluated for their impact on ozone levels. On-road emissions, as detailed in table 6-4, are projected to decrease by maintenance year 2012.

Throughout the continuing planning process, the air quality impact on the region's ozone levels imposed by transportation patterns will be evaluated and assessed by technical staff of various local, regional, state, and federal offices. As specified in 6.3.2, the ongoing technical collaboration between AACOG and the local MPO is the central conduit such that updated transportation planning becomes integrated in air quality planning. These cooperative relations will assist in maintaining the 8-hour ozone standard by the technical assistance provided by each agency and in the event additional planning is necessary.

6.4 NEW STRATEGY REQUIREMENTS

The annual reviews of growth, including the updates and the continuing planning processes reported in the Semi-Annual Updates will provide air quality planners the insight necessary to ensure attainment of the 8-hour standard up to 2012. The extensive clean air strategy modeling performed by AACOG staff will facilitate the planning if the continuous review process indicates additional measures should be considered.

If at any time the review of growth demonstrates that adopted control measures are inadequate to address growth in emissions, additional measures will be added to the plan. If additional control measures for 2007 attainment are suggested as being necessary through a review of growth, they will be verified using the current attainment demonstration photochemical model and adopted according to the public review process overseen by the Air Improvement Resources Committee. If additional control measures for 2012 attainment are suggested as being necessary through a review of growth, AACOG staff will work with the TCEQ and EPA to analyze control strategies based on then-currently available photochemical models. Appropriate control strategies will be adopted according to the public review process overseen by the Air Improvement Resources Committee.

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APPENDIX A

CONCEPTUAL MODEL AND EPISODE SELECTION FOR THE SAN ANTONIO EAC REGION

SAN ANTONIO EAC REGION ATTAINMENT DEMONSTRATION

MARCH 2004

Conceptual Model and Episode Selection for the San Antonio EAC Region

Prepared by:
The Alamo Area Council of Governments
Natural Resources / Transportation Department
San Antonio, Texas

September 2000

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INTRODUCTION

The U.S. Environmental Protection Agency (EPA) is charged with the maintenance of regional air quality across the United States through a series of standards, the National Ambient Air Quality Standards (NAAQS). When regions fail to comply with these standards, the region joins together with the state and several federal entities to create and agree upon a State Implementation Plan (SIP). The SIP is a blueprint for the methodology that the region and state will follow to allow the region to regain the federal air quality standards.

Air quality analysis and the modeling of control strategies are elements of a SIP. Since control strategy modeling requires extensive technical analyses of control strategy impacts under all meteorological conditions that give rise to high levels of ozone formation, it is important that each photochemical modeling episode be built upon a time period characterized by such meteorological conditions. Hence, careful selection of the proper episode is important for use in photochemical modeling.

The EPA suggests that a conceptual description[1], or model, be developed to aid in the selection of modeling episodes. The following paper represents a Preliminary Conceptual Model (PCM), developed and used for episode selection for initial eight-hour modeling. A conceptual model profiles or typifies the meteorological conditions during which high levels of ozone are created for a region through the study of the meteorology accompanying high levels of ozone. The days which will comprise the modeling episode are specifically chosen because they reflect the area's meteorology during the formation of high ozone levels. Thus, a successful PCM will supply an identification of the best time periods for the modeler to incorporate into a photochemical model in order to evaluate control strategies. An interim conceptual model includes modifications made to the PCM during the development of the modeling protocol and base case modeling. The refined conceptual model will be developed after initial modeling has been completed and control strategies have been implemented [2].

The San Antonio area episode(s) will include days during which measured ozone levels exceed the 8-hour average ozone NAAQS concentration standard of 85 parts per billion (ppb). If during a single day it is found that the 8-hour average ozone level is 85 ppb or above, while meteorological conditions are unexceptional, special notice of that day is taken. When several such days occur in a series, that set of days is a photochemical model episode candidate. The process undertaken for identification of such episodes in the San Antonio region, the analysis of the candidate episodes, and the rationale for their final ranking and selection are the subject of this report.

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[1] Pg 18 of 168, "DRAFT GUIDANCE ON THE USE OF MODELS AND OTHER ANALYSES IN ATTAINMENT DEMONSTRATIONS FOR THE 8-HOUR OZONE NAAQS," EPA-454/R-99-004, May 1999. Online: http://www.epa.gov/ttn/scram/draft8hr.zip

[2] Page 2, "Development of a Conceptual Model for Episode Selection of High Eight-Hour Ozone Events in the Dallas / Fort Worth area," C. Durrenberger, P. Breitenbach, J. Red, D. Sullivan, S. Minto, TNRCC

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PRELIMINARY CONCEPTS

CAMS in the San Antonio Region

There are currently four air quality monitors in the San Antonio region that record ozone levels reported to the public. The data from these sites are archived and displayed on the Internet[3] by the Texas Natural Resource Conservation Commission (now known as the Texas Commission on Environmental Quality), and is quality-assured to EPA standards. The monitoring equipment sets within this network are called CAMS, which is an acronym for Continuous Air Monitoring Station[4]. Information about San Antonio CAMS sites is contained in the table below, Table A-1. Figure A-1, on the following page, shows the locations of the local monitoring sites.

Notice that CAMS07 was deactivated on August 11, 1998 and CAMS58 was activated on August 12, 1998; the monitoring equipment located at CAMS07 was moved to its present location at CAMS58. Notice also that only CAMS23 has been active during the entire 1997, 1998 and 1999 ozone seasons; data from this monitor will be critical to any change in designation under the 8-hour ozone NAAQS.

Table A-1. Ozone-Recording CAMS sites in the San Antonio (SA) Airshed

CAMS Designation / Site Name	**Address; Location Description**	**Data Measured**	**First date of data reporting (online); maintained by**
CAMS23 / Marshall High School	6655 Bluebird Lane; northwestern SA	Ozone, Weather	Since September 17, 1996; TNRCC
CAMS58 / Camp Bullis	Near Wilderness road; far northern SA	Ozone, Weather and NOx	Since August 12, 1998; TNRCC
CAMS59 / Calaveras Lake	14620 Laguna Road; southeastern San Antonio	PM 2.5, NOx, Ozone, and Weather	Since May 13, 1998; University of Texas at Austin
CAMS678 / CPS/Trinity	802 Pecan Valley Dr.; near eastern San Antonio	CO, SO_2, NOx, Ozone, and Weather	Since March 4, 1999; by Trinity Consultants for CPS
CAMS07 / San Antonio North C07	522 Pilgrim Dr.; near northern San Antonio	CO, NOx, Ozone, and Weather	Deactivated on August 11, 1998

In addition to various pollutant readings, the weather data reported from each of these sites include location-specific temperature, wind direction and wind speed. This data is reported online as hourly-averaged values. Since promulgation of the 8-hour ozone NAAQS in 1997, eight-hour ozone reading averages are available online as well.

As mentioned in the Introduction, the 8-hour average concentration of 85 ppb for ozone is the single most important air quality measurement for San Antonio. According to the NAAQS, this critical threshold value determines whether an area is or is not in attainment of the 8-hour standard. If the average of the annual fourth-highest eight-hour average for three consecutive years is at or above 85 ppb at any one monitor, that region is not in attainment of the NAAQS.

[3] "Air and Water Monitoring," on-line August 3, 2000: http://www.tnrcc.state.tx.us/air/monops/
[4] "What is a CAMS?", http://www.tnrcc.state.tx.us/cgi-bin/monops/daily_info?cams

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Figure A-1. Monitoring locations in the San Antonio airshed.

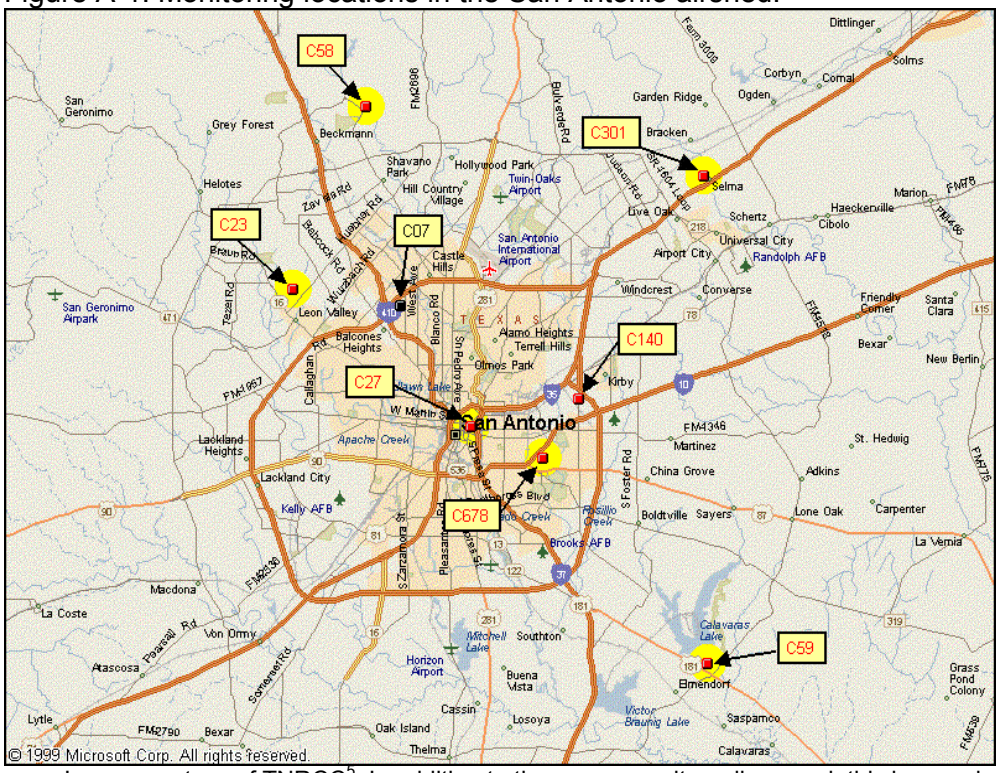

Image courtesy of TNRCC[5]. In addition to the ozone monitors discussed, this image shows C140 (weather only), C301 (PM 2.5 only) and C27 (CO and NOx only) CAMS sites.

Design Value

Another useful statistic is the design value. In the San Antonio area, the current design value is 88 ppb, the average of the annual fourth-highest ozone readings recorded at CAMS 23 (Marshall High School) during the 1997, 1998, and 1999 ozone seasons. The effectiveness of control strategies in helping a region to regain attainment is measured against this value. Also, when selecting episode days, the EPA recommends that daily peak ozone 8-hour averages be generally within 10 ppb above the 8-hour design value[6]. The design value will be discussed further in the section treating Episode Selection.

[5] http://www.tnrcc.state.tx.us/cgi-bin/monops/select_month?region13.gif
[6] Conversation with Pete Breitenbach, TNRCC, August 18, 2000

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ELEMENTS OF THE CONCEPTUAL MODEL

A conceptual model identifies meteorological conditions that occur during days of excessive ozone formation. A high ozone day is classified as a day during which an ozone level of 85 ppb or above, when averaged for an eight-hour period, or 125 ppb or above for a one-hour averaging period, is recorded. Such levels exceed NAAQS air quality standards. Days during which such levels are achieved are also called exceedance days, and are candidate days for inclusion in a modeling episode. (While the one-hour average ozone NAAQS carries the 125 ppb one-hour average standard, San Antonio is currently at risk to lose only the attainment status for the 8-hour standard.)

Local Monitored Data

Seasonal Patterns of High Ozone Occurences

After compiling a list of these ozone exceedance days -- using both the one-hour and eight-hour definitions for exceedance -- from TNRCC's archives, the task of identifying patterns in the data begins. The meteorology determined for all exceedance days will, by definition, reflect all of the meteorological patterns that correspond to high ozone.

The ozone season for the region is seven months long, lasting from April to October. If, on a given day from 1990 to 1999, any monitor in the San Antonio region showed an exceedance for either the one-hour or the eight-hour ozone standard (125 ppb and 85 ppb, respectively), that day was counted. Such counts were totaled by two-week (half-month) periods and plotted in Figure 2. No day was counted more than once.

Within the ozone season, as shown in Figure A-2, there are two prominent periods during which the greatest number of exceedances occurred. Of the 57 exceedance days counted for San Antonio, 16 (28.1%) occurred between early May and late July. Also, 29 (50.9%) occurred between early August and late September.

This guides us in the first consideration. That is, we should further study episode candidates associated with each of these two periods within the ozone season[7]. It will likely be advisable that one modeling episode be drawn from each period.

---

[7] In the more advanced conceptual model, the seasonal periods identified should be scrutinized for underlying patterns unique to each season; perhaps wind patterns are unique to that season in the target airshed. Wind patterns may indict transport sources. Or perhaps there are sources identifiable within the emissions inventory which follow seasonal activity patterns. In both cases, such identification may lead to season-specific control strategies. In brief, ozone day occurence patterns identified according to season hint at further underlying factors affecting ozone formation. Marking the patterns by the calendar is not important; identifying the causes underlying the temporal distribution of occurences is important.

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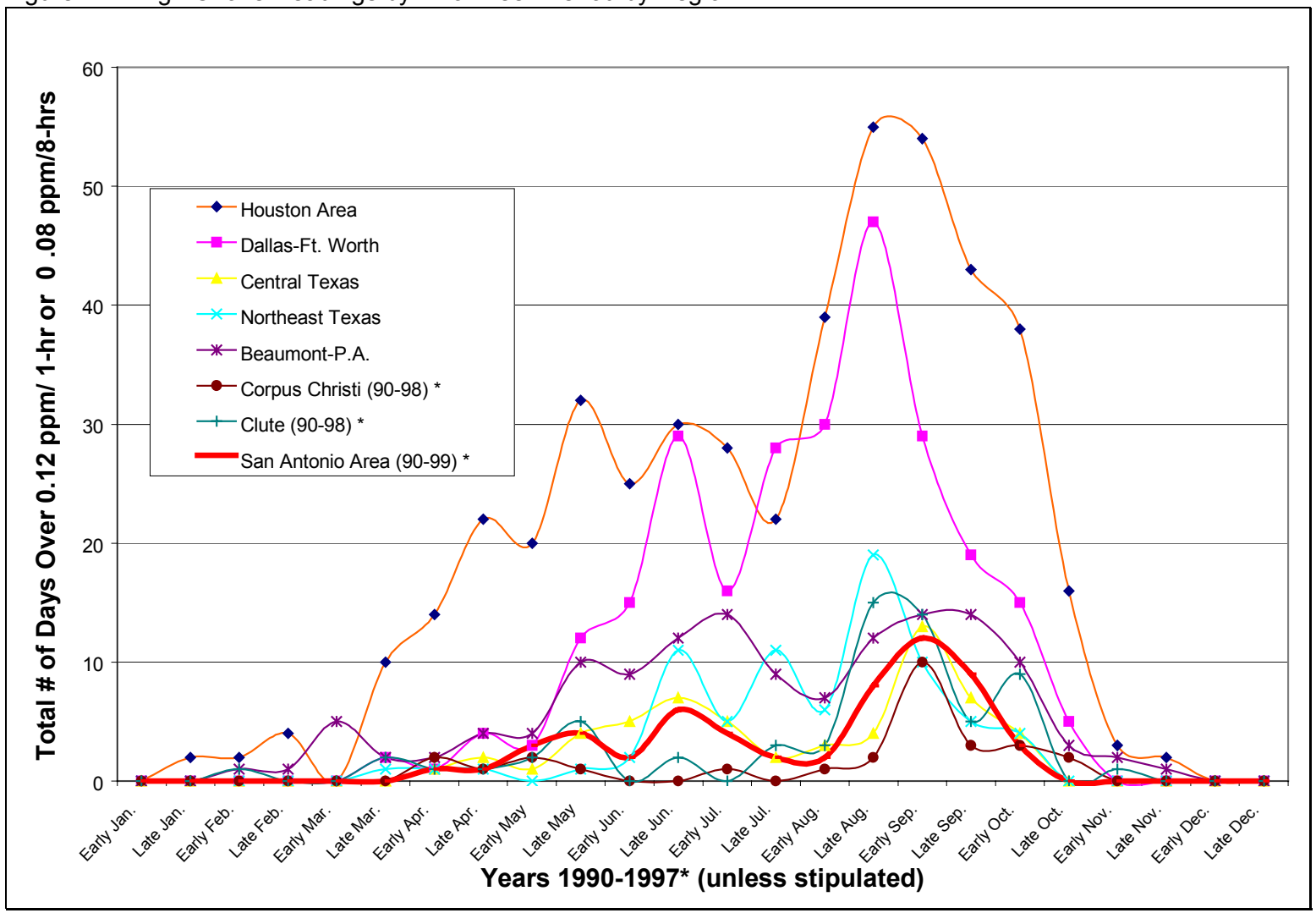
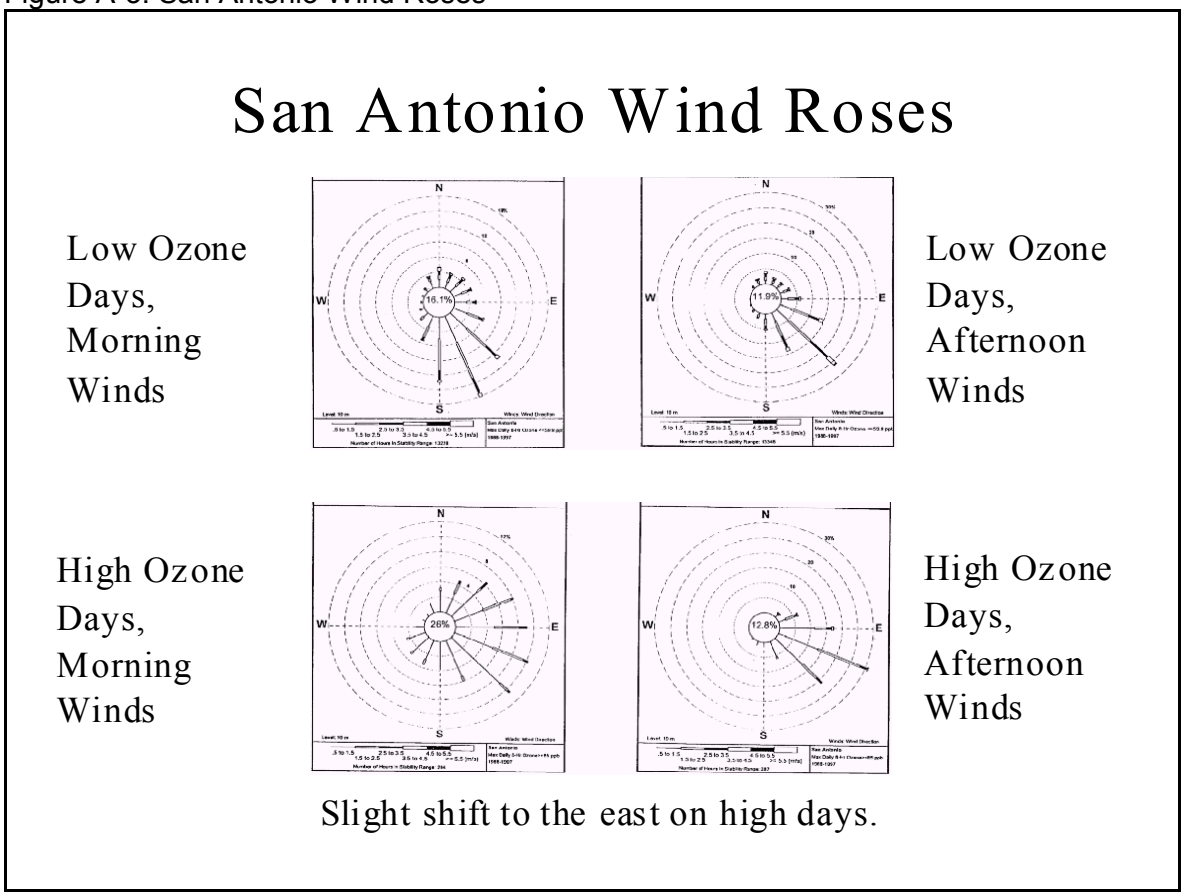
Figure A-2. High Ozone Readings by Two-Week Period by Region.



Local Wind Patterns: Monitoring Station Data

As prepared by TNRCC data analysis staff, the following figure, Figure A-3, shows the wind patterns associated with days of both low and high levels of ozone formation. This is a compilation of days within the ozone seasons (April 1 through October 31) from 1988 to 1997. The CAMS morning wind velocities (direction and speed) are averaged between 7:00 hours through 10:59 hours Central Standard Time (CST), inclusive. The afternoon wind velocities are averaged between 13:00 and 16:59 CST, inclusive. The averages shown are from 5 minute averages taken at all CAMS stations, averaged together.

Figure A-3. San Antonio Wind Roses



This graph shows that, during low ozone days, 16.1% of the velocity readings in the morning are light and variable (wind speed < 0.5 meters per second), while the direction for the morning winds are from the south, southeast or southeasterly. In contrast, during high ozone days, 26% of the velocity readings in the morning are light and variable, while the morning winds shift to the east.

In the same manner, during low ozone days, the image shows that 11.9% of the velocity readings in the afternoon are light and variable, while the direction for the afternoon winds are from the southeast. During high ozone days, 12.8% of the velocity readings in the afternoon are light and variable, while the afternoon winds shift to the east again.

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This provides evidence of the wind directions one should anticipate seeing at the monitors when scrutinizing meteorological data for candidate episode days. However, just as the ozone season could be narrowed to the two periods within which one may select representative episodes, the Hysplit model will allow a refinement to the description of wind directions and speeds beyond the monitored, station-specific weather data.

Regional Modeling Data

The HYSPLIT Model

The Texas Natural Resource Conservation Commission (TNRCC) recommends back trajectory analysis as the preferred method in obtaining data necessary to track air parcels. Given a final geographic destination for an air parcel, back trajectories show the path followed by the parcel before reaching the destination. Theoretically, back trajectories effectively track air displacement over time, distance, and, consequently, over emission source areas.

The TNRCC recommends use of the HYSPLIT model to develop back trajectories. The Air Resources Laboratory of the National Oceanic and Atmospheric Administration (NOAA) maintains the HYSPLIT model. It is available for public use on the Internet at their Realtime Environmental Applications and Display sYstem (READY) webpage[8]. This versatile model can be run either as a trajectory (parcel displacement) or air dispersion model, using either forecast or archived meteorological data. The necessary data for creating the back trajectories used in this conceptual model development is linked to the online model. Point and click operation of the online model requires minimal data input by the user. While the meteorological database is not inexhaustible, the model and database is applicable across the United States, which provides a national reference for air trajectory and dispersion modeling needs.

Regional Wind Patterns: Back Trajectories

Earlier, the list of exceedance days was used to identify the annual periods during which ozone exceedance days frequently occurred, on a seasonal basis. That is, temporal patterns were identified for exceedance days. The HYSPLIT model is first used to estimate air parcel paths typical to ozone exceedance days. By running back trajectories for thirty-two of forty exceedance days in the San Antonio area from 1993 to 1996, TNRCC staff identified spatial patterns for exceedance days, shown in Figure A-4.

[8] READY Homepage: http://www.arl.noaa.gov/ready.html . Online August 3, 2000.

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Figure A-4. Typification of Air Parcel Paths Arriving in San Antonio, Ozone Exceedance Days 1993 - 1998

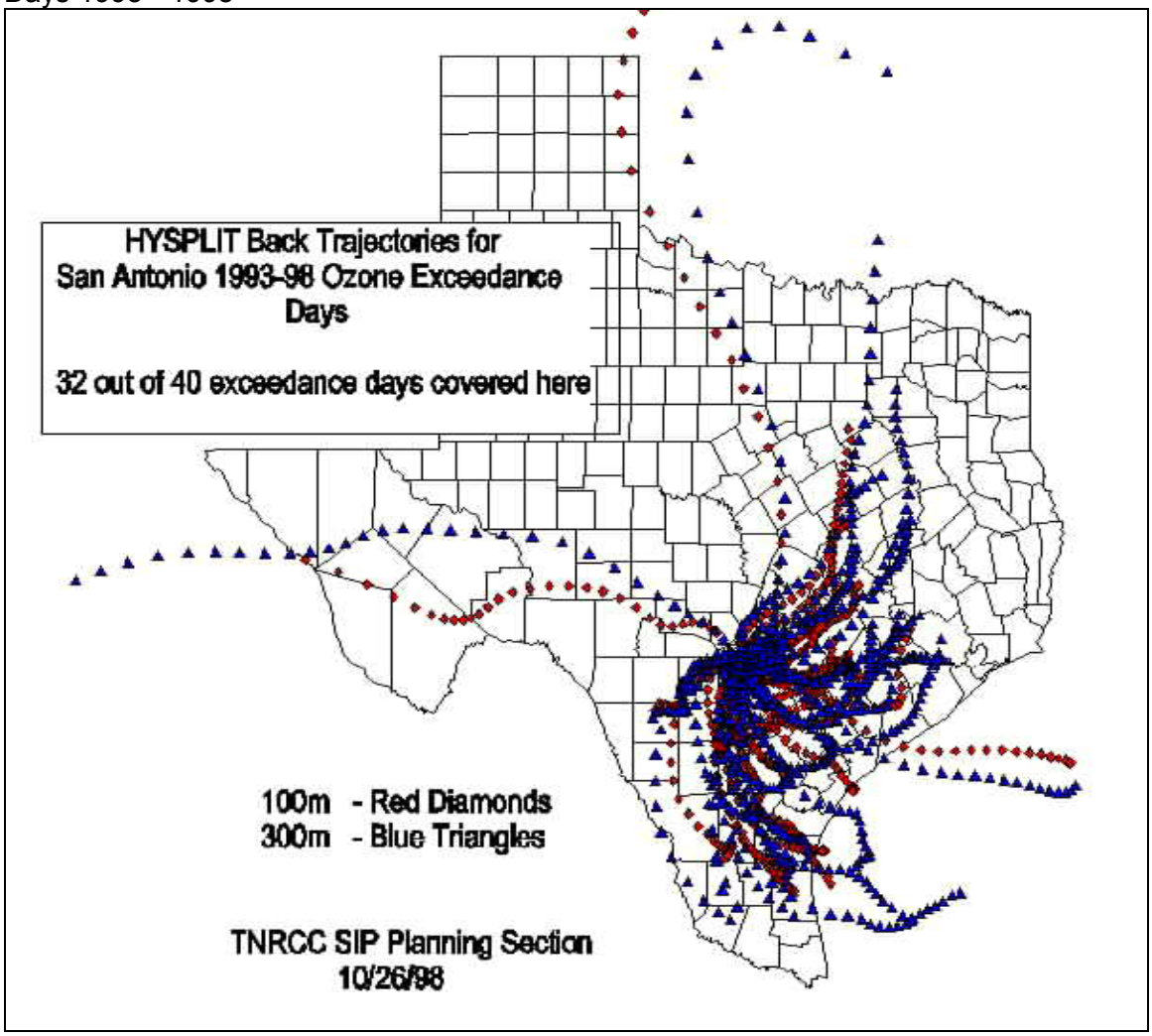

Figure A-4 shows the pattern of air parcel positions on their path to the San Antonio International Airport. The HYSPLIT model produces air parcel positions for every hour in the model run by latitude and longitude. Figure 4 shows that, on high ozone days, it is rare that air arriving in San Antonio will have come from the northwest or the southwest.

A quantitative refinement of the above data is presented next. In Figure A-5, the air parcel back trajectory locations have been sorted into bins and counted. More specifically, the region of central Texas within a 250 mile radius of the San Antonio International Airport (SAIA) has been partitioned into octants; northern, northeastern, eastern, southeastern, etc. Then, the region has been further subdivided by distance boundaries; area within 50 miles of SAIA, 50 to 100 miles of SAIA, etc., out to 250 miles from SAIA. Next, a count of the air parcel locations that fall in each bin were made, as they are given in the HYSPLIT model output files. Finally, these raw counts were converted into percentages and written into the representative bins. Note that the percentages in bold font outside of the 250 mile boundary are sums of the percentages within the octant. That is, for example, the image shows that 3.5% of the air parcel passed to the west and within 50 miles of SAIA; 0.6% passed to the west and between

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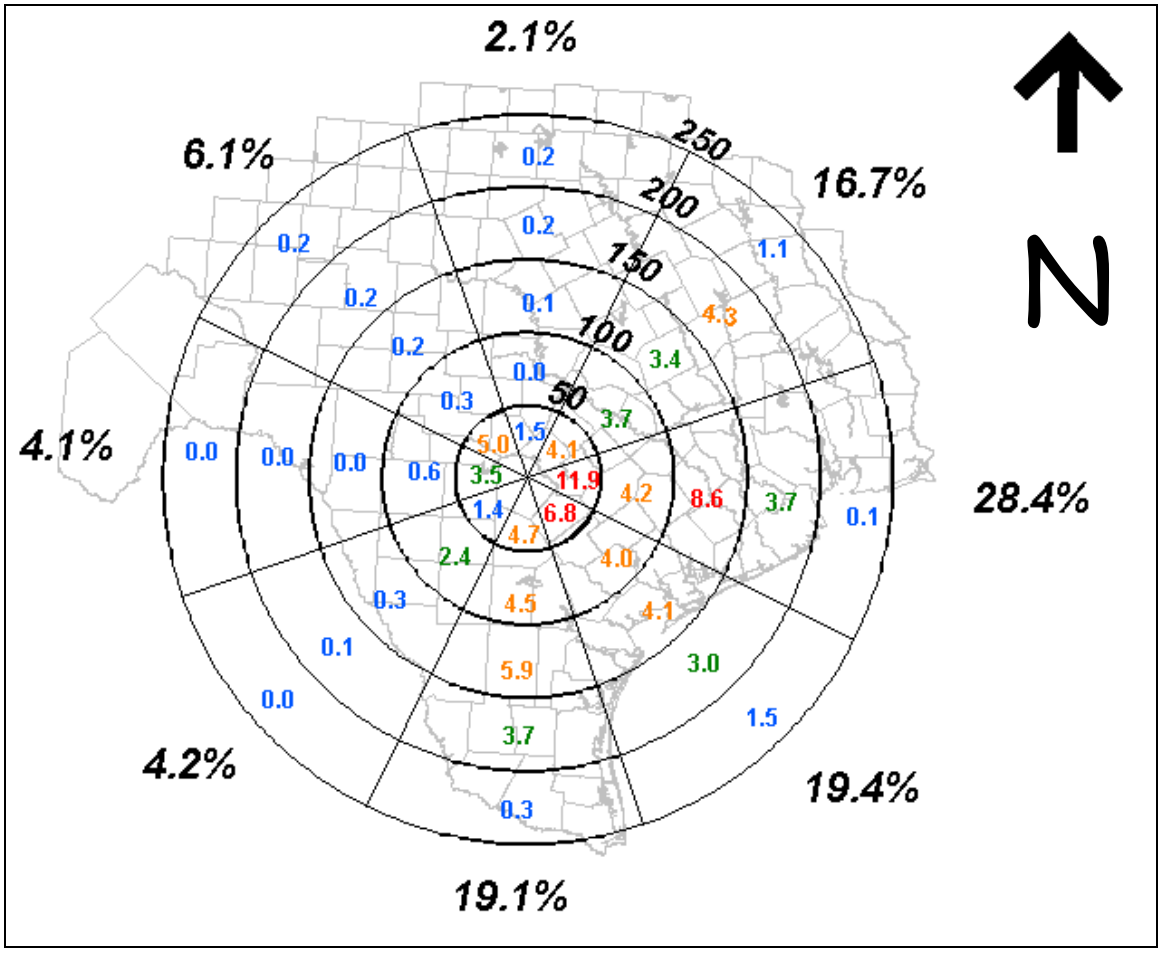
50 and 100 miles of SAIA. Due west of SAIA, outside the 250 mile boundary, the figure in bold, 4.1%, indicates the sum of all air parcels that passed to the west of SAIA within the western octant.

Figure A-5. Back Trajectories Percentages by Direction for High Ozone Days, 1993-1998



This is extremely valuable information. Just as the exceedance day list was used to identify the temporal occurrence of exceedance days, this calculation shows clearly how frequently air parcels passed through a given region, by distance and direction (octant), before coming to San Antonio on a high ozone day. Industrial (point) sources can be identified within the zones delineated in the image. Figure A-6 presents NOx Point Sources in the Eastern Half of Texas by their distance, magnitude and direction from San Antonio.

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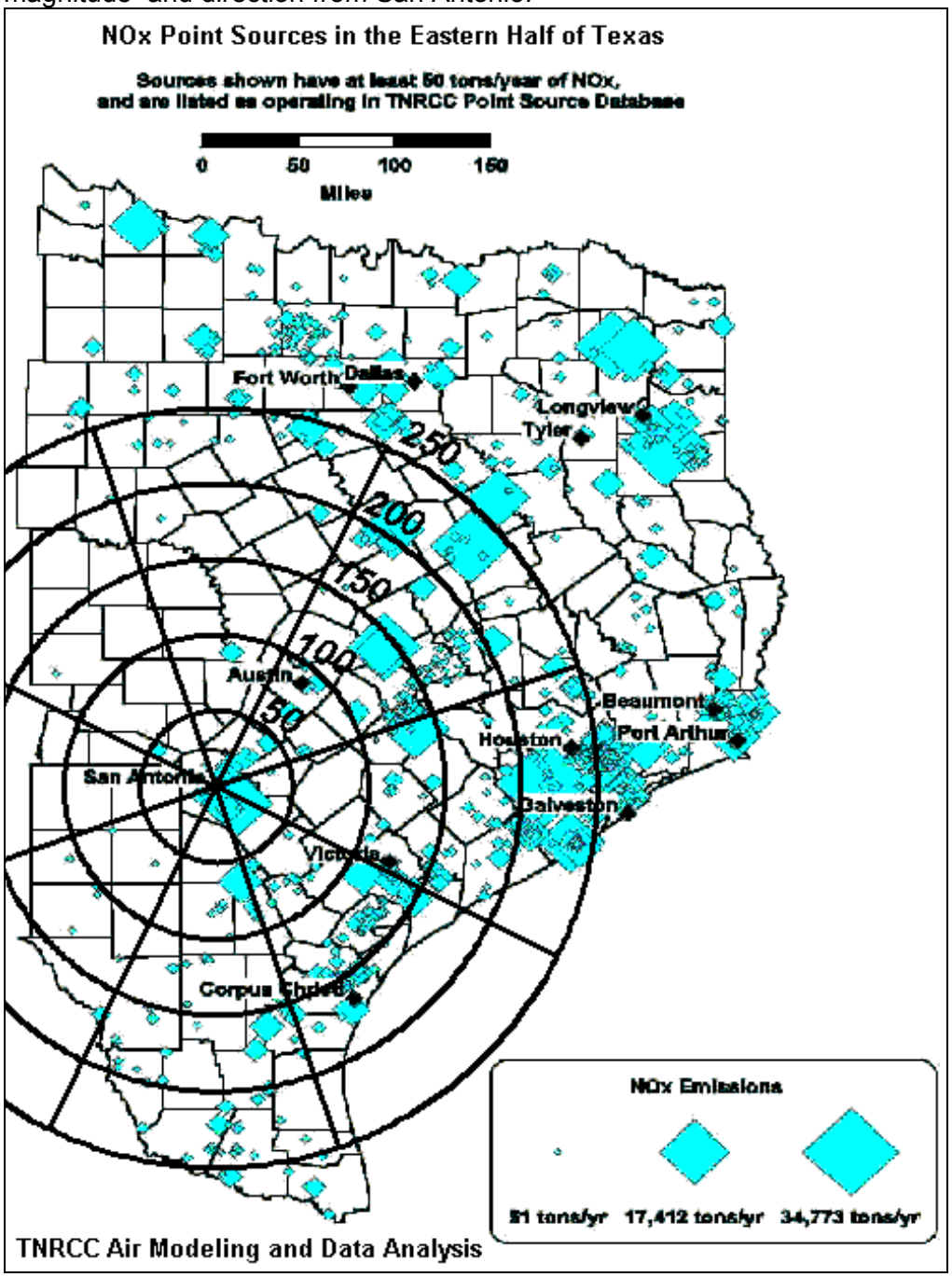
Figure A-6. NOx Point Sources in the Eastern Half of Texas by their distance, magnitude and direction from San Antonio.



Now that the seasonal time periods and typical air movements prior to ozone exceedances in the San Antonio region have been identified, the exceedance day information must be reviewed. The preceding statistical work has allowed identification of particular meteorological parameters which candidate episodes must fulfill. Episodes must have winds from the south, southeast, east and northeast. Episodes should be chosen from the two annual periods for exceedances: May to early July, and late August to late September. Depending on episode selection availability, air parcels traveling through the eastern octant, where some of the larger point sources are found, may

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weigh favorably on episode selection. Next, the exceedance day data will be reviewed for formation of candidate episodes.

EPISODE SELECTION

Episode Candidates: Exceedance Days

San Antonio does not have many episode candidates, simply because San Antonio ozone levels are not typically excessive. The following table (A-2) lists all eight-hour ozone exceedance days recorded in San Antonio for ozone seasons 1995 through 1999. While the one-hour high values for the same days are listed, not every eight-hour exceedance day is a one-hour exceedance day. In fact, only three one-hour exceedances (one of which was excused by EPA) exist on these records. Every one-hour exceedance is listed.

The years 1995-1999 alone are listed, since earlier years are not considered feasible for emission inventory and photochemical modeling development. A preference is placed on modeling 1997 and more recent years, since these are the years during which the 8-hour ozone NAAQS has been in effect. Note also that the column heading "Episode Dates" refers either to existing modeling episode dates -- in which case ramp-up days are included in the episode dates listed -- or refers to the episode candidate period marked exclusively by exceedance days. In the latter case, ramp-up days, which are negotiable but are not part of the analysis considered here, are not included in the episode date period listed.

Table A-2. 1995-1999 Ozone Exceedances and Possible Modeling Episodes for the AACOG Region: Ozone Readings from San Antonio Region Monitors

1995 Ozone Exceedance Days

	1 Hour	8 Hour	Episode Dates	Notes
6/13/95	*105*	*96*		
6/21/95	*100*	*93*	June 18-22	Existing UT Episode
6/22/95	*97*	*85*		
6/23/95	*111*	*89*		
6/27/95	*105*	*86*		
7/8/95	*109*	*87*	July 7-12	Existing AACOG Episode
7/9/95	*99*	*87*		
7/11/95	*109*	*86*		
9/3/95	*120*	*104*	August 31-September 3	Existing TNRCC Episode
9/9/95	*105*	*94*		
9/10/95	*108*	*91*		
9/25/95	*119*	*108*		
9/26/95	*122*	*101*		
10/10/95	*108*	*90*		

1996 Ozone Exceedance Days

	1 Hour	8 Hour	Episode Dates	Notes
6/3/96	*130*	*97*	No Modeling Episode	Not sufficient ozone exceedances for a 1996 modeling episode
7/3/96	*106*	*89*		

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1997 Ozone Exceedance Days

	1 Hour	8 Hour	Episode Dates	Notes
7/16/97	*123*	*95*	No Modeling Episode	Not sufficient ozone exceedances for a 1997 modeling episode
8/26/97	*103*	*95*		
9/6/97	*100*	*88*		

1998 Ozone Exceedance Days

	1 Hour	8 Hour	Episode Dates	Notes
5/7/98	*140*	*101*	No Modeling Episode	Mexican Forest Fires; excused by EPA
5/10/98	*107*	*89*		
8/28/98	*99*	*89*	August 28 - September 3	
8/30/98	*99*	*92*		
9/3/98	*105*	*87*		
9/4/98	*141*	*110*	No Modeling Episode	
9/16/98	*107*	*91*		
10/9/98	*121*	*95*		

1999 Ozone Exceedance Days

	1 Hour	8 Hour	Episode Dates	Notes
8/5/99	*120*	*100*		
8/16/99	*109*	*87*	August 16-21	
8/21/99	*109*	*87*		
8/30/99	*101*	*85*	August 30-September 1	
8/31/99	*108*	*95*		
9/1/99	*109*	*91*		
9/16/99	*93*	*85*	September 16 – 20	
9/18/99	*108*	*96*		
9/19/99	*96*	*91*		
9/20/99	*107*	*86*		
10/1/99	*99*	*88*		

Requirements Limiting Episode Selection

One criterion for episode selection is that there be more than two exceedance days in the episode. In all, the episode should be between three to ten days[9] or so. Due to the expense and time required to model episodes, it is not practical to model all episode days. With these introductory guidelines in mind, reinforced by the desirability of developing 1997-1999 episodes, there are no episode candidates in 1995, 1996 or 1997, although June 21-23, 1995 are three exceedance days for San Antonio. This is not a strong candidate since the period is in 1995. This consideration tends to exclude August 16-21, 1999 in which only two exceedance days appear.

Note also that on September 4, 1998, a one-hour ozone high of 141 ppb and an eight-hour ozone high of 110 were recorded (both at CAMS 58). This day comes at the end of an episode candidate, the August 28 - September 3, 1998 period. Exceedance days within 10 ppb above the design value of 88 ppb are preferred. The September 4th 8-hour

[9] Page 2, "Development of a Conceptual Model for Episode Selection of High Eight-Hour Ozone Events in the Dallas / Fort Worth area," C. Durrenberger, P. Breitenbach, J. Red, D. Sullivan, S. Minto, TNRCC

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average value of 110 ppb is 22 ppb above the design value. This high value tends to exclude September 4th from consideration as part of the August 28 - September 3 episode. The high values for both the one- and eight-hour averages recorded on September 4th represent an anomaly and are the highest in this record set. On the other hand, if the August 28 - September 3, 1998 period is valuable as a modeling episode, it is within the modeler's discretion to note the anomaly and choose to include September 4 in the episode. It may be of interest to note the response of the model on this day to the control strategies considered. Also, since this exceedance comes as the very last day in an episode, there is no following exceedance day. There might be conceivably be debate about the value of an episode with such an anomaly surrounded by other exceedance days.

A restriction on episode selection has arisen since some meteorological data is missing. At this time, Eta Data Assimilation System (EDAS) data is unavailable to create the meteorological modeling required for the August 30 - September 1, 1999 candidate episode[10]. There are no current plans to replace this data. Coarse grid data exists which may be used to interpolate the missing data, but this is not a preferred methodology and would require additional expense. The August 30 - September 1, 1999 candidate episode is effectively removed from consideration for this time.

Other data is missing from the same data set. Due to a fire at the National Weather Service's National Centers for Environmental Prediction (NCEP) computer facility at the end of September 1999, EDAS data was not produced between October 1 and November 4, 1999. There currently are no plans to reproduce the missing EDAS data[11]. EDAS data is used both by the HYSPLIT model and to create the meteorological input files to the photochemical model.

With the above considerations in mind, August 16-21, 1999 and August 30-September 1, 1999 are excluded. A list of two candidate episodes can be defined. They are presented in Table A-3 below.

None of the one-hour daily highs are within 15 ppb of the one-hour threshold of 125 ppb. The highest of the eight-hour averaged daily high values, 96 ppb for September 18, 1999, is eight ppb above the design value of 88 ppb. That is, none of the values in the remaining candidate episodes are excessively elevated, but rather are near the design value. This is fortunate, since very elevated daily high values are anomalies to be avoided, as are the rare events previously discussed. These eight-hour values are within 10 ppb above the design value, as discussed in Section 2.0.

[10] EDAS data is missing for August 29 at 15Z - 21Z and August 30 at 00Z. Conversation with Pete Brietenbach and Shannon Minto, TNRCC, August 15, 2000.
[11] According to "HYSPLIT4 ARCHIVE TRAJECTORIES," http://www.arl.noaa.gov/ready-bin/traj1file.pl

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Table A-3. Candidate Ozone Episodes

1998 Ozone Exceedances

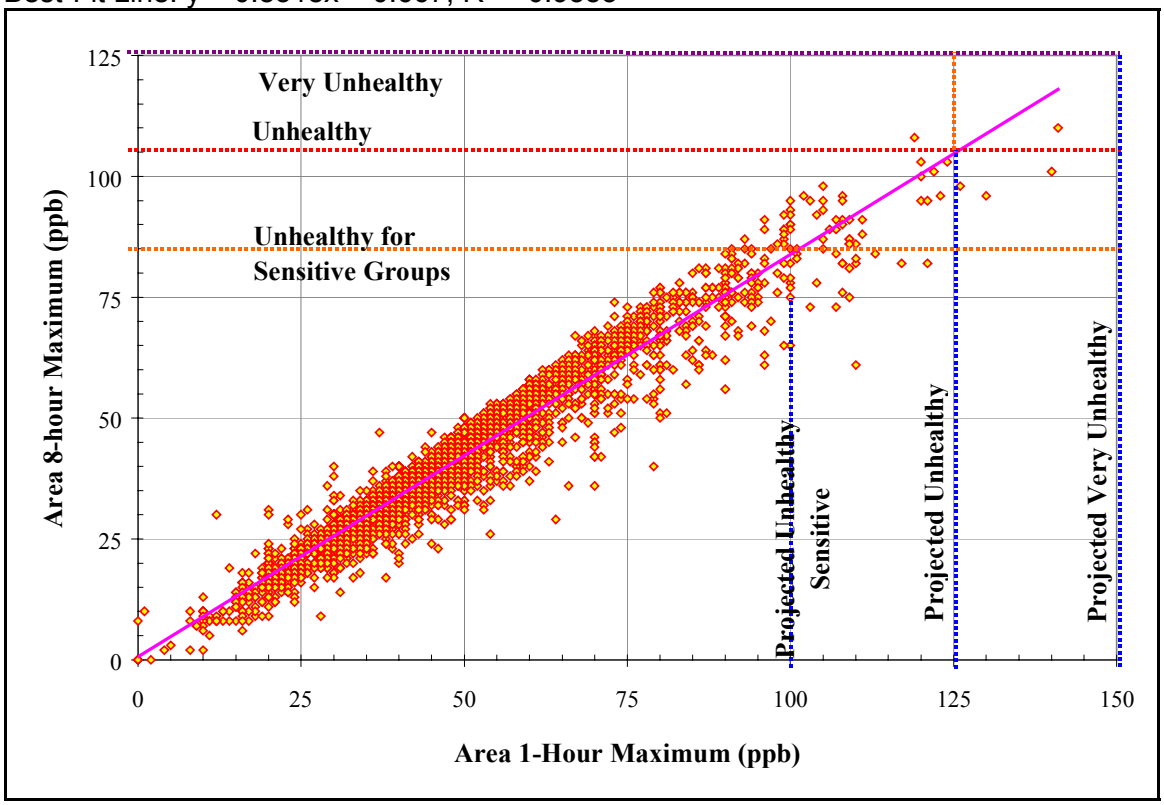
	1 Hour Daily High	8 Hour Daily High	Modeling Episode Dates w/o Ramp Up	# Days Required to model, including Start-to-End Dates	Modeling Episode Dates with 3 Ramp Up Days	# Days Required to model
8/28/98	*99*	*89*	August 28 - September 3	7	August 25 - September 3	10
8/30/98	*99*	*92*				
9/3/98	*105*	*87*				

1999 Ozone Exceedances

9/16/99	*93*	*85*	September 16 - 20	5	September 13 - 20	8
9/18/99	*108*	*96*				
9/19/99	*96*	*91*				
9/20/99	*107*	*86*				

A closely-related consideration is the relationship between high one-hour averages and high eight-hour averages. The following figure, Figure A-7, shows the close correlation between high one- and eight-hour values for 1990 through 1999. This graph was prepared by TNRCC staff meteorologists.

Figure A-7. San Antonio Area Maximum Ozone 1990-1999
Best-Fit Line: $y = 0.8318x + 0.667$; $R^2 = 0.9353$



The best-fit line for the data has an R^2 value of 0.9353, an indication that the correlation between one- and eight-hour data is generally high. The table below, Table A-4, gives

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the comparison between the best-fit line equation and the observed values recorded in Table A-3.

Table A-4. Observed and Predicted values correlated with Best Fit line, 1990-1999

	Observed 1 Hour Daily High	Observed 8 Hour Daily High	Predicted 8-hour high, based on y=0.8318*x + 0.667	Observed - Predicted
1995				
	July 8, 9, 11, 1995 - **Existing AACOG Photochem. Model Episode Exceedance Days**			
7/8/95	109	87	91.3332	-4.332
7/9/95	99	87	83.0152	3.9848
7/11/95	109	86	91.3332	**-5.3332**
1998				
	August 28 - September 3, 1998			
8/28/98	99	89	83.0152	5.9848
8/30/98	99	92	83.0152	**8.9848**
9/03/98	105	87	88.006	-1.006
9/04/98	*141*	*110*	*117.9508*	*-7.9508*
1999				
	September 16 - 20, 1999			
9/16/99	93	85	78.0244	6.9756
9/18/99	108	96	90.5014	5.4986
9/19/99	96	91	80.5198	**10.4802**
9/20/99	107	86	89.6696	**-3.6696**

The correlation between the best fit line itself and the one- and eight-hour observed values is poorest for September 19, 1999 and August 30, 1998. Underlying these differences is an unusually-long sustained ozone level, near in value to the day's highest one-hour value, during the eight hours used in the eight-hour averaging period for that day. This lifts the day's corresponding eight-hour averages above the best-fit line, that is, nearer the numerically higher one-hour value itself, on those two days.

In contrast, the difference (negative) between observed and predicted values on September 20, 1999, show that the one-hour value "spiked;" the low eight-hour average of 86 ppb required much lower values in the set to bring the one-hour high of 107 ppb down in the average. Yet, as can be seen from the data within the existing AACOG photochemical model episode, July 11, 1995 shows an even more pronounced "spike." (The September 4, 1998 values, included here in italics, for the sake of comparison, show this relationship.)

Judging from the acceptability of the existing 1995 modeling episode, the September 20, 1999 value is acceptable as well. In all, the differences reported above are not seen as valid reasons for disqualifying the 1998 and 1999 episode days from further consideration.

Staff produced one-hour versus eight-hour plots, like Figure 5, for 1995, 1996, 1998, and 1999. The results are provided in Figures A-8 through A-11, respectively.

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Figure A-8. 1995 San Antonio 1hr - 8hr Ozone Regression

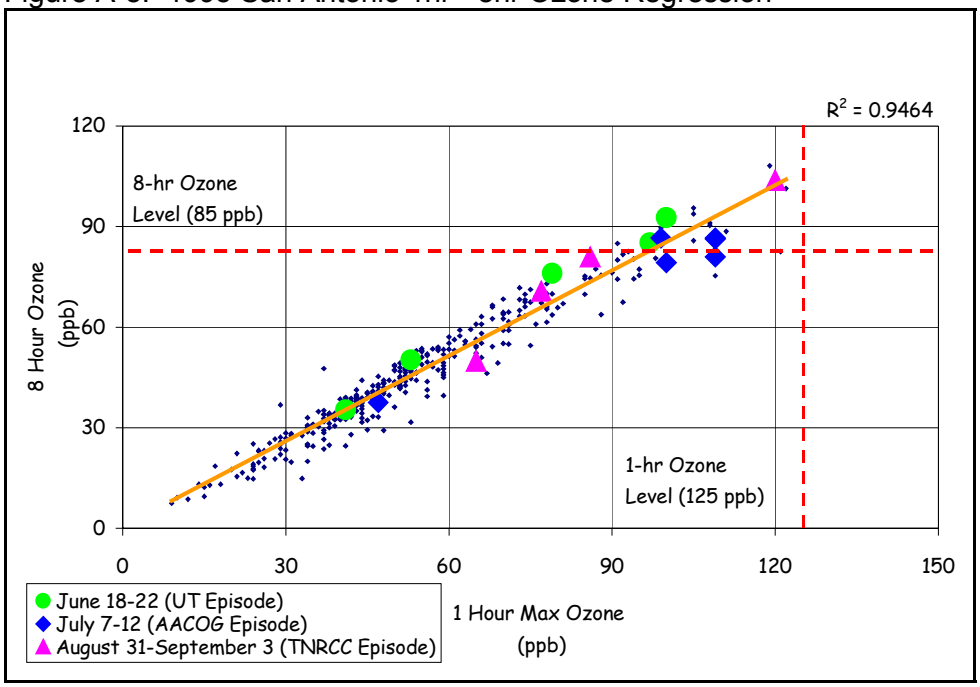

Figure A-9. 1996 San Antonio 1hr - 8hr Ozone Regression

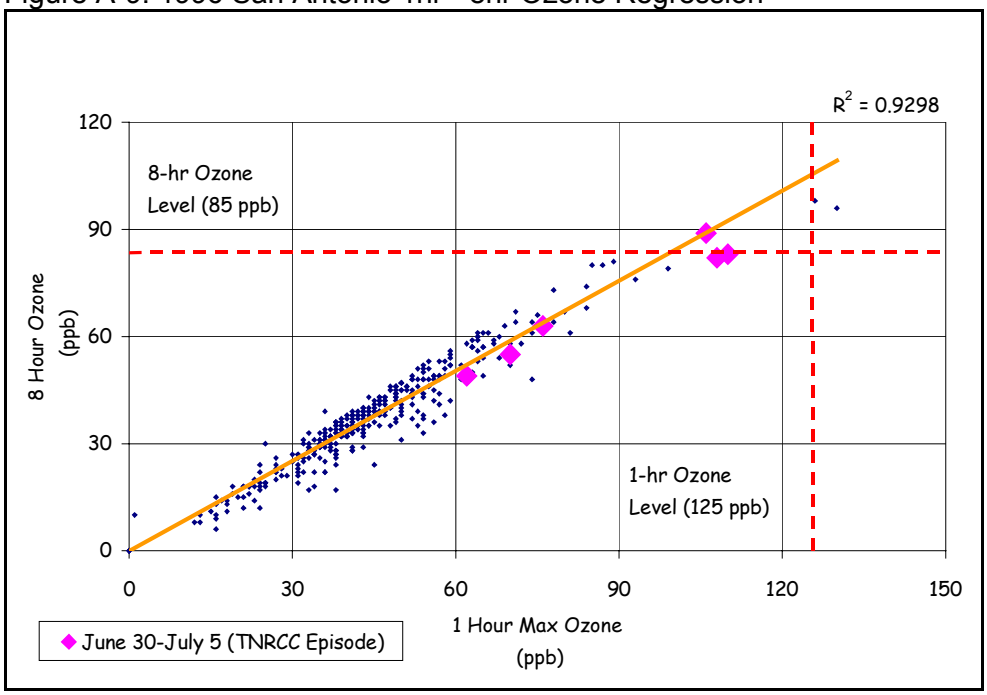

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Figure A-10. 1998 San Antonio 1hr - 8hr Ozone Regression

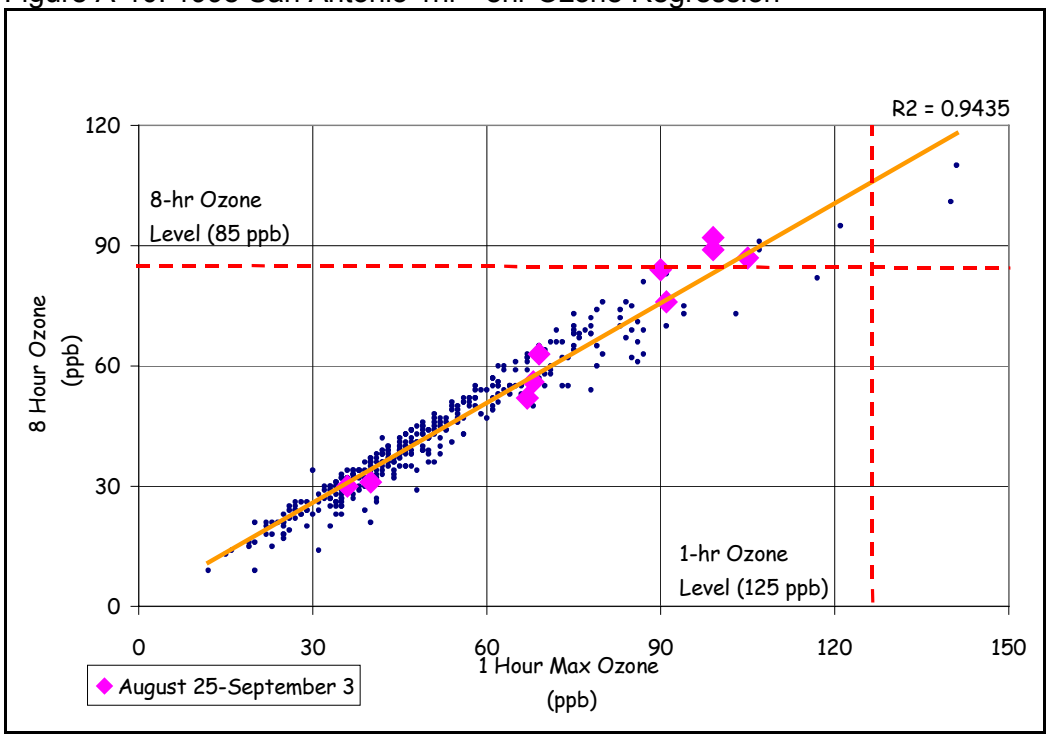
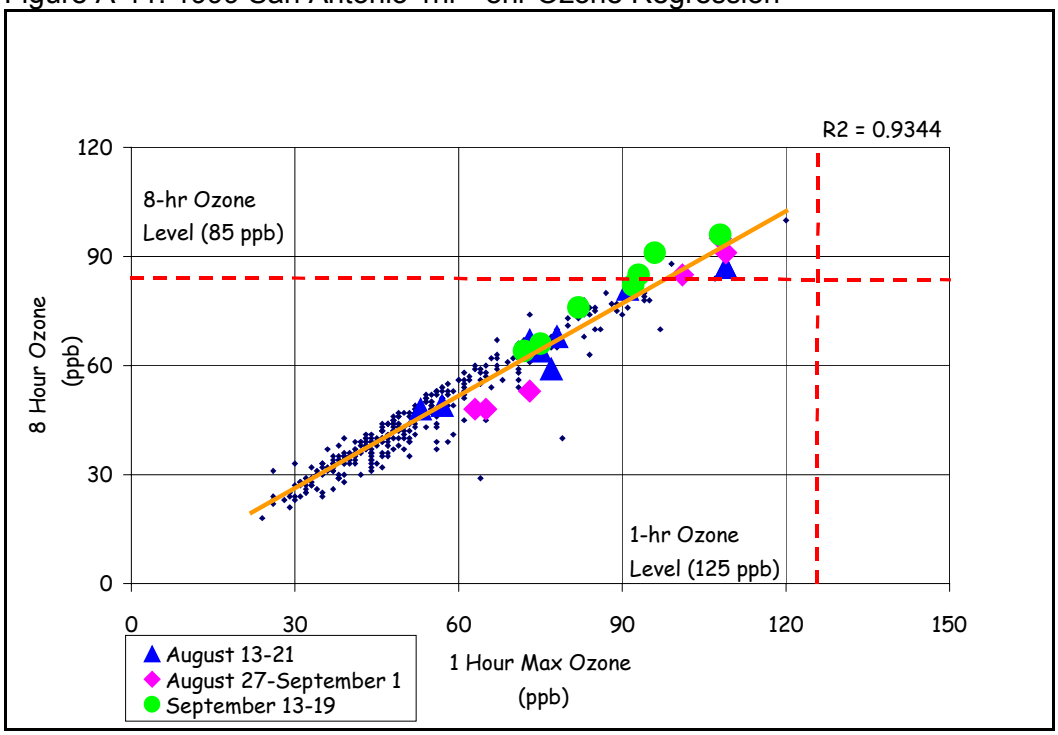


Figure A-11. 1999 San Antonio 1hr - 8hr Ozone Regression



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Comparison of Back Trajectories

The following comparison between the Back Trajectories for the 1993-1998 High Ozone Days, the existing 1995 Photochemical Model Episode, and the 1998 & 1999 Episode Candidates begins the final analysis of the wind trajectories. Figure 5 shows the direction (by octant) and distance of the air parcel trajectories from 1993 through 1998 for all high ozone days. The distribution of air parcel locations in the northeast, east, southeast and southern octants represents 83.6% of the total high ozone day air parcel locations for the entire six year period. In a sense, the goal for this section of the conceptual model development is to incorporate back trajectories for the exceedance days found in the existing 1995 photochemical model together with one or more of the candidate episodes such that the resulting combination generally matches the distribution of the 1993-1998 back trajectory set.

Each exceedance day of the two candidate episodes (not including ramp-up days), August 28, 30 and September 3, 1998, and September 16, 18 - 20, 1999, was run through the Hysplit model to determine a back trajectory. In all cases, the back trajectory ended at the San Antonio International Airport at 21 UTC (4 p.m., Central Standard, Daylight Savings time), with the exception of one day: August 31, 1998. The back trajectory ended at 12 UTC (7 a.m.) instead. This was necessary due to missing EDAS data required in the Hysplit model. For the same reasons, all back trajectories were 33 hours except for August 28, 1998 (19 hours), and September 3, 1998 (19 hours).

By entering the data from the Hysplit model as input to GIS software (ARC INFO), the following graphs were developed. They indicate air parcel positions for each of the episodes. Graphs showing both raw position counts given by the Hysplit model and percentages of the total are given.

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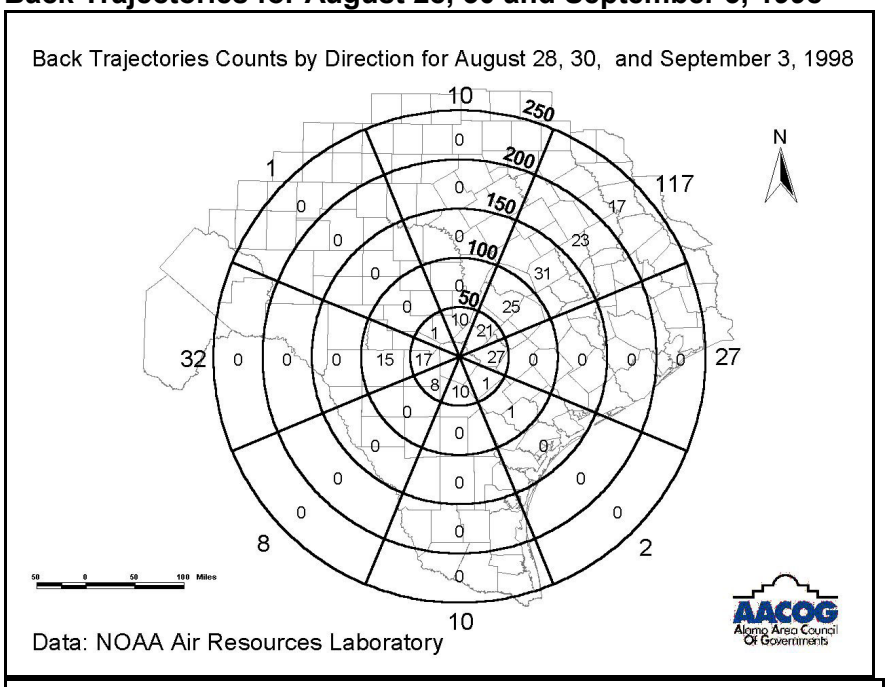
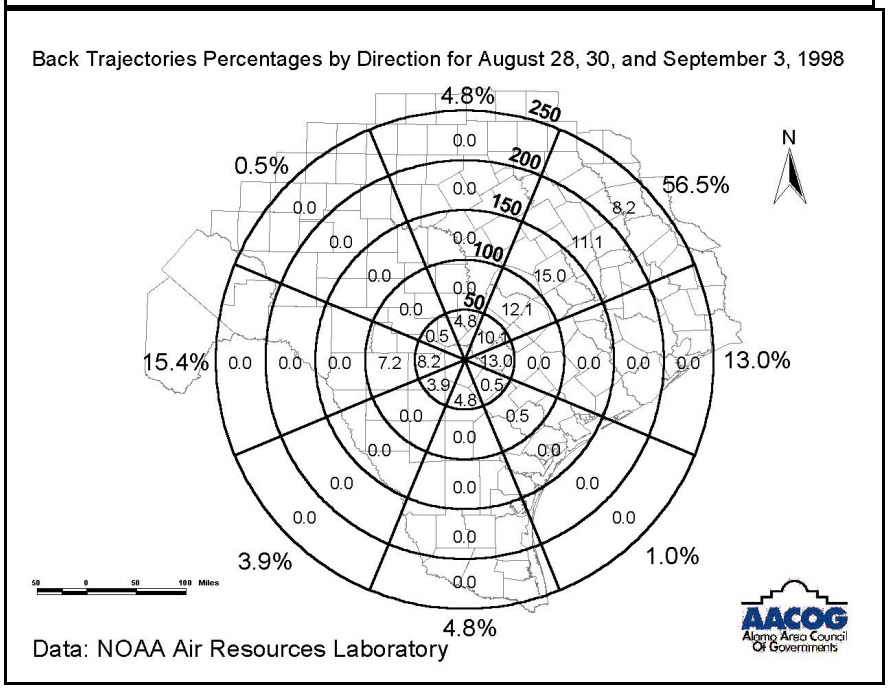
Back Trajectories for August 28, 30 and September 3, 1998





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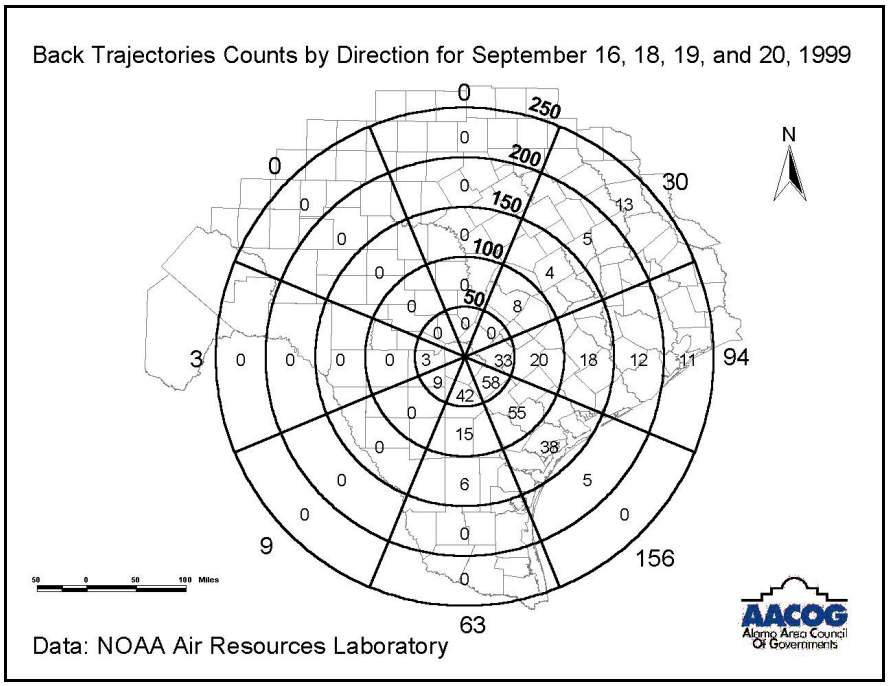
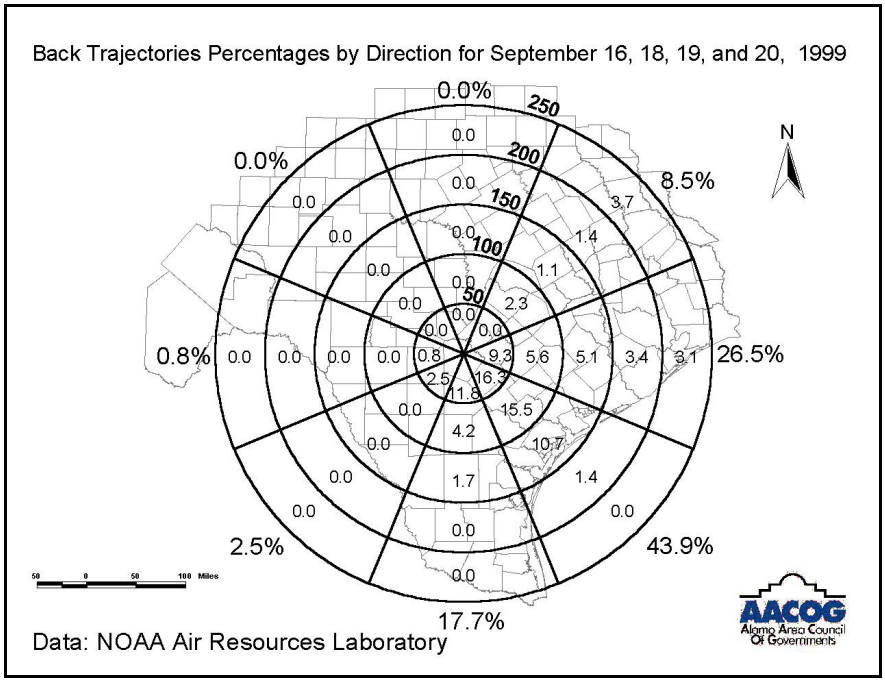
Back Trajectories for September 16, 18, 19 and 20, 1999





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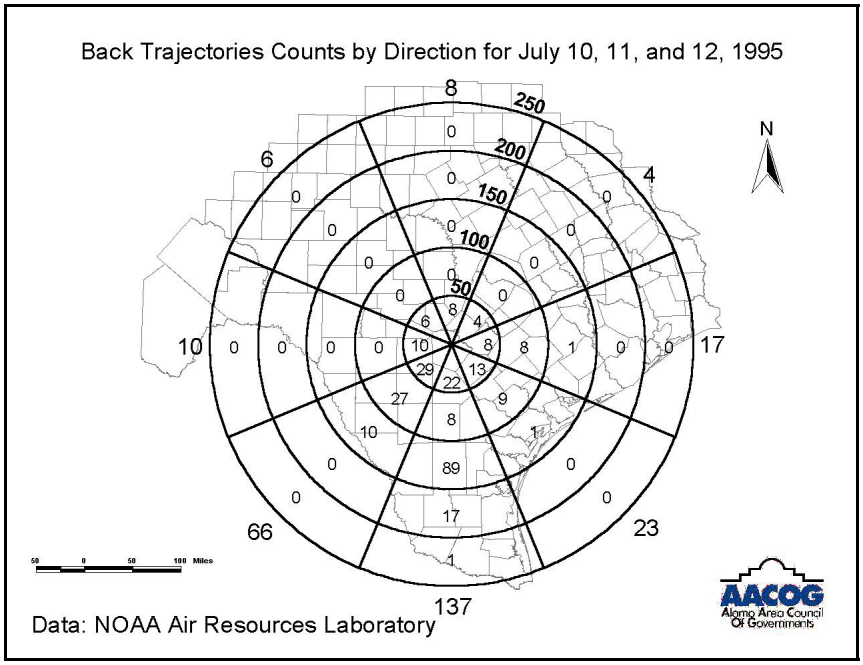
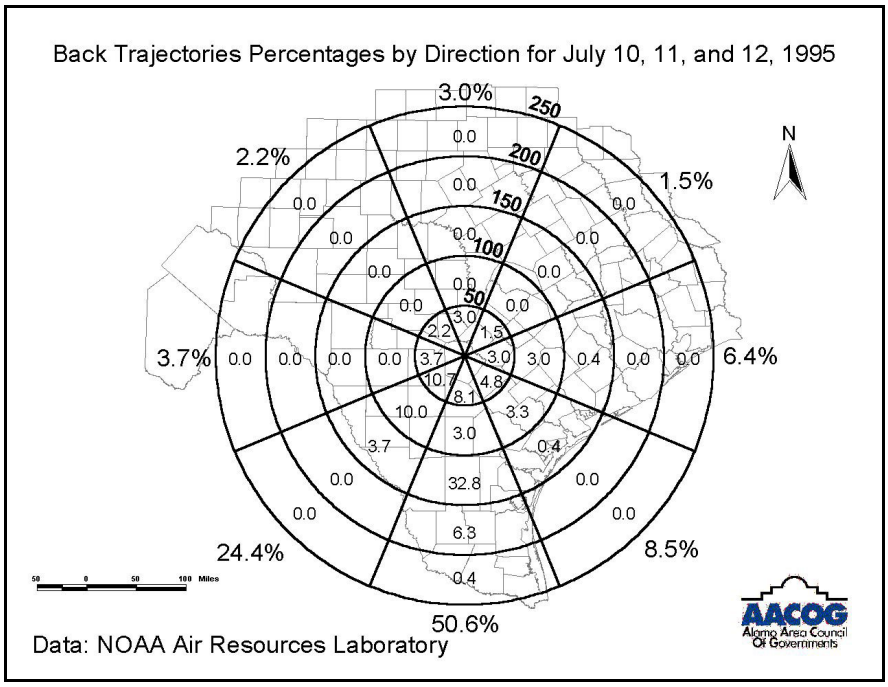
In addition, the back trajectories were calculated for the AACOG Photochemical model days currently used for analysis, July 10 - 12, 1995. The resulting analysis is contained in the graphs below.

Back Trajectories for July 10 - 12, 1995





Note that the air parcel trajectories associated with the 1995 AACOG Photochemical Modeling episode are essentially (75%) all within the southern or southwestern octant. As shown in Figure A-5, very few trajectory positions in the 1993-1998 trajectory sum

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were in the southwestern octant; the southwestern octant need not be well-represented by the modeling episodes. Ideally, a second modeling episode candidate would provide the missing back trajectories required in Figure A-5 for the southeastern, eastern and northeastern octants. Back trajectories filling the northeast, east, and southeast octants are required in a 16.7/28.4/19.4 ratio, or, roughly, an equivalent ratio of 26/44/30. The following table, A-5, presents a comparison of the counts and percentages in these three quadrants, by episode.

Table A-5. Comparison of Back Trajectories without 1995 AACOG episode

	#, % of all Trajectory Points in NE, E, SE	% Trajectory Points in Northeast	% Trajectory Points in East	% Trajectory Points in Southeast	Ratio NE/E/SE
1993-1998 Back Trajectories	565, 64.5%	16.7%	28.4%	19.4%	26 / 44 / 30
Aug 28, 30 Sept 3, 1998	146, 70.1%	56.5%	13%	1%	80 / 19 / 1
Sept 16, 18 - 20, 1999	280, 78.9%	8.5%	26.5%	43.9%	11 / 36 / 56

The 1998 scenario contains many trajectory points in the northeast octant. The September 16 - 20, 1999 scenario ratio seems better balanced.

The next table, A-6, presents a similar comparison of the four major octants which must be accounted for. Here, the candidate episode trajectories are combined with the Base Case 1995 AACOG Photochemical Model (BC) to compare with the 1993 - 1998 trajectory data. Because the attainment modeling will use both episodes, the 1995 Base Case plus at least one additional episode, for demonstration purposes, this shows the combined effectiveness of multiple episode considerations.

Table A-6. Comparison of Back Trajectories with 1995 AACOG episode

	#, % of all Trajectory Points in NE, E, SE, S	% Trajectory Points in Northeast	% Trajectory Points in East	% Trajectory Points in Southeast	% Trajectory Points in South	Ratio NE/E/SE/S
1993-1998 Back Trajectories	732, 83.6%	16.7%	28.4%	19.4%	19.1%	20 / 34 / 23 / 23
Aug 28, 30 Sept 3, 1998 + BC	337, 70.5%	25.3%	9.2%	5.3%	30.8%	36 / 13 / 8 / 44
Sept 16, 18 - 20, 1999 + BC	524, 83.7%	5.4%	17.7%	28.6%	32%	7 / 21 / 34 / 38

Table A-6 shows that both combined episodes cover the four essential octants. This same data is presented in more detail in tables A-7 through A-9 below.

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Table A-7. 1993 - 1998 Ozone Exceedance Days for San Antonio

	0 - 50 Miles	50 - 100	100 - 150	150 - 200	200 - 250	Counts	Percent
North	13	0	1	2	2	18	2.05%
Northeast	36	32	30	38	10	146	16.67%
East	104	37	75	32	1	249	28.42%
Southeast	60	35	36	26	13	170	19.41%
South	41	39	52	32	3	167	19.06%
Southwest	12	21	3	1	0	37	4.22%
West	31	5	0	0	0	36	4.11%
Northwest	44	3	2	2	2	53	6.05%
	341	172	199	133	31	<= Counts	
	38.93%	19.63%	22.72%	15.18%	3.54%	<= Percent	

Table A-8. Base Case (July 10, 11, and 12, 1995) plus Aug 28, 30 Sept 3, 1998

	0 - 50 Miles	50 - 100	100 - 150	150 - 200	200 - 250	Counts	Percent
North	18	0	0	0	0	18	3.77%
Northeast	25	25	31	23	17	121	25.31%
East	35	8	1	0	0	44	9.21%
Southeast	14	10	1	0	0	25	5.23%
South	32	8	89	17	1	147	30.75%
Southwest	37	27	10	0	0	74	15.48%
West	27	15	0	0	0	42	8.79%
Northwest	7	0	0	0	0	7	1.46%
	195	93	132	40	18	<= Counts	
	40.79%	19.46%	27.62%	8.37%	3.77%	<= Percent	

Table A-9. Base Case (July 10, 11, and 12, 1995) plus Sept 16, 18 - 20, 1999

	0 - 50 Miles	50 - 100	100 - 150	150 - 200	200 - 250	Counts	Percent
North	8	0	0	0	0	8	1.28%
Northeast	4	8	4	5	13	34	5.43%
East	41	28	19	12	11	111	17.73%
Southeast	71	64	39	5	0	179	28.59%
South	64	23	95	17	1	200	31.95%
Southwest	38	27	10	0	0	75	11.98%
West	13	0	0	0	0	13	2.08%
Northwest	6	0	0	0	0	6	0.96%
	245	150	167	39	25	<= Counts	
	39.14%	23.96%	26.68%	6.23%	3.99%	<= Percent	

These tables show that the combined episode using August 28, 30 and September 3, 1998, weighs heavily in the Northeast octant (25.3% compared to 16.7% in the 1993 - 1998 set, a difference of 8.6%), while the combined episode using September 16, 18-20, 1999 is very light (5.4% to 16.7% -- a difference of 11.3%) in the same octant. Both combined episodes weigh heavily in the Southern octant (~31% to 19%). However, the 1998 episode is very light in the East (9.2% to 28.4% -- a difference of 19.2%) and the Southeast (5.2% to 19.4% -- a difference of 14.2%). The 1999 episode is better balanced in the East (17.7% to 28.4% -- a difference of 10.7%) and the Southeast (28.6% to 19.4% -- a difference of 9.2%). In this light, the September 16, 18-20, 1999 episode, combined with the Base Case set, does represent the required back

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trajectories marginally better than does the August 28, 30 and September 3, 1998 combined set.

Figure A-6 shows that large NOx Point Sources exist to the east of San Antonio. Many are based in the Houston / Galveston area. This also argues in favor of the September 16, 18-20, 1999 episode, which shows a greater percentage of eastern trajectories than does the August 28, 30 and September 3, 1998 trajectory set.

Combining the Base Case episode with the 1998 and 1999 episodes described above gives a good coverage of the required back trajectories. This is shown in table A-10 below. Compare these values with those in Table A-7.

Table A-10. Base Case (July 10, 11, and 12, 1995), Sept 16, 18 - 20, 1999 and Aug 28, 30 Sept 3, 1998

	0 - 50 Miles	50 - 100	100 - 150	150 - 200	200 - 250	Counts	Percent
North	18	0	0	0	0	18	2.16%
Northeast	25	33	35	28	30	151	18.13%
East	68	28	19	12	11	138	16.57%
Southeast	72	65	39	5	0	181	21.73%
South	74	23	95	17	1	210	25.21%
Southwest	46	27	10	0	0	83	9.96%
West	30	15	0	0	0	45	5.40%
Northwest	7	0	0	0	0	7	0.84%
	340	191	198	62	42	<= Counts	
	40.82%	22.93%	23.77%	7.44%	5.04%	<= Percent	

The conclusion for this chapter is that, in consideration of the back trajectories provided by the HYSPLIT model and the point source locations, the September 16, 18-20, 1999 will be a preferable episode to model next. However, the same data set strongly argues for another episode, the August 28, 30 and September 3, 1998 period to follow. Recall that, according to Table A-3, the 1999 episode also would require a minumum of five days to model (excluding ramp-up days), while the 1998 episode would require seven days to model (also excluding ramp-up days). Thus the 1999 episode might be less expensive to model. A detailed trajectory count, both by combined and uncombined Hysplit runs, is provided in Table A-11.

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Table A-11. Total and Episode-specific Trajectory Counts.
1993 - 1998 Ozone Exceedance Days for SA

	0 - 50 Miles	50 - 100	100 - 150	150 - 200	200 - 250	Counts	Percent
North	13	0	1	2	2	18	2.05%
Northeast	36	32	30	38	10	146	16.67%
East	104	37	75	32	1	249	28.42%
Southeast	60	35	36	26	13	170	19.41%
South	41	39	52	32	3	167	19.06%
Southwest	12	21	3	1	0	37	4.22%
West	31	5	0	0	0	36	4.11%
Northwest	44	3	2	2	2	53	6.05%
	341	172	199	133	31	<= Counts	
	38.93%	19.63%	22.72%	15.18%	3.54%	<= Percent	

Base Case -- July 10, 11, and 12, 1995

	0 - 50 Miles	50 - 100	100 - 150	150 - 200	200 - 250	Counts	Percent
North	8	0	0	0	0	8	2.95%
Northeast	4	0	0	0	0	4	1.48%
East	8	8	1	0	0	17	6.27%
Southeast	13	9	1	0	0	23	8.49%
South	22	8	89	17	1	137	50.55%
Southwest	29	27	10	0	0	66	24.35%
West	10	0	0	0	0	10	3.69%
Northwest	6	0	0	0	0	6	2.21%
	100	52	101	17	1	<= Counts	
	36.90%	19.19%	37.27%	6.27%	0.37%	<= Percent	

August 28, 30 and September 3, 1998

	0 - 50 Miles	50 - 100	100 - 150	150 - 200	200 - 250	Counts	Percent
North	10	0	0	0	0	10	4.83%
Northeast	21	25	31	23	17	117	56.52%
East	27	0	0	0	0	27	13.04%
Southeast	1	1	0	0	0	2	0.97%
South	10	0	0	0	0	10	4.83%
Southwest	8	0	0	0	0	8	3.86%
West	17	15	0	0	0	32	15.46%
Northwest	1	0	0	0	0	1	0.48%
	95	41	31	23	17	<= Counts	
	45.89%	19.81%	14.98%	11.11%	8.21%	<= Percent	

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August 30 - September 1, 1999

	0 - 50 Miles	50 - 100	100 - 150	150 - 200	200 - 250	Counts	Percent
North	0	0	0	0	0	0	0.00%
Northeast	4	1	0	0	4	9	3.93%
East	51	43	14	7	0	115	50.22%
Southeast	60	25	18	2	0	105	45.85%
South	0	0	0	0	0	0	0.00%
Southwest	0	0	0	0	0	0	0.00%
West	0	0	0	0	0	0	0.00%
Northwest	0	0	0	0	0	0	0.00%
	115	69	32	9	4	<= Counts	
	50.22%	30.13%	13.97%	3.93%	1.75%	<= Percent	

September 16, 18 - 20, 1999

	0 - 50 Miles	50 - 100	100 - 150	150 - 200	200 - 250	Counts	Percent
North	0	0	0	0	0	0	0.00%
Northeast	0	8	4	5	13	30	8.45%
East	33	20	18	12	11	94	26.48%
Southeast	58	55	38	5	0	156	43.94%
South	42	15	6	0	0	63	17.75%
Southwest	9	0	0	0	0	9	2.54%
West	3	0	0	0	0	3	0.85%
Northwest	0	0	0	0	0	0	0.00%
	145	98	66	22	24	<= Counts	
	40.85%	27.61%	18.59%	6.20%	6.76%	<= Percent	

A comparison may be made between the 1993 - 1998 ozone exceedance days data and combinations of the base case with various candidate episode data. These combinations (see Table A-12) help demonstrate that the back trajectories given by the combination of base case and various episodes will, to varying degrees, represent the back trajectories required to comprehensively represent the 1993 - 1998 ozone exceedance days trajectories. This represents one goal of the Conceptual Modeling exercise, identification of likely episodes according to the similarity of the candidate episode conditions -- in this case, wind trajectories -- compared to composite profile of high ozone days.

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Table A-12. Back Trajectories Counts and Percentages, Combined Data

1993 - 1998 Ozone Exceedance Days for San Antonio							
	0 - 50 Miles	50 - 100	100 - 150	150 - 200	200 - 250	Counts	Percent
North	13	0	1	2	2	18	2.05%
Northeast	36	32	30	38	10	146	16.67%
East	104	37	75	32	1	249	28.42%
Southeast	60	35	36	26	13	170	19.41%
South	41	39	52	32	3	167	19.06%
Southwest	12	21	3	1	0	37	4.22%
West	31	5	0	0	0	36	4.11%
Northwest	44	3	2	2	2	53	6.05%
	341	172	199	133	31	<= Counts	
	38.93%	19.63%	22.72%	15.18%	3.54%	<= Percent	

Base Case (July 10, 11, and 12, 1995) plus Aug 28, 30 Sept 3, 1998							
	0 - 50 Miles	50 - 100	100 - 150	150 - 200	200 - 250	Counts	Percent
North	18	0	0	0	0	18	3.77%
Northeast	25	25	31	23	17	121	25.31%
East	35	8	1	0	0	44	9.21%
Southeast	14	10	1	0	0	25	5.23%
South	32	8	89	17	1	147	30.75%
Southwest	37	27	10	0	0	74	15.48%
West	27	15	0	0	0	42	8.79%
Northwest	7	0	0	0	0	7	1.46%
	195	93	132	40	18	<= Counts	
	40.79%	19.46%	27.62%	8.37%	3.77%	<= Percent	

Base Case (July 10, 11, and 12, 1995) plus Sept 16, 18 - 20, 1999							
	0 - 50 Miles	50 - 100	100 - 150	150 - 200	200 - 250	Counts	Percent
North	8	0	0	0	0	8	1.28%
Northeast	4	8	4	5	13	34	5.43%
East	41	28	19	12	11	111	17.73%
Southeast	71	64	39	5	0	179	28.59%
South	64	23	95	17	1	200	31.95%
Southwest	38	27	10	0	0	75	11.98%
West	13	0	0	0	0	13	2.08%
Northwest	6	0	0	0	0	6	0.96%
	245	150	167	39	25	<= Counts	
	39.14%	23.96%	26.68%	6.23%	3.99%	<= Percent	

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Base Case (July 10, 11, and 12, 1995), Sept 16, 18 - 20, 1999 and Aug 28, 30 Sept 3, 1998							
	0 - 50 Miles	50 - 100	100 - 150	150 - 200	200 - 250	Counts	Percent
North	18	0	0	0	0	18	2.16%
Northeast	25	33	35	28	30	151	18.13%
East	68	28	19	12	11	138	16.57%
Southeast	72	65	39	5	0	181	21.73%
South	74	23	95	17	1	210	25.21%
Southwest	46	27	10	0	0	83	9.96%
West	30	15	0	0	0	45	5.40%
Northwest	7	0	0	0	0	7	0.84%
	340	191	198	62	42	<= Counts	
	40.82%	22.93%	23.77%	7.44%	5.04%	<= Percent	

Regional Considerations

An overview of a data set pair is included here for the eastern half of Texas. A list of exceedance days is included below (tables A-13 and A-14), which covers the August 25 - September 4, 1998 and the September 13 - 20, 1999 periods.

Table A-13. Regional Considerations, 1998

	Highest Daily Maximum by Area, 8-hour ozone average												
Exceedance Days for San Antonio	**1998**	Dallas-Fort Worth	Tyler	Longview-Marshall	Beaumont-Port Arthur	Houston-Galveston-Austin		San Antonio	Victoria	Corpus Christi	Laredo	McAllen-Edinburg-Brownsville-Harlingen	
	8/25	79	63	63	45	72	44	30	23	23	24	25	19
	8/26	83	68	85	82	111	42	31	17	26	20	23	14
	8/27	90	84	104	87	132	62	56	51	42	29	28	16
X	8/28	84	87	114	93	114	84	89	55	52	36	33	30
	8/29	84	83	96	87	**149**	88	84	72	75	52	38	31
X	8/30	100	85	73	99	118	92	92	48	42	56	33	27
	8/31	96	78	82	46	72	84	74	60	49	33	31	26
	9/1	102	73	73	41	53	79	69	47	53	54	44	41
	9/2	120	99	86	62	75	74	76	62	82	55	64	56
X	9/3	100	91	107	94	**152**	101	87	71	76	51	41	36
X	9/4	92	90	96	97	128	95	110	78	78	50	59	63

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Table A-14. Regional Considerations, 1999

	Highest Daily Maximum by Area, 8-hour ozone average												
Exceedance Days for San Antonio	**1999**	Dallas-Fort Worth	Tyler	Longview-Marshall	Beaumont-Port Arthur	Houston-Galveston-Brazoria	Austin	San Antonio	Victoria	Corpus Christi	Laredo	McAllen-Edinburg-Mission	Brownsville-Harlingen
	9/13	49	43	45	66	82	55	64	67	70	48	47	50
	9/14	69	60	58	64	88	62	66	67	76	61	50	54
	9/15	80	85	75	70	97	78	82	78	82	56	70	68
X	9/16	78	82	79	89	104	85	85	79	81	65	68	66
	9/17	99	86	75	69	111	99	76	86	81	55	64	57
X	9/18	99	91	86	101	98	99	96	87	89	61	71	66
X	9/19	96	91	97	100	120	101	91	84	88	59	71	55
X	9/20	92	99	110	79	124	87	86	99	75	53	65	54

The near non-attainment areas for the 8-hour ozone NAAQS in Texas are Austin, San Antonio, Tyler-Longview-Marshall, Victoria and Corpus Christi for the 1997-1999 period. If a combined, regional photochemical model was to be undertaken by these areas, the September 1999 episode is preferable, in that there are no 8-hour exceedances for Corpus Christi or Victoria in the 1998 data set.

CONCLUSION

Historical data reveals two annual periods of likely high ozone exceedances: May-July and August-October, with the central occurences in late June - early July and late August - late September. The 1995 Base Case Photochemical Model now with AACOG extends from July 7 August 28, 30 and September 3, 1998 through July 12th. The two final episode candidates are represented by the September 16, 18-20, 1999 exceedance days or the August 28, 30 and September 3, 1998 exceedance days. The 1995 Base Case and either of the two final candidates represent the two seasonal periods.

The wind patterns for these two candidate episodes do follow the patterns of direction given in the wind roses fairly well. According to the wind roses for high ozone days, the morning winds are most likely to come from the south to southeast. According to CAMS 23 (Marshall High) data, the morning winds for the episodes in question come from (on average) the south or southeast. And the afternoon winds do swing to a more easterly direction. CAMS 23 has been in place since 1996, and so will most closely match the 1998-1997 data in the wind roses. Details of wind speed, resultant wind speed, and wind direction during the exceedance days, by monitoring station, are provided in tables A-15 through A-22. Wind direction, the direction from which the wind is blowing, is measured to the nearest degree based on a 360 degree compass with 360 degrees being from the North and 180 degrees being from the South.

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Table A-15. Wind Speed and Resultant Wind Speed at CAMS 58, 1998 and 1999 Episodes

Camp Bullis, CAMS 58					
August - September 1998	8-hour O3 high (ppb)	8-10:59 a.m. Wind Speed Average (mph)	8-10:59 a.m. Resultant Wind Speed Average (mph)	1-3:59 p.m. Wind Speed Average (mph)	1-3:59 p.m. Resultant Wind Speed Average (mph)
28-Aug-98	82.25	4.10	3.63	5.78	4.68
30-Aug-98	87.50	5.13	4.65	5.53	4.80
03-Sep-98	87.38	3.88	3.30	3.68	2.75
04-Sep-98	110.25	3.13	2.35	4.43	3.20
Average		4.06	3.48	4.85	3.86
September 1999	8-hour O3 high (ppb)	8-10:59 a.m. Wind Speed Average (mph)	8-10:59 a.m. Resultant Wind Speed Average (mph)	1-3:59 p.m. Wind Speed Average (mph)	1-3:59 p.m. Resultant Wind Speed Average (mph)
16-Sep-99	78.25	5.10	4.48	7.95	6.98
18-Sep-99	96.75	4.03	3.05	6.08	4.50
19-Sep-99	91.13	3.73	2.80	5.43	3.85
20-Sep-99	81.88	4.23	3.50	5.73	3.83
Average		4.27	3.46	6.29	4.79

Table A-16. Wind Direction at CAMS 58, 1998 and 1999 Episodes

Camp Bullis, CAMS 58			
August - September 1998	8-hour O3 high (ppb)	8-10:59 a.m. Average Resultant Wind Direction	1-3:59 p.m. Average Resultant Wind Direction
28-Aug-98	82.25	327	109
30-Aug-98	87.50	122	120
03-Sep-98	87.38	279	201
04-Sep-98	110.25	253	160
Average		245	147
September 1999	8-hour O3 high (ppb)	8-10:59 a.m. Average Resultant Wind Direction	1-3:59 p.m. Average Resultant Wind Direction
16-Sep-99	78.25	194	110
18-Sep-99	96.75	236	148
19-Sep-99	91.13	246	175
20-Sep-99	81.88	258	172
Average		233	151

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Table A-17. Wind Speed and Resultant Wind Speed at CAMS 678, 1999 Episode*

CPS/Trinity Pecan Valley C678					
September 1999	8-hour O3 high (ppb)	8-10:59 a.m. Wind Speed Average (mph)	8-10:59 a.m. Resultant Wind Speed Average (mph)	1-3:59 p.m. Wind Speed Average (mph)	1-3:59 p.m. Resultant Wind Speed Average (mph)
16-Sep-99	74.00	3.93	3.35	5.58	4.80
18-Sep-99	76.25	2.70	1.70	3.88	2.55
19-Sep-99	84.88	2.55	1.88	3.85	1.93
20-Sep-99	86.88	4.38	3.85	3.53	1.98
Average		3.39	2.69	4.21	2.81

Table A-18. Wind Direction at CAMS 678, 1999 Episode*

CPS/Trinity Pecan Valley C678			
September 1999	8-hour O3 high (ppb)	8-10:59 a.m. Average Resultant Wind Direction	8-10:59 p.m. Average Resultant Wind Direction
16-Sep-99	74.00	129	90
18-Sep-99	76.25	205	102
19-Sep-99	84.88	241	147
20-Sep-99	86.88	248	157
Average		206	124

*There is no data available at CPS/Trinity Pecan Valley C678 for August - September, 1998.

Table A-19. Wind Speed and Resultant Wind Speed at CAMS 23, 1998 and 1999 Episodes

Marshall High C23					
August - September 1998	8-hour O3 high (ppb)	8-10:59 a.m. Wind Speed Average (mph)	8-10:59 a.m. Resultant Wind Speed Average (mph)	1-3:59 p.m.. Wind Speed Average (mph)	1-3:59 p.m. Resultant Wind Speed Average (mph)
28-Aug-98	89.13	2.98	2.33	6.13	5.55
30-Aug-98	90.88	5.28	4.93	5.45	4.98
03-Sep-98	76.00	5.28	3.78	4.88	2.40
04-Sep-98	93.50	3.13	2.70	4.35	2.98
Average		4.16	3.43	5.20	3.98
September 1999	8-hour O3 high (ppb)	8-10:59 a.m. Wind Speed Average (mph)	8-10:59 a.m. Resultant Wind Speed Average (mph)	1-3:59 p.m.. Wind Speed Average (mph)	1-3:59 p.m. Resultant Wind Speed Average (mph)
16-Sep-99	85.63	5.85	5.25	7.23	6.45
18-Sep-99	92.88	3.73	2.55	4.83	3.23
19-Sep-99	89.88	3.58	2.70	4.33	2.60
20-Sep-99	84.63	5.08	4.43	4.60	2.80
Average		4.56	3.73	5.24	3.77

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Table A-20. Wind Direction at CAMS 23, 1998 and 1999 Episodes

Marshall High C23			
August - September 1998	8-hour O3 high (ppb)	8-10:59 a.m. Average Resultant Wind Direction	1-3:59 p.m. Average Resultant Wind Direction
28-Aug-98	89.13	282	101
30-Aug-98	90.88	55	108
03-Sep-98	76.00	248	215
04-Sep-98	93.50	183	141
Average		192	141
September 1999	8-hour O3 high (ppb)	8-10:59 a.m. Average Resultant Wind Direction	1-3:59 p.m. Average Resultant Wind Direction
16-Sep-99	85.63	66	83
18-Sep-99	92.88	184	133
19-Sep-99	89.88	219	169
20-Sep-99	84.63	232	122
Average		175	126

Table A-21. Wind Speed and Resultant Wind Speed at CAMS 59, 1998 and 1999 Episodes

Calaveras Lake C59					
August - September 1998	8-hour O3 high (ppb)	8-10:59 a.m. Wind Speed Average (mph)	8-10:59 a.m. Resultant Wind Speed Average (mph)	1-3:59 p.m. Wind Speed Average (mph)	1-3:59 p.m. Resultant Wind Speed Average (mph)
28-Aug-98	66.25	4.58	4.23	5.73	4.95
30-Aug-98	74.38	8.00	7.78	5.70	5.03
03-Sep-98	78.00	6.03	5.75	4.03	3.35
04-Sep-98	78.75	3.70	3.38	4.35	2.88
Average		5.58	5.28	4.95	4.05
September 1999	8-hour O3 high (ppb)	8-10:59 a.m. Wind Speed Average (mph)	8-10:59 a.m. Resultant Wind Speed Average (mph)	1-3:59 p.m. Wind Speed Average (mph)	1-3:59 p.m. Resultant Wind Speed Average (mph)
16-Sep-99	90.75	6.68	6.38	9.33	8.63
18-Sep-99	89.13	4.75	4.15	5.05	2.53
19-Sep-99	98.88	3.53	2.40	5.40	3.78
20-Sep-99	88.88	5.08	4.63	4.00	3.05
Average		5.01	4.39	5.94	4.49

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Table A-22. Wind Direction at CAMS 59, 1998 and 1999 Episodes

Calaveras Lake C59			
August - September 1998	8-hour O3 high (ppb)	8-10:59 a.m. Average Resultant Wind Direction	1-3:59 p.m. Average Resultant Wind Direction
28-Aug-98	66.25	232	83
30-Aug-98	74.38	46	127
03-Sep-98	78.00	256	99
04-Sep-98	78.75	197	99
Average		183	102
September 1999	8-hour O3 high (ppb)	8-10:59 a.m. Average Resultant Wind Direction	1-3:59 p.m. Average Resultant Wind Direction
16-Sep-99	90.75	35	59
18-Sep-99	89.13	31	175
19-Sep-99	98.88	169	106
20-Sep-99	88.88	259	80
Average		123	105

While the complete list of exceedance days showed five possible episode candidates, several factors cut the list down to two. These factors are: lack of meteorological data; less than three ozone exceedance days within a single identifiable period; episode sequence was not found during the 1997 through 1999 ozone season period.

For the remaining two candidates, September 16-20, 1999, or August 28 - September 3, 1998, an analysis of the back trajectories provided by the HYSPLIT model was performed. Comparing the back trajectories of historical ozone exceedance days with those of the exceedance days from each episode set, the September 16-20, 1999 trajectory set more closely resembled the desired balance of back trajectories. Moreover, the September 16-20, 1999 set showed a higher percentage of back trajectories from the east, a valuable asset, given the large number of NOx emitters found within 250 miles of San Antonio. However, a combination of the September 16-20, 1999 and the August 28 - September 3, 1998 episodes well filled the back trajectory requirements.

Finally, if regional modeling considerations are weighed, the September 16-20, 1999 is the most practical next modeling episode for most of the other near non-attainment areas to attempt. Of the two candidates, exceedance days for more of the five near non-attainment areas occured during the September 16-20, 1999 period. For these reasons, the September 16-20, 1999 is advised as the next photochemical modeling episode to be undertaken for photochemical modeling in the San Antonio region.

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APPENDIX B

DEVELOPMENT OF THE METEOROLOGICAL MODEL

SAN ANTONIO EAC REGION ATTAINMENT DEMONSTRATION

MARCH 2004

Appendix B

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BACKGROUND

The meteorological inputs used to create the original 1999 episode were developed by ENVIRON using the Fifth Generation Mesoscale Model, referred to as MM5. In their report on development of the 1999 episode simulation, ENVIRON acknowledged certain placement, and precipitation rather well for the September 1999 episode for the entire 4-km domain (South Texas). However, the model only performed marginally when predicting humidity and pressure. Two persistent problems with the original MM5 model simulation, referred to as Met 3b, included wind speed – over predicting of wind speed at night and under predicting during the daytime – and over predicting of early morning temperatures.

The most significant problem in the San Antonio area was aloft wind direction[1]. On September 17 and 18, 1999, air quality sampling was conducted in the San Antonio – Austin area as part of the Baylor University Airborne Sampling Project conducted by TCEQ. The data collected from the Baylor aircraft flights were compared to predictions from the 1999 model simulation for the same days. While the model performed well in replicating peak ozone aloft in the urban plumes for the 17th and 18th, the spatial distribution was poor, indicating a problem with wind direction at those altitudes. Figure B-1 provides a comparison between the aircraft data and ozone levels predicted by the model for the correct time period and altitude of the flights. On September 17th the aircraft took measurements between 600 – 800 meters beginning at 1400 CDT. The flight on September 18th began at 1700 CDT and data were collected at about 700 meters during most of the flight. (Emery, et. al., 2002) As shown in the figure, the peak ozone plumes predicted by the model are south of observed plumes for both days that data were collected.

In addition to wind direction issues, simulated ozone levels between the plumes were under predicted by 10 – 20 ppb when compared to observed data. This problem suggests that the model was generating insufficient regional background ozone levels. According to ENVIRON, insufficient background ozone indicates problems with the regional emissions inputs to the model, such as too few VOC emissions from biogenic sources. (Emery, et. al., 2002)

As part of the effort to improve the accuracy of the model, the South Texas Near Non Attainment areas contracted with the ENVIRON and with the University of Texas' Center for Energy and Environmental Resources (UT-CEER) to improve accuracy of meteorological input data for the 1999 episode model.

[1] Typically, surface winds transport pollutants locally, while upper (aloft) winds have the potential to transport ozone and its precursors much greater distances, often hundreds of kilometers (APTI).

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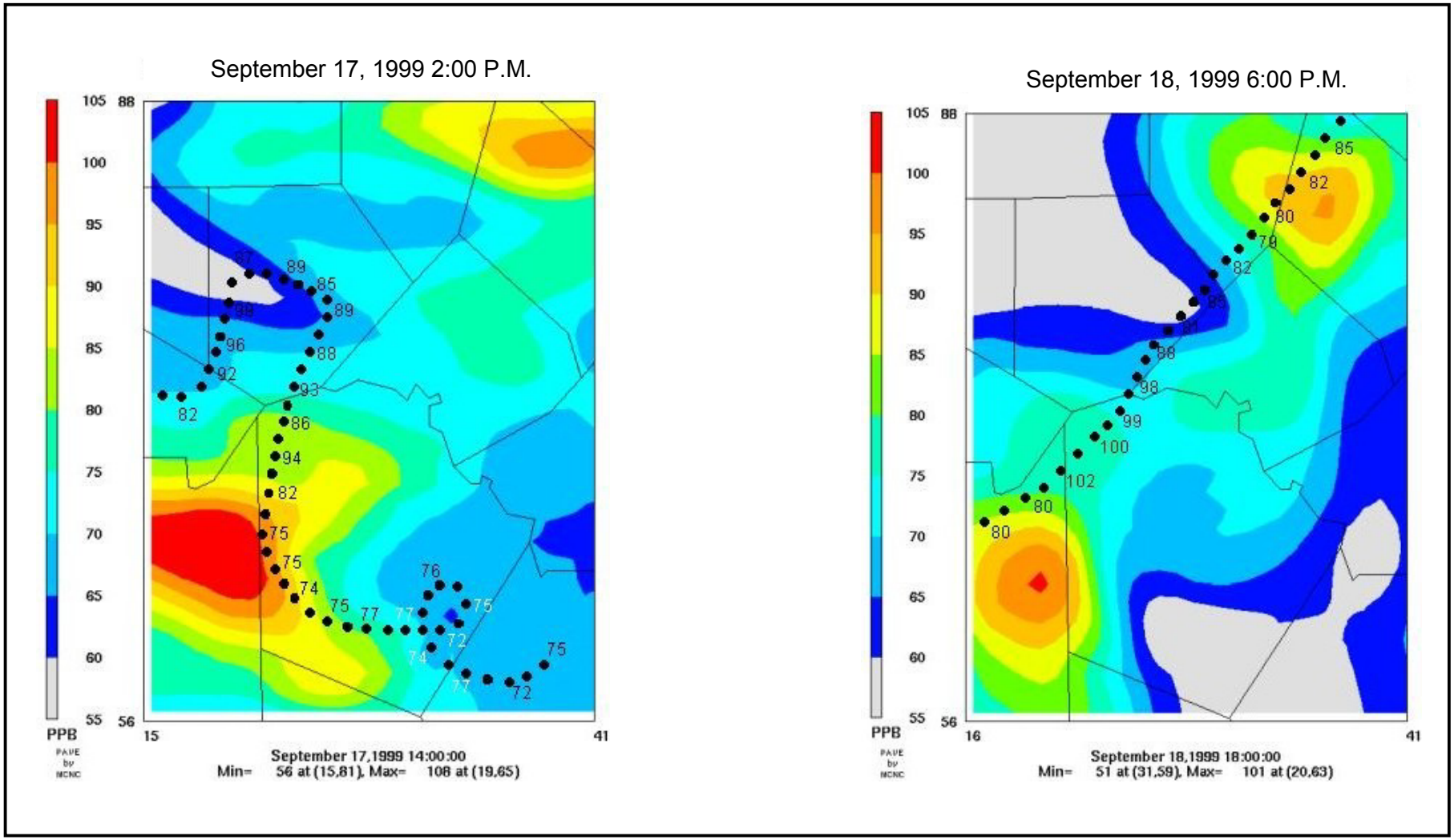
Figure B-1. Comparison of Ozone Levels Measured during Baylor University Airborne Sampling Project on September 17th and 18th with Ozone Levels Predicted by Original 1999 Model Simulation Met 3b for Time of Day and Altitude of Flights. (Dotted lines represent collected ozone data in parts per billion.)



ENVIRON, in conjunction with UT-CEER, tested alternative MM5 configurations and parameter algorithms to find the combination that best replicate actual meteorological conditions during the 1999 high-ozone episode. The best of these runs were presented to the air quality planners at TCEQ, and the four NNA partners for further analysis. The runs, labeled 5d, 5g, and 6f, each have unique strengths and weaknesses and impact the photochemical model in various ways, as described below.

METEOROLOGICAL RUN 5d

The ENVIRON/UT team conducted eight meteorological runs, labeled 5a, b, c, d, e, f, h, and I, using version 3.4 of the MM5 model while incorporating new databases and model configurations that proved to be successful in other applications throughout the country.

- Change to an alternative boundary layer scheme (Blackadar or MRF) to investigate sensitivity to boundary layer mixing;
- Change to an alternative radiation scheme (RRTM) that is known to perform better in the humid Texas climate and may reduce the morning over-predicted surface temperatures;
- Utilize interactive multi-layer soil moisture schemes now available with the latest release of MM5 (v3.5) that would provide a more realistic feedback between soil and atmosphere; and
- Test the effects of alternative observational analyses and FDDA techniques that may better characterize conditions in the south central U.S.

Table B-1. Summary of Meteorological Sensitivity Tests (eight runs)

Run ID	Configuration
Run 5c	Identical to Run 4c (the best performing of the original runs reported by Emery and Tai, 2002), except that the Blackadar PBL scheme was replaced by the Gayno-Seaman PBL scheme.
Run 5	Identical to Run 5c except that the Dudhia Cloud radiation scheme was replaced by the RRTM radiation scheme
Run 5b	Identical to Run 5 except that data from the Texas Coastal Ocean Observation Network (TCOON) and NOAA National Buoy Center were added to the original observational FDDA input data set.
Run 5d	Identical to Run 5b, except that the MRF PBL scheme replaced the Blackadar PBL scheme.
Run 5e	Identical to Run 5d, except that the standard 5-layer soil model was augmented by the bucket soil moisture option, and Run 5e used the standard climatological default soil moisture to define the initial soil conditions by land use category (up to this point, soil moisture was reduced 25% from standard values as in the original Run 4c).
Run 5f	Identical to Run 5e, except that the reduced soil moisture was used similarly to Runs 4c and 5-5d.
Run 5i	Identical to Run 5d except that the number of vertical layers was increased from 28 to 41, resulting in about twice the vertical resolution between approximately 250 and 4600 meters above the surface.
Run 5h	Identical to Run 5e (bucket soil moisture with standard default initial soil moisture values) except that the number of vertical layers was increased from 28 to 41.

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When conducting the eight runs, which are listed on table B-1, modelers tested two methodologies for determining the depth of the planetary boundary layer (the Blackadar and Medium Range Forecast schemes), two radiation schemes[2] (the Dudhia-Cloud and Rapid Radiation Transfer Model), three versions of the four dimensional data assimilation (FDDA) model[3] (versions 11, 12, and 13), three soil moisture schemes, and two vertical-layer[4] resolutions (28 layers versus 41 layers).

Diurnal Temperatures

The Dudhia Cloud scheme overestimated the amount of radiation absorbed and re-radiated by the atmosphere. This resulted in very warm nighttime minimum temperatures. When the RRTM radiation scheme was used rather than the Dudhia Cloud scheme, the simulated temperature range compared very closely with the observed diurnal temperature ranges. The simulated maximum temperatures were too cool compared to the observed maximum temperatures.

Wind Speeds

Wind speeds were analyzed with the Blackadar PBL scheme and the MRF PBL scheme. The Blackadar PBL produced high daytime and nighttime winds, which suggested that the Blackadar approach produced an overly aggressive vertical transfer of momentum. It was also noted that higher winds near the top of the boundary layer may mix to the surface too rapidly. These occurrences can be related to the under prediction of maximum temperatures. The MRF PBL scheme did result in an improved prediction of both daytime and nighttime wind speeds. Nighttime winds were noted to be high however. With the MRF PBL scheme, the daytime maximum temperatures warmed by 1 to 2 K but remained below the observed temperatures.

Soil Moisture

The use of the bucket soil moisture option in the model, rather than the five-layer soil model, produced a consistent increase in wind speed. Maximum temperatures also improved slightly during the final days of the episode.

Vertical Layers

In the modified run, the model was configured to run with 41 layers rather than 28 in order to investigate the effects of increased vertical resolution. Higher resolution (usually more than 30 layers) in the vertical direction is recommended and widely adopted. The run did not indicate improvement in model performance at the boundary layer or at the surface.

---

[2] Shortwave radiation from the sun and longwave radiation from the earth impact atmospheric processes by producing heat, moisture, and momentum exchanges, which drive the PBL.

[3] Four dimensional data assimilation (FDDA) refers to a sophisticated method of initializing a predictive model such as MM5. MM5 and similar models estimate meteorological processes using numerical equations. To make numerical forecasts, the models must have a starting point in which initial conditions are provided in the form of gridded data. FDDA combines numerical predictions with observations to provide a 4-dimensional estimate of initial meteorological parameters. The FDDA technique utilized to develop the refined 1999 episode was the “nudging” technique in which the model is gently pushed toward observed values using numeric equations.

[4] The modeling team employed the “Sigma Coordinate System” in which the lowest vertical coordinate follows a smoothed version of the actual terrain. The higher sigma surfaces parallel the lowest coordinate but gradually transition to being nearly horizontal at the top of the coordinate system, typically above the tropopause. When 28 sigma levels are used, the 8 lowest layers make up the planetary boundary layer. By increasing the vertical layers to 41, additional vertical layers are focused in the boundary layer and jet stream, which provides a higher resolution than the 28-layer system.

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Weather Patterns

Surface pressure patterns predicted by both the Blackadar and MRF runs compared well with observed pressure patterns. Cloud type and coverage across the domain were similar, however the Blackadar runs produced greater amounts of low-level cloudiness over South Texas and Gulf of Mexico on some of the modeling days. Rainfall amounts was not predicted after the 14th of September, which was in concurrence with the observed rainfall levels. A deeper mixed layer was produced by the MRF PBL scheme than the Blackadar runs with heights greater by 25% - 35%.

Evaluation of the Best Performing Simulation

Overall, run 5d produced the best results of the eight sensitivity runs. Wind speed and wind direction improved when comparing run 5d results with the meteorological inputs used in the original 1999 simulation. However, 5d maintained a northerly wind bias throughout much of the episode. Run 5d predicted cooler daily temperatures than observed; but daily minimum temperatures were much closer to observed values than those predicted by other runs. Humidity resulted as erroneous predictions and may be a cause for concern not on model performance but rather errors in the simulation of spatial and temporal evolution of the boundary layer by the PBL scheme, particularly along the coast line. Figure B-2 provides a comparison between observed and predicted (run 5d) wind speeds, wind direction, temperature, and humidity in the San Antonio – Austin region during the September 1999 episode. As shown, there was a high degree of correlation between observed and predicted values for these four meteorological variables.

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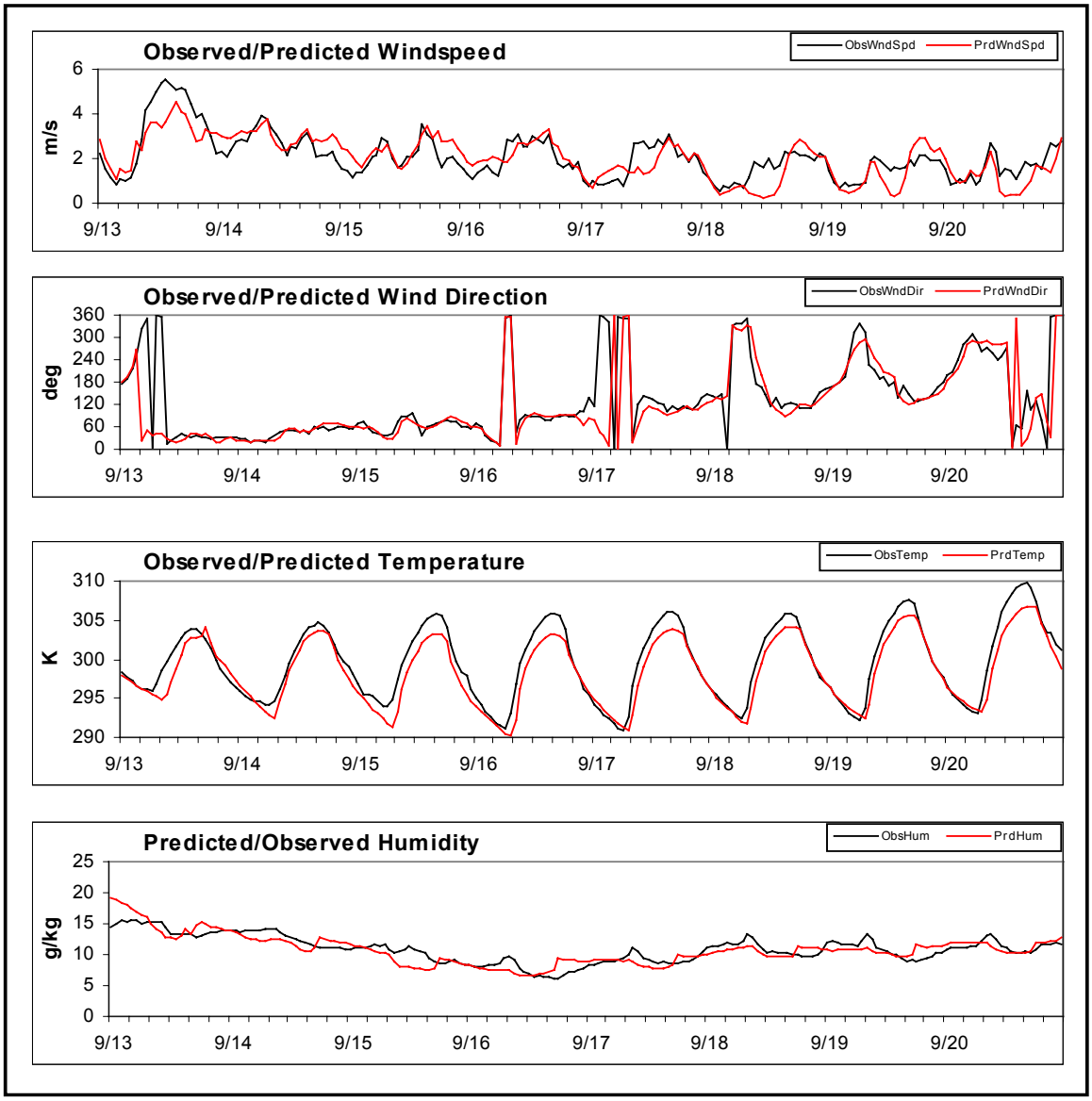
Figure B-2. Observed (black) and Predicted (red) Values for Run 5d for San Antonio/Austin Region



METEOROLOGICAL RUN 6f

The ENVIRON/UT-CEER team also developed a series of meteorological runs which took advantage of new / additional input data from EPA as well as the expanded capabilities of MM5 version 3.5. Improvements within version 3.5 included improvements within known deficiencies and to access additional modeling capabilities. These modifications included:

1. The same four-domain nested mesh with 108/36/12/4-km resolution, but with an expanded 36 km grid in order to move possible 108/36 boundary artifacts away from the area of interest and to better simulate the dominant regional-scale

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meteorology over the entire central U.S. that dictated flow and pressure patterns in Texas during the episode.

2. The coupled Pleim-Xiu Land Surface Model and boundary layer model, which required additional datasets such as soil type, vegetation categories, deep soil temperature, and vegetation fraction archived at the National Center for Atmospheric Research.

3. Three-hourly observational "analysis" fields from the Eta Data Assimilation System, (EDAS) as opposed to EDAS "initialization" data used in previous modeling to establish initial/boundary conditions and inputs to the MM5 Four Dimensional Data Assimilation (FDDA) package.

4. Incorporation of routine surface and upper-air observation data obtained from NCAR archives into the EDAS fields processed for each MM5 modeling grid. This modification was made to ensure that the mesoscale and local meteorological features in the south-central U.S. were faithfully characterized in the EDAS analysis dataset. This preprocessing step was skipped in the original application because it was believed that the relatively high spatial and temporal resolution of the EDAS fields was sufficient to capture these details.

5. Use of the RRTM radiation scheme for all grids, based on the favorable results from the sensitivity tests.

6. Use of two-way interactive nesting for all grids. The 4-km grid was run as an independent one-way nest in the original application.

7. Modifications to the FDDA nudging technique to include two-dimensional surface analysis nudging, altered nudging strengths, and recommendations of Dr. Nelson Seaman at the Pennsylvania State University. The TCOON and NOAA buoy data were also added to the observation FDDA nudging inputs.

These capabilities were not available in version 3.4 of MM5 used to develop the original 1999 simulation, nor were they addressed in runs 5a – 5i. The new runs, labeled 6c – 6f, were each modified to reflect different parameters applied to each run.

Runs 5a – 5i contained a 36 –km grid system that was arranged in 55 X 55 grid cells. The "run 6" series used an expanded 36-km grid system that covered 85 X 61 grid cells. All nested grids within the 108-, 36-, 12-, and 4-km grid system, were run in two-way interactive mode.[5] In contrast, the run 5 series incorporated one-way interaction[6] on the 4-km grid, with 2-way interaction on other nested grids. All "6 series" runs were conducted with 28 vertical layers, since the run 5 series results indicated this resolution performed best.

[5] Finer resolution grids are nested inside of coarser-resolution grids. The information for the outermost grid is supplied from an outside source using one-way interaction. The coarse grids provide boundary conditions on the mesh interfaces between coarse/fine grids. Forecast variables developed in the fine grids are used to update the coarse grids that they cover, resulting in two-way interaction since information flows from coarse to fine grid as well as from fine grid to coarse grid.

[6] In one-way interaction, information flows in one direction: from the coarser grid system to the finer grid system. Computations within the fine model do not affect the larger grid system.

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Cloud options remained consistent with runs 4 and 5, which mainly consisted of treating cloud microphysics with the "simple ice" mechanism.

The run 6 series also varied by the grids in which the settings were modified. For example, the sole difference between runs 6c and 6e was that 6e included initial / boundary condition modifications applied to all grids, whereas these modifications were only applied to the three largest grids in 6c.

ENVIRON/UT also employed a Land Surface Model to improve handling of surface-atmospheric interactions for the run 6 series. The more sophisticated Land Surface Models (LSMs) would provide advantages for mesoscale modeling than did the simple "five-layer" soil model. Surface-atmosphere processes affect the magnitude and direction of sensible and latent heat transfer which then defines boundary layer development, surface temperature, and humidity which are important for successful air pollution modeling. The Pleim-Xiu approach was reputable for outstanding results in air quality planning in other parts of the county therefore was utilized in correlation with the MM5 application.

In addition, the modeling team incorporated supplemental data sets, such as soil type, vegetation categories, and deep soil temperature. The following information describes the revised MM5 applications.

Table B-2. Summary of Revised MM5 Applications

Run ID	Configuration
Run 6c	Includes 2-D surface nudging toward wind, temperature, and humidity analyses, and soil moisture nudging toward surface humidity
Run 6d	Identical to Run 6c, except soil moisture nudging was turned off
Run 6e	Identical to Run 6c, except 2-D analysis and soil moisture nudging was applied to the 4 km domain
Run 6f	Identical to Run 6e, except with additional surface observations from TCOON and NBDC buoy sites in the observation nudging database.

Diurnal Temperatures

The diurnal temperature range was suppressed, resulting in cooler afternoon maxima and warmer morning minima. In run 6d, temperatures improved significantly when the soil moisture nudging was turned off yet still produced worse results than in run 4c. Run 6e had comparable diurnal temperatures to the 4c original run.

Wind Speed

Wind speed trends in run 6c were much better simulated than in the 4c original run. The speeds were stronger in the afternoon and lighter at night. The first four days of the simulation had wind speeds that were overpredicted. However, wind speeds during September 17th through September 20th corresponded well to the observed wind speeds. Run 6d resulted in stronger wind speeds. Run 6e predicted wind speeds and direction which were compatible to observed levels.

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Weather Patterns
Diurnal trends of moisture were not predicted well in run 6c as compared to the run 4c. Run 6d had poor moisture performance on all modeling days. Humidity in run 6e was generally higher than the other runs but most closely matched observed values.

Evaluation of the Best Performing Simulation
The final run, 6f, incorporated additional surface observation data from the Texas Coastal Ocean Observation Network and the National Buoy Data Center. Of this series, run 6f was considered the best performing simulation. Run 6f predicted temperature and humidity more accurately than 5d and demonstrated improved wind speed and wind direction when compared to the original 1999 simulation. However, the improved wind statistics for 6f were inferior to the improvements demonstrated by 5d. Furthermore, the boundary layer patterns from 6f were considered questionable. (ENVIRON, 2003) This is shown graphically in figure B-3, which compares the mixing height between the original model, 5d, and 6f. The graph for 6f displays an area of suppressed mixing that appears to track a swath of sandy soil from southern San Antonio to Bryan, Texas. According to ENVIRON, this indicates the run 6f configuration was excessively sensitive to sandy soil.

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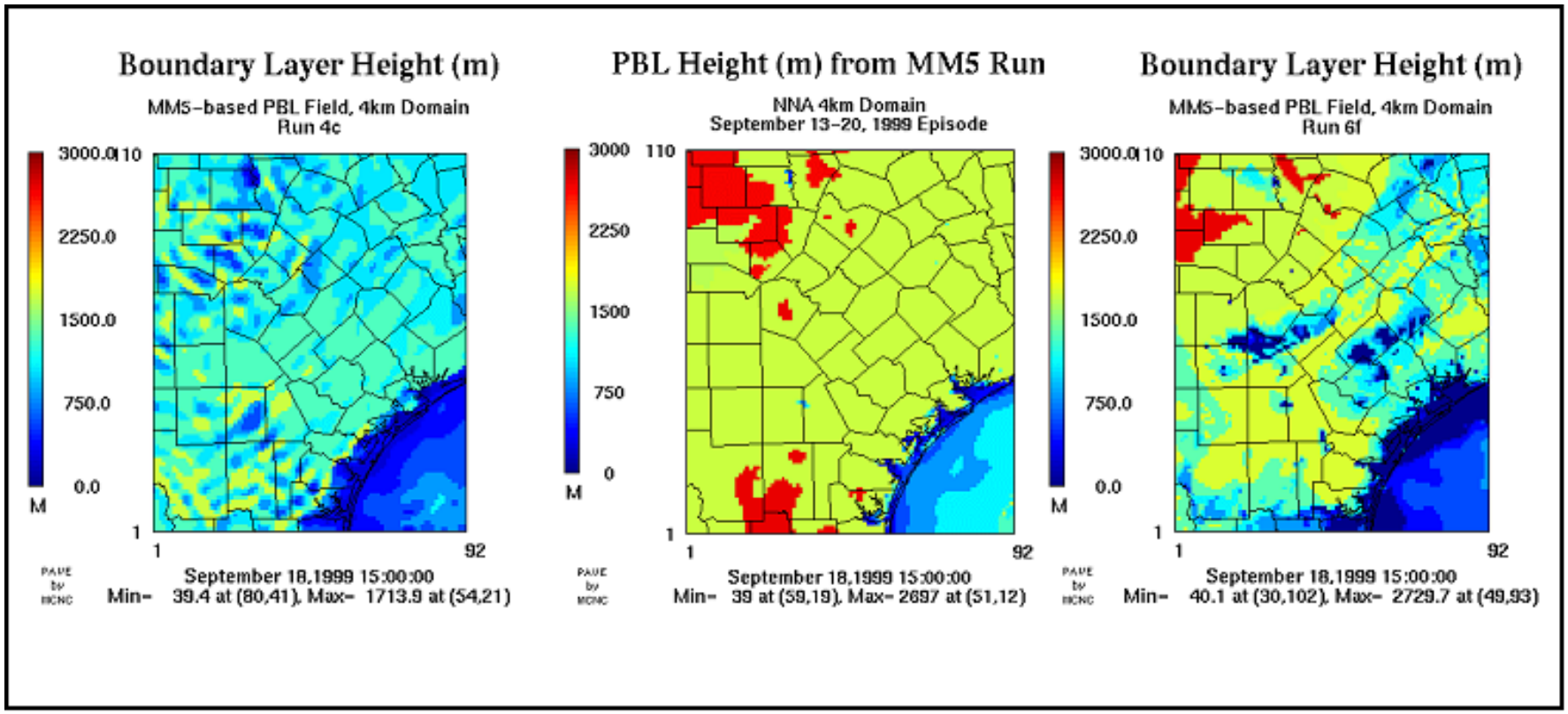
Figure B-3. Comparison of the Mixing Height Between the Original Model (Run 4c), 5d, and 6f



FINAL MM5 CONFIGURATION

Overall, the ENVIRON/UT-CEER team considered run 5d to outperform all other 5 and 6 series runs. Their conclusions were based on measurements as to how accurately the runs simulated observed conditions as well as other performance statistics. These performance results are shown in figures B-4 through B-7. Figure B-4 provides a comparison of observed wind speed, wind direction, temperature, and humidity with values predicted by the original meteorological model, run 5d, and 6f. Figures B-5 through B-7 provide statistical measures of performance for wind speed / direction, temperature and humidity, respectively.

Figure B-4. Comparison of Wind Speed and Direction, Temperature, Humidity Statistics for Original Meteorological Model Run (black), 5d (red), and 6f (blue) for San Antonio – Austin

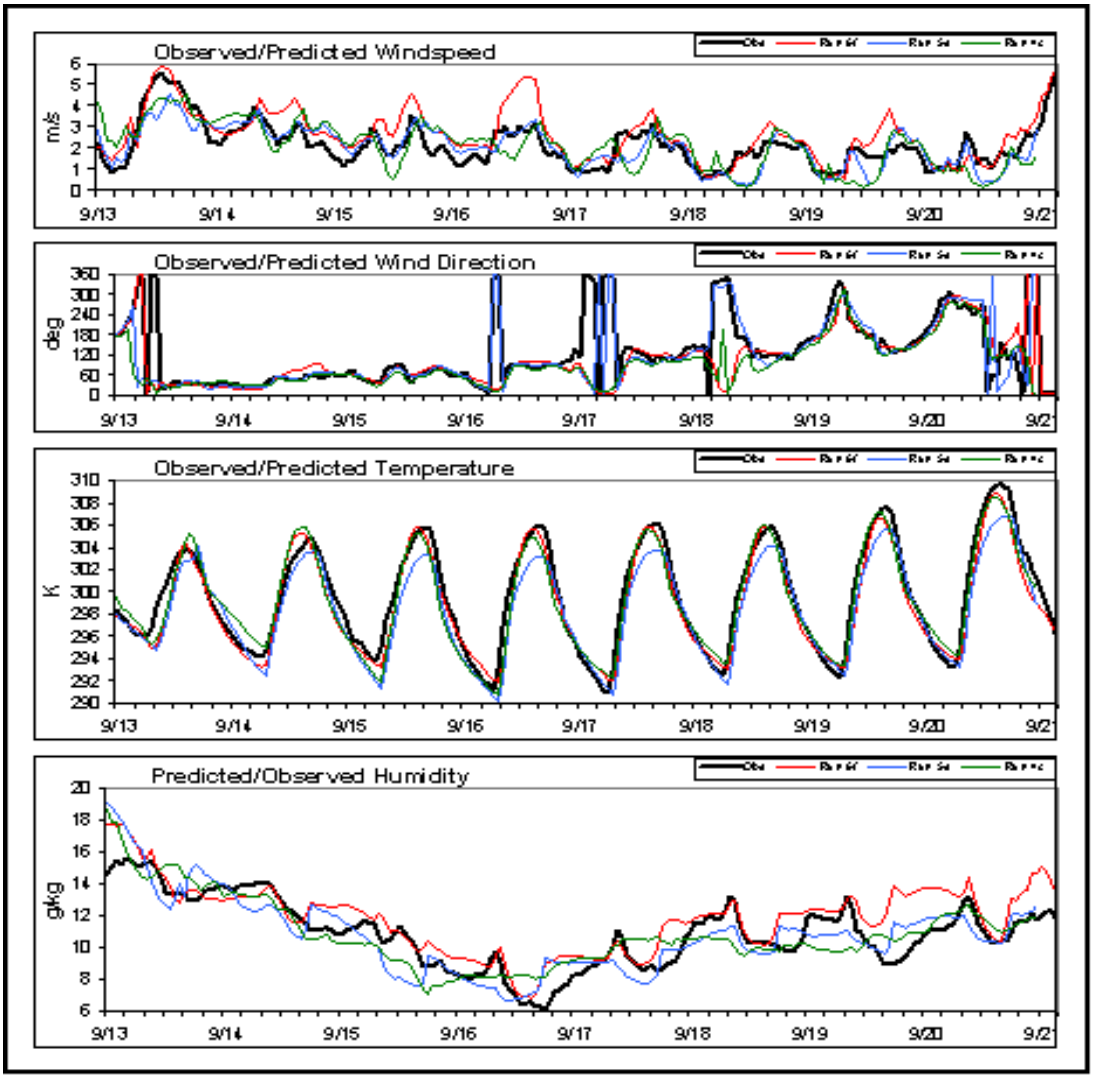


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Figure B-5. Wind Statistics for Original Meteorological Model Run (black), 5d (red), and 6f (blue) for San Antonio – Austin Region

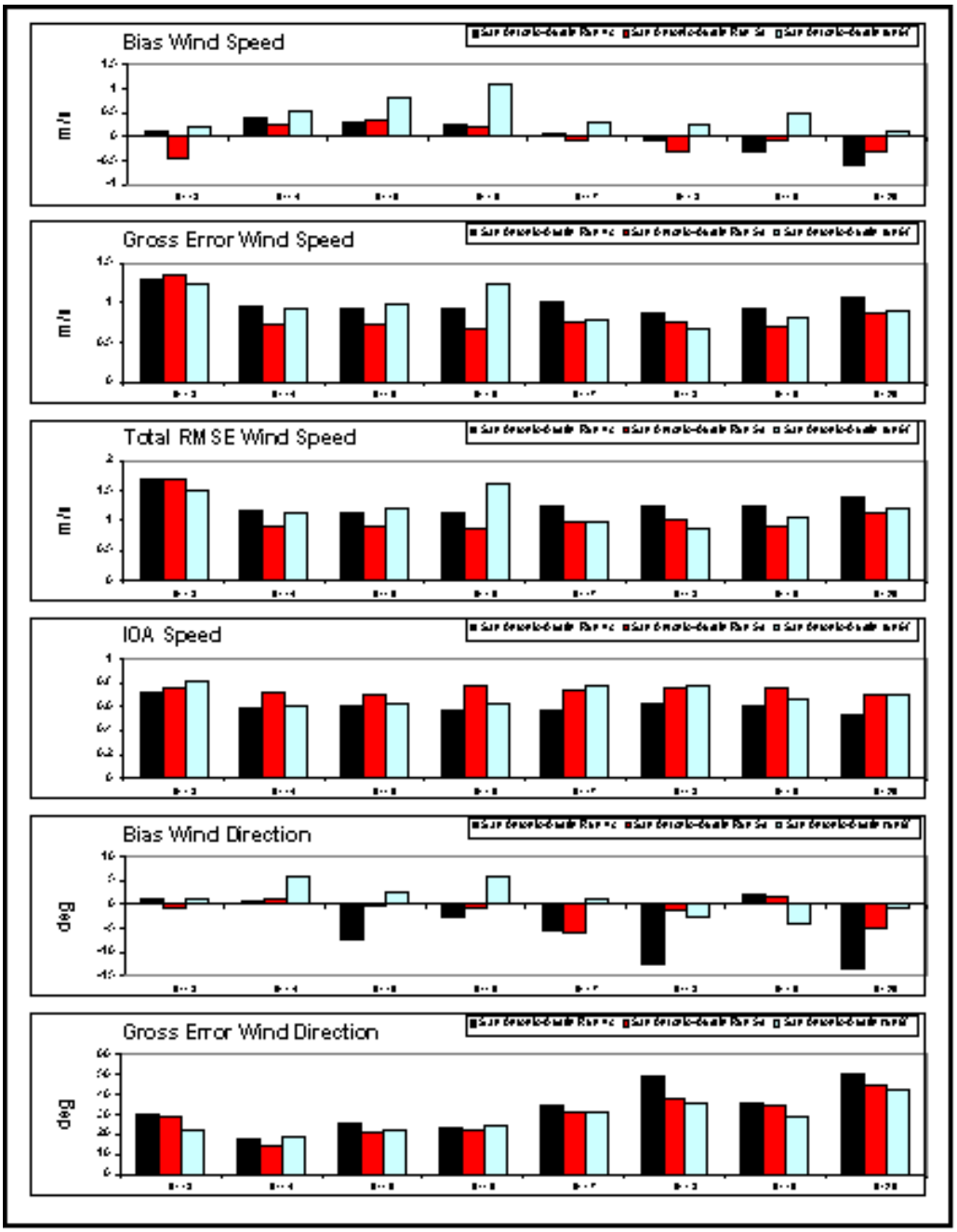

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Figure B-6. Temperature Statistics for Meteorological Model Run (black), 5d (red), and 6f (blue) for San Antonio – Austin Region

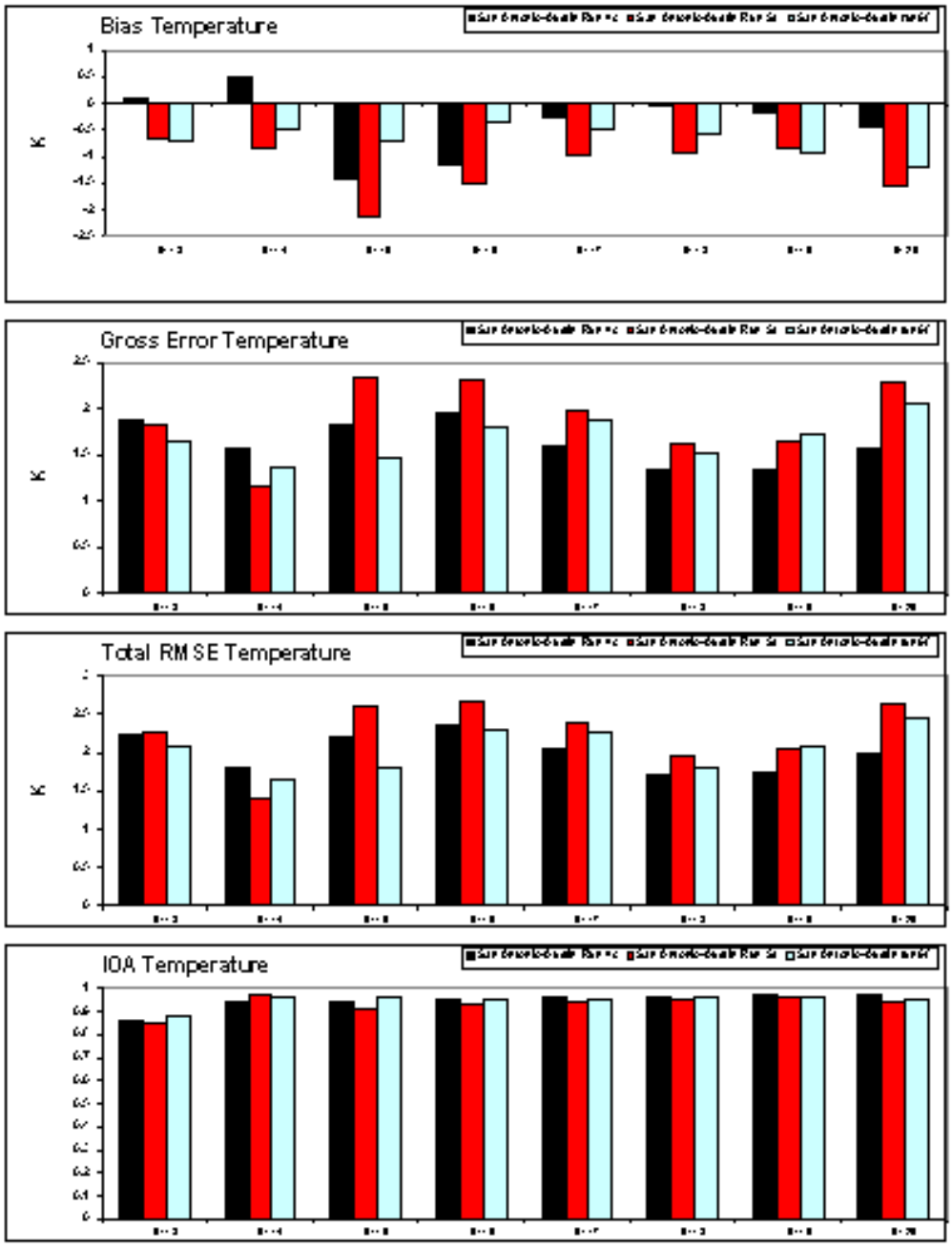

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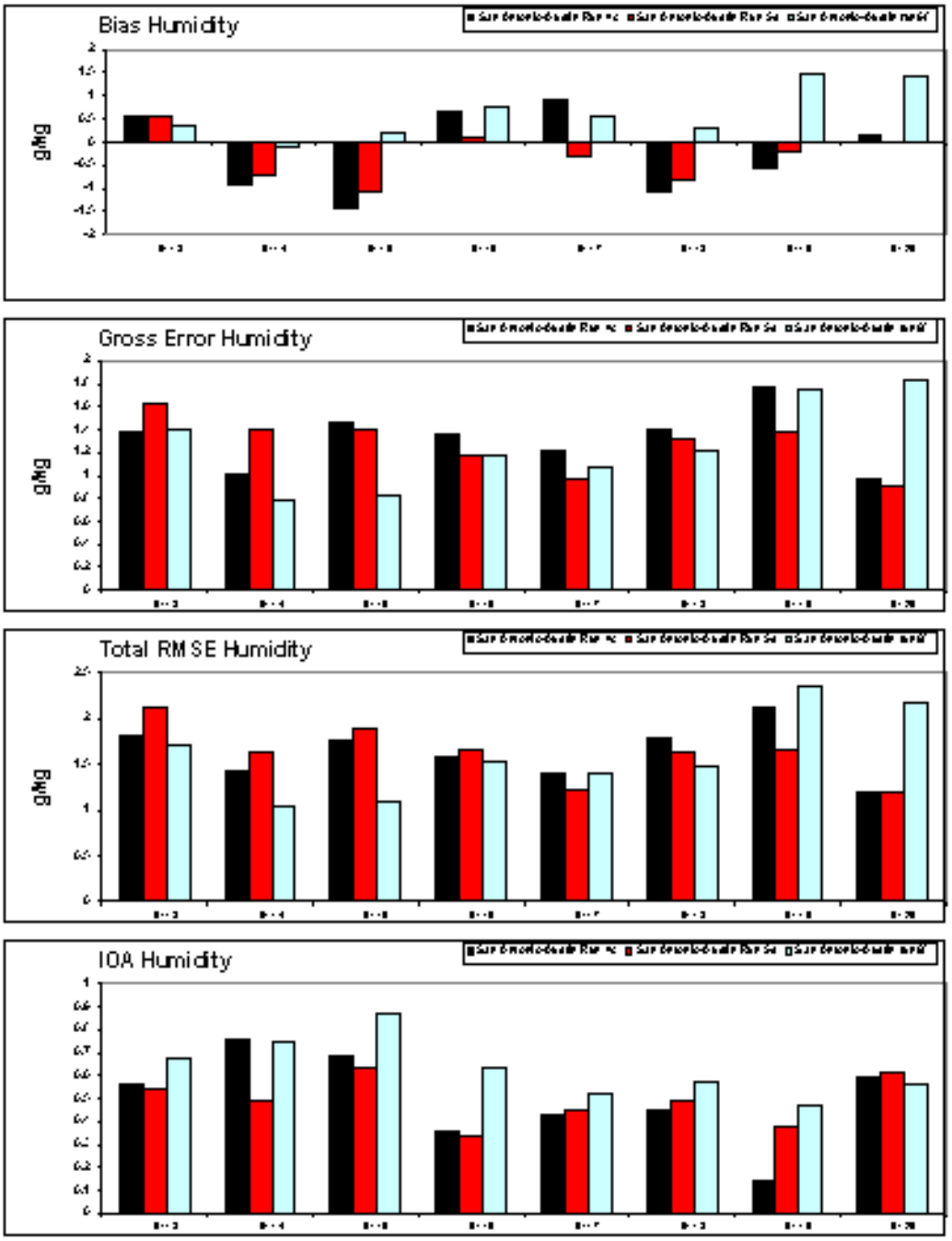
Figure B-7. Humidity Statistics for Original Meteorological Model Run (black), 5d (red), and 6f (blue) for San Antonio – Austin Region



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METEOROLOGICAL RUN 5g

The ENVIRON/UT-CEER team undertook one additional run to merge the best configurations of the 5 and 6 series runs. The team recommended that the MM5 Run 5d set of meteorological fields for the photochemical model be used in combination with important FDDA and input database changes adopted in MM5 Run 6f, but the MRF PBL scheme and five-layer soil model of Run 5d be maintained. This configuration included:

- 28 sigma levels
- Expanded 36-km domain used in Run 6f
- Two-way interactive 108/36/12/4-km grids
- FDDA analysis nudging on the 108/36/12-km grids:
    - 3-D analysis nudging: MM5 was lightly nudged toward 3-hourly gridded EDAS analysis of winds (in the boundary layer and aloft) and temperature and humidity (only above the boundary layer), which were improved by the blending of routine surface and upper-air observational data
    - 2-D surface analysis nudging: MM5 was lightly nudged toward 3-hourly gridded surface analyses of winds, temperature, and humidity generated by the RAWINS program.
- Observation nudging on the 12/4-km grids: MM5 was strongly nudged toward discrete hourly wind observations from routine and special measurement networks operating in Texas during the episode.
- MRF PBL
- Simple ice cloud microphysics
- Kain-Fritsch cumulus parameterization except on 4-km grid
- Five-layer soil model
- RRTM radiation scheme
- Reduced soil moisture and thermal inertia to account for drier conditions

The results of run 5d and 5g are very comparable; for example, both runs predicted similar PBL heights. However, there were strengths / weaknesses found in both models. Run 5g out-performed 5d in terms of predicting temperature and humidity. Conversely, run 5d out-performed 5g in terms of wind speed and ground-level wind direction. Run 5g wind speed and direction predictions for Central Texas during the first half of the episode were slightly degraded compared to Run 5d; however, along the coast, Run 5g showed enhanced onshore afternoon flow that was in better agreement with observations. Figures B-8 through B-11 provide comparisons of wind speed, wind direction, temperature, and humidity, between observed values and values predicted by runs 5d and 5g.

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Figure B-8. Hourly Wind Speed for Runs 5d and 5g in the 4-km San Antonio Area Domain

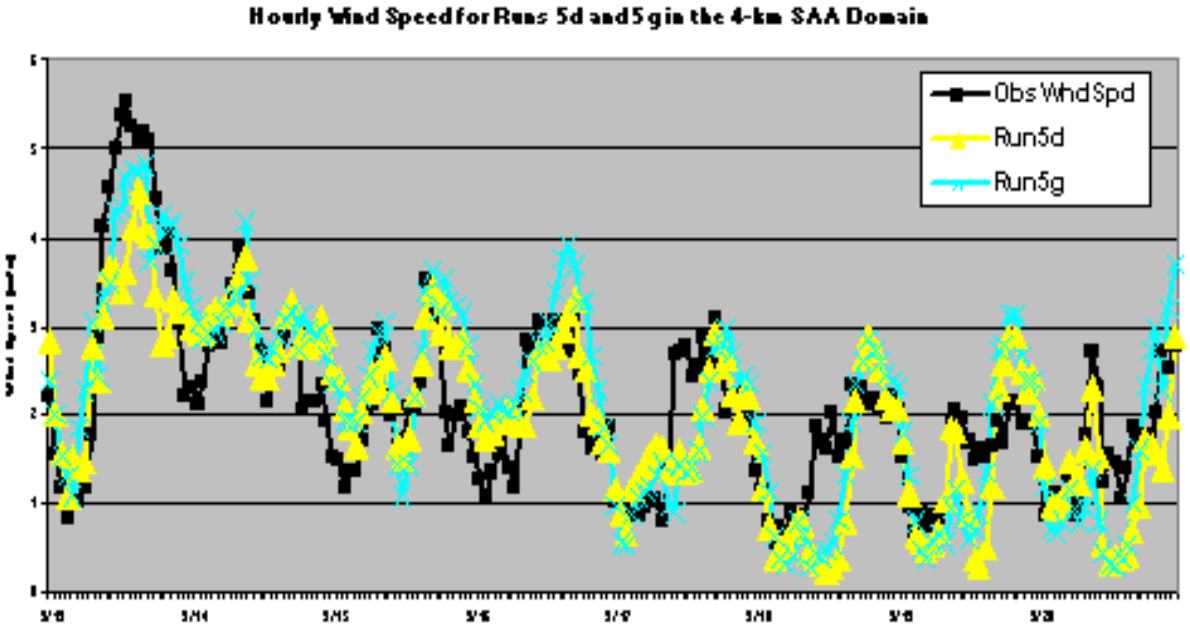

Figure B-9. Hourly Temperature for Runs 5d and 5g in the 4-km San Antonio Area Domain.

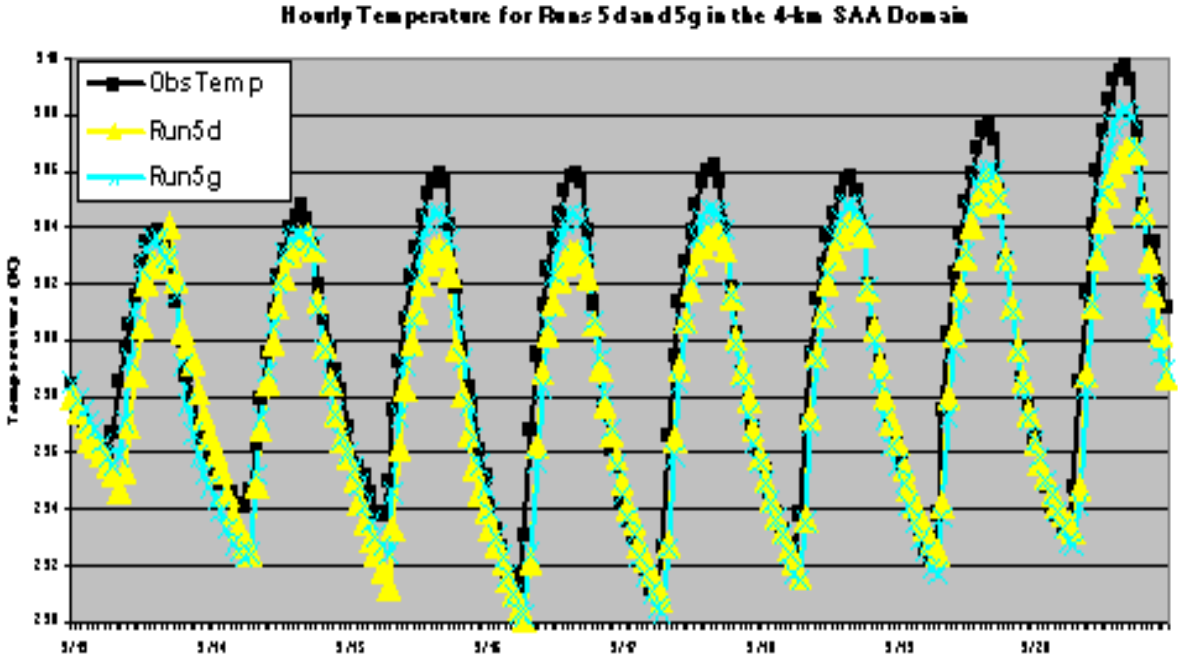

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Figure B-10. Hourly Wind Direction for Runs 5d and 5g in the 4-km San Antonio Area Domain

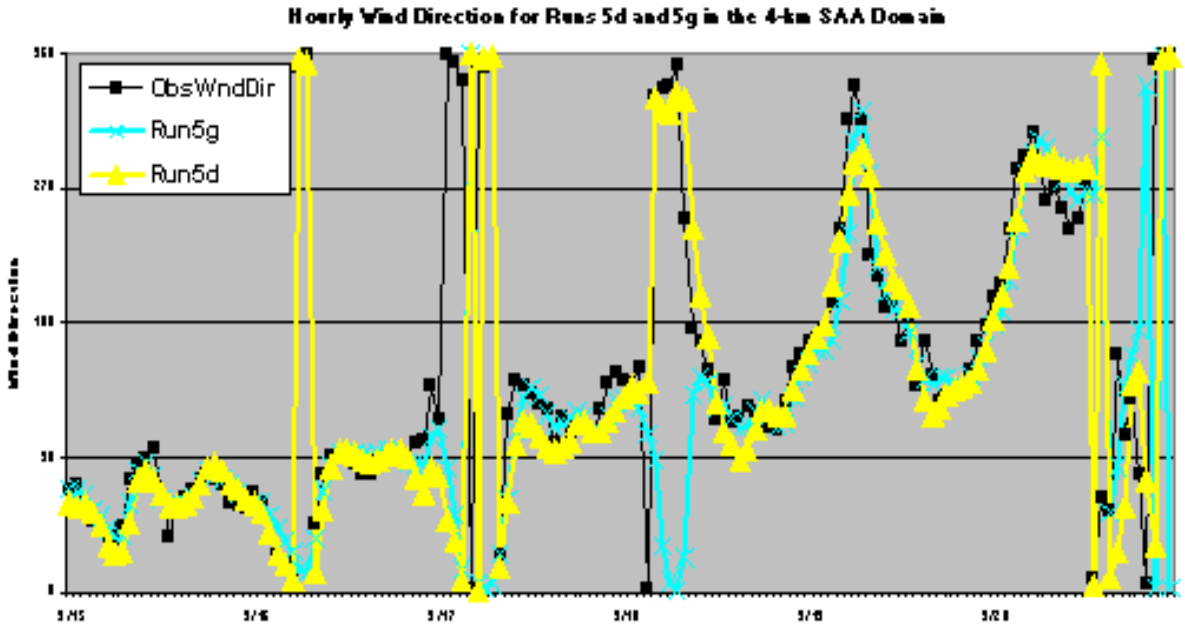
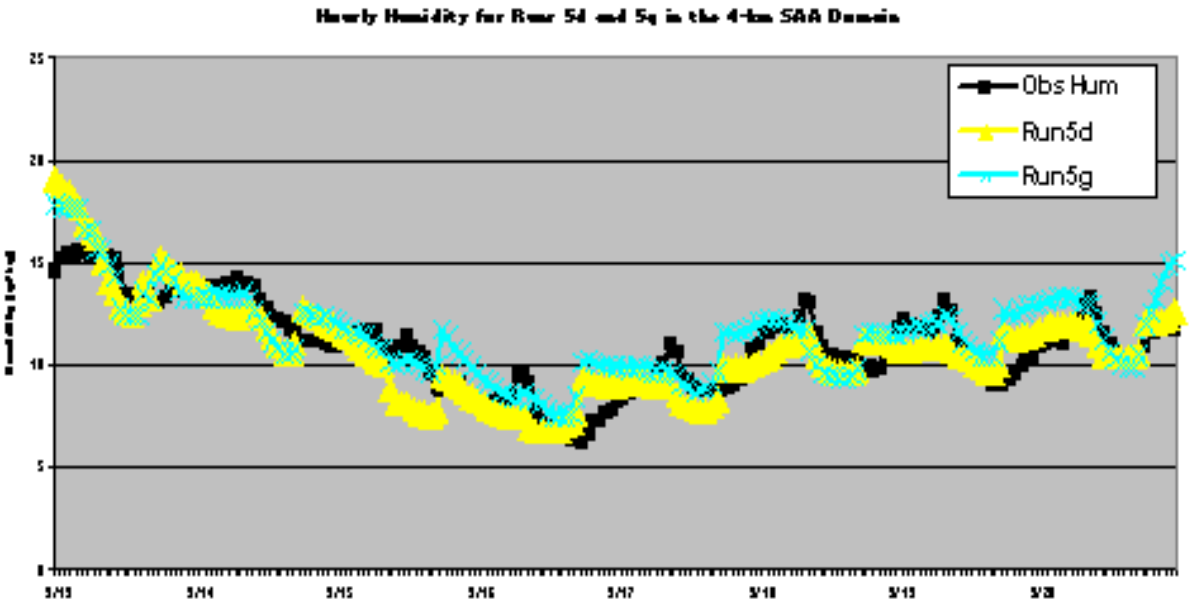


Figure B-11. Hourly Humidity for Runs 5d and 5g in the 4-km San Antonio Area Domain.



Since the results of the 5d and 5g wind speed/direction, temperature, and humidity comparisons were inconclusive in terms of which one was the superior meteorological

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run, additional analyses were conducted. These included running the two meteorological simulations through the CAMx photochemical model to determine the impact each run had on predicting ozone levels; and further, comparing the photochemical results to the Baylor aircraft sampling data for the time and altitude of the flights. The two photochemical runs, labeled run 14 (using the 5d meteorological run) and run 16 (using the 5g meteorological run) were identical with the exception of the meteorological inputs.

A problem that was significant in the San Antonio area was aloft wind direction. While the model performed well in replicating peak ozone aloft in the urban plumes with the original Met 3b run for the 17th and 18th, the spatial distribution was poor, indicating a problem with wind direction at those altitudes. The data collected from the Baylor aircraft flights were compared to predictions from the 1999 model simulation for the same days for Met Run 5d and 5g. Figure B-12 provides a comparison between the aircraft data collected by Baylor University and ozone levels predicted by the model for the correct time period and altitude of the flights. As shown in the figure, the peak ozone plumes predicted by the model are vastly improved.

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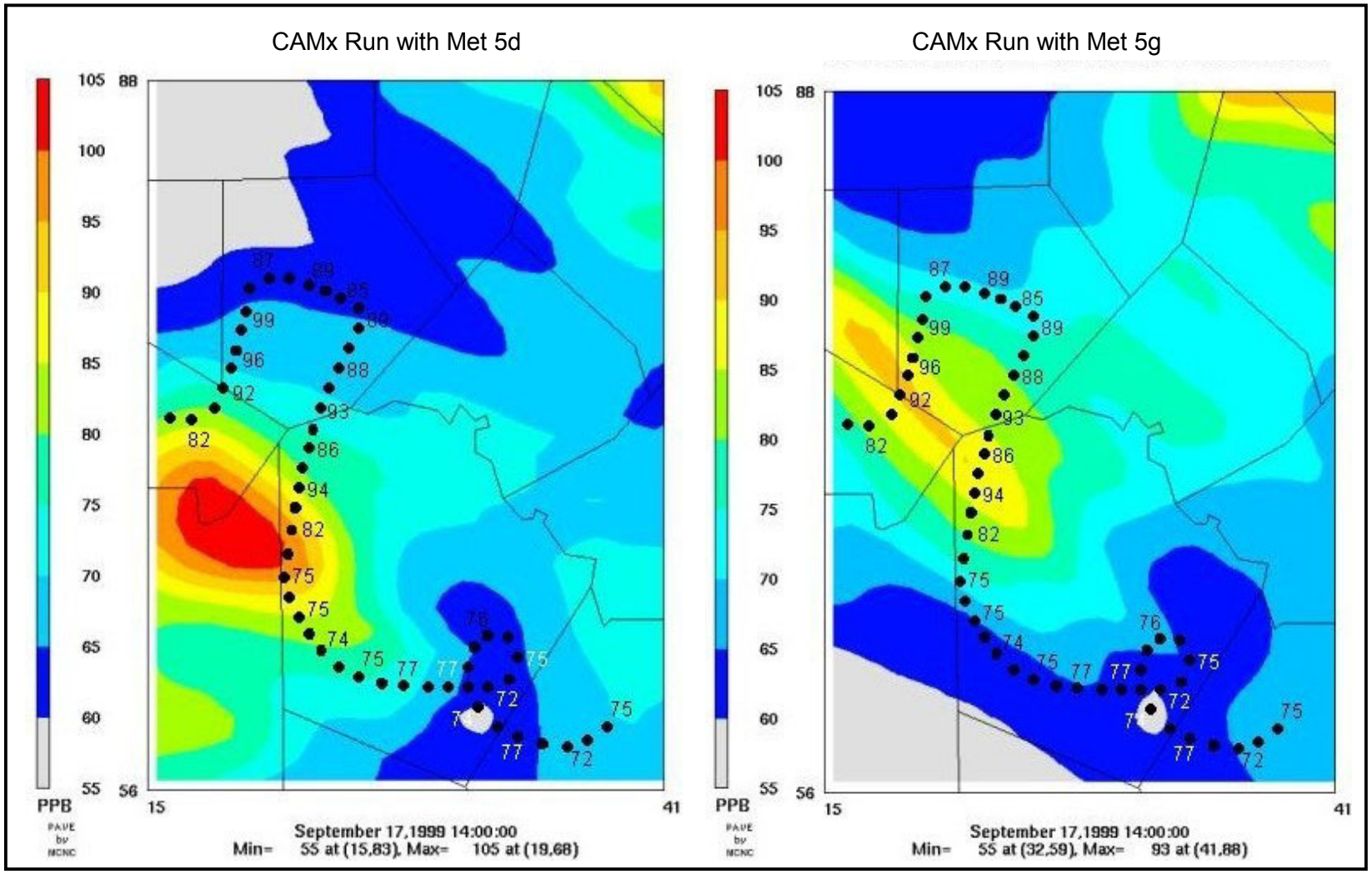
Figure B-12. Comparison of Ozone Levels Measured during Baylor University Airborne Sampling Project on September 17th with Ozone Levels Predicted by Met 5d and 5g Model Simulation for Time of Day and Altitude of Flights. (Dotted line represents collected ozone data in parts per billion (ppb).)



STATISTICAL EVALUATION OF MM5 RUN 5g

The University of Texas at Austin provided the following information regarding the statistical evaluation of the MM5 model performance. Winds, temperature, and humidity were quantitatively assessed to analyze MM5 performance at all available surface observation stations across the 4-km domain. The METSTAT program developed by ENVIRON (2001) was utilized for the evaluation. The METSTAT program generates pairing of observations and predictions and calculates statistical measures for wind speed, wind direction, temperature, and humidity. The following statistical metrics were examined:

- Bias error – mean difference between pairings of predicted and observed data over a region.
- Gross error – mean absolute value of difference between pairings of predicted and observed data over a region.
- Root Mean Square Error (RMSE) – the square root of the mean of the squared difference between pairings of predicted and observed data over a region.
- Index of agreement (IOA) – at each monitoring site, calculate the sum of the absolute value of the difference between the prediction and the mean of the observations and the absolute value of the difference between the observation and the mean of the observations. These sums are added over all monitoring sites and divided into the square of the RMSE. This value is then subtracted from one.

Performance goals for the above parameters were established from a comparison of statistical summaries of the results of nearly thirty regional meteorological model simulations used to drive photochemical models throughout the country. Performance goals were chosen to establish a level of performance that most past modeling has achieved and to filter out those applications that exhibit particularly poor performance. It should be stressed that these goals are guided by the results of meteorological models that have been accepted and used in support of historical regulatory photochemical air quality modeling efforts. The performance goals will require refinement as the state of the science of meteorological modeling improves.

Comparisons of mean daily statistics on the 4-km grid against the statistical benchmarks are summarized in table B-3 for the San Antonio/Austin, Corpus Christi/Victoria, and Houston/Galveston sub-domains. The importance of the various meteorological input fields on CAMx air quality modeling can be ranked as follows (in descending order):

1. Surface and vertical profiles of wind speed/direction;
2. Boundary layer mixing depth and intensity;
3. Temperature (primarily the extent to which it influences boundary layer characterization, but secondarily, the extent to which it affects chemical reaction rates);
4. Humidity and clouds (assuming cloud cover was insignificant, which was the case during this episode).

The table B-3 reveals that excellent performance for wind speed and direction and good performance for temperature and humidity was achieved by the Run 5g simulation on the 4-km domain. The reader is cautioned that these results are based on comparisons to observations obtained from ground-level monitoring stations. Upper air observations

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in the 4-km domain were limited to two locations. Vertical profiles of observed wind, temperature, and humidity were available from the Corpus Christi National Weather Service rawinsonde station. Vertical profiles of boundary layer winds were available from a special air quality study (Big Bend Regional Aerosol and Visibility Observational) profiler located in Llano, Texas. Run 5g and Run5d achieved the best performance at these two monitoring stations.[7] (EMERY, C.A., et. al., 2003)

Table B-3. Comparison of Mean Daily Statistics Against Statistical Benchmark for the 4-km grid.[8]

Parameter	Benchmark	Episode Mean		
		Austin/ San Antonio	Corpus Christi/ Victoria	Houston/ Galveston/ Beaumont/ Port Arthur
Wind Speed RMSE*	<2.0 m/s	1.2	1.3	1.3
Wind Speed Bias	± 0.5 m/s	0.0	0.5	0.4
Wind Speed IOA**	>0.60	0.68	0.81	0.63
Wind Direction Gross Error	<30 deg	36	23	30
Wind Direction Bias	± 10 deg	-6	-5	2
Temperature Gross Error	<2.0 K	2.1	1.3	1.5
Temperature Bias	± 0.5 K	-1.3	0.4	-0.6
Temperature IOA**	>0.80	0.92	0.92	0.95
Humidity Gross Error	<2.0 g/kg	1.4	2.4	1.1
Humidity Bias	± 1.0 g/kg	-0.3	-1.6	-0.3
Humidity IOA**	>0.60	0.47	0.53	0.61

* RMSE: root mean square error
**IOA: index of agreement

Processing of MM5 Meteorological Fields for CAMx

Meteorological data from the Run5g simulation were used to generate the required three-dimensional gridded meteorological fields shown in table B-4 for the September 13-20, 1999 CAMx model. The MM5 output fields were translated to CAMx-ready inputs using ENVIRON's MM5CAMx translation software. This program performs several functions:

- Extracts wind, temperature, pressure, humidity, cloud, and rain fields from each MM5 grid that matches the corresponding CAMx grid;
- Performs mass-weighted vertical aggregation of data for CAMx layers that span multiple MM5 layers;
- Diagnoses fields of vertical diffusion coefficient (Kv), which are not directly output by MM5 (Kv was diagnosed using the O'Brien 1970 method);

[7] Emery, C.A., E. Tai, and G. McGaughey. 2003b. "Revised Meteorological Modeling of the September 13-20, 1999 Texas Ozone Episode – Final Report." Prepared for The Texas Joint Near Nonattainment Areas and Texas Commission on Environmental Quality, by ENVIRON International Corporation, 101 Rowland Way, Novato, CA 94945 and the University of Texas at Austin, Center for Energy and Environmental Resources, 10100 Burnet Road, MS R7100, Austin, TX 78758. 31 March 2003

[8] Value in red denotes statistics outside the benchmark.

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Table B-4. Meteorological Data Requirements for CAMx.

CAMx Input Parameter	Description
Layer interface height (m)	3-D time-varying layer heights for the start and end of each hour
Winds (m/s)	3-D wind vectors (u,v) for the start and end of each hour
Temperature (K)	3-D temperature and 2-D gridded surface temperature for the start and end of each hour
Pressure (mb)	3-D pressure for the start and end of each hour
Vertical Diffusivity (m^2/s)	3-D vertical exchange coefficients for each hour
Water Vapor (ppm)	3-D water vapor mixing ratio for each hour
Cloud Cover	3-D cloud cover for each hour
Rainfall Rate (in/hr)	2-D rainfall rate for each hour

The MM5CAMx program has been written to carefully preserve the consistency of the predicted wind, temperature, and pressure fields output by MM5. This is important for preparing mass-consistent inputs, and consequently, for obtaining high quality performance from CAMx.

Most data prepared by MM5CAMx were directly input to CAMx. A single 40-meter deep CAMx surface layer was extracted from aggregation of the lowest two 20-meter MM5 layers. The structures for vertical layers for MM5 and CAMx are shown in table B-5. The CAMx vertical layer structure is consistent with recommendations described in the EPA's 8-hour modeling guidance (EPA, 1999) which specifies that the surface layer should be no more than 50 meters deep, no layer beneath the mixing height should be greater than about 300 meters thick, 7-9 vertical layers with the planetary boundary layer and 1-2 layers above it. (Emery, C.A., et. al., 2002)

The horizontal extent of the MM5 4-km domain was defined to be much larger than the CAMx 4-km domain (the MM5 domain reached to the Texas-Louisiana border). The differences in spatial extents of the domains could lead to inconsistencies in the flow and hydrodynamic fields just inside and along the eastern boundary of the CAMx 4-km grid and 12-km grids, if meteorological fields for the 12-km CAMx grid were derived only from the 12-km MM5 output. To ensure consistency for this portion of the CAMx grids, an alternative approach was designed. The 4-km meteorological output fields were extracted for the entire MM5 4-km grid coverage using MM5CAMx, averaged to 12-km resolution, then used to replace the meteorological fields on that portion of the CAMx 12-km grid.

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Table B-5. Vertical Layer Structure for MM5 and CAMx for Sept. 13-20, 1999 Episode

k	sigma	pressure	height	thickness	CAMx Layers
28	0.0000	50.00	18874.41	1706.76	
27	0.0250	73.75	17167.65	1362.47	
26	0.0500	97.50	15805.17	2133.42	
25	0.1000	145.00	13671.75	1664.35	
24	0.1500	192.50	12007.40	1376.75	
23	0.2000	240.00	10630.65	1180.35	
22	0.2500	287.50	9450.30	1036.79	
21	0.3000	335.00	8413.52	926.80	
20	0.3500	382.50	7486.72	839.57	
19	0.4000	430.00	6647.15	768.53	
18	0.4500	477.50	5878.62	709.45	
17	0.5000	525.00	5169.17	659.47	
16	0.5500	572.50	4509.70	616.58	
15	0.6000	620.00	**3893.12**	579.34	--12---
14	0.6500	667.50	3313.78	546.67	
13	0.7000	715.00	**2767.11**	517.77	--11---
12	0.7500	762.50	2249.35	491.99	
11	0.8000	810.00	**1757.36**	376.81	--10---
10	0.8400	848.00	**1380.55**	273.60	---9---
9	0.8700	876.50	**1106.95**	266.37	---8---
8	0.9000	905.00	**840.58**	259.54	---7---
7	0.9300	933.50	**581.04**	169.41	---6---
6	0.9500	952.50	**411.63**	166.65	---5---
5	0.9700	971.50	**244.98**	82.31	---4---
4	0.9800	981.00	**162.67**	65.38	---3---
3	0.9880	988.60	**97.29**	56.87	---2---
2	0.9950	995.25	**40.43**	20.23	---1---
1	0.9975	997.62	20.19	20.19	
0	1.0000	1000.00	**0.00**	==========Surface======	

An alternative set of vertical diffusivity input fields were developed for CAMx. Vertical diffusivities (K_v) are important inputs to the CAMx model because they determine the rate and depth of mixing in the PBL and above. Original diffusivity fields derived by MM5CAMx were passed through an additional algorithm that sets minimum Kv values between layers 1 and 2 to ensure that nocturnal stability near the surface is not over-stated. The minimum value is tied to the land use (e.g., urban, forest, agricultural, water, etc.) to represent different impacts of mechanical mixing and surface heat input (e.g., urban heat island effect).

References:

Emery, C.A, E. Tai., G.M. Wilson, and G. Yarwood. 2002. "Development of a Joint CAMx Photochemical Modeling Episode for the Four Southern Texsa Near Non-Attainment Area." Prepared for the Texas Near Non-Attainment Areas through the Alamo Area Council of Governments, by ENVIRON International Corporation, 101 Rowland Way, Novato, CA 94945. 3 April 2002.

Emery, C.A., E. Tai, and G. McGaughey. 2003. "Revised Meteorological Modeling of the September 13-20, 1999 Texas Ozone Episode – Final Report." Prepared for The Texas Joint Near Nonattainment Areas and Texas Commission on Environmental Quality, by ENVIRON International Corporation, 101 Rowland Way, Novato, CA 94945 and the University of Texas at Austin, Center for Energy and

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Environmental Resources, 10100 Burnet Road, MS R7100, Austin, TX 78758. 31 March 2003

ENVIRON, UT/CEER 2003 presentation "Revised MM5 Modeling for the Texas Joint NNAs", slide 50

United States Environmental Protection Agency (EPA), 1999. "Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS. EPA 454/R-99-004, U.S. Environmental Protection Agency, Research Triangle Park, NC. May 1999.

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APPENDIX C

ON-ROAD MOBILE EMISSIONS INVENTORY DEVELOPMENT

SAN ANTONIO EAC REGION ATTAINMENT DEMONSTRATION

MARCH 2004

Texas Transportation Institute

San Antonio Metropolitan Statistical Area On-Road Mobile Source Modeling Emissions Inventories: 1999, 2007, and 2012

TEXAS TRANSPORTATION INSTITUTE
THE TEXAS A&M UNIVERSITY SYSTEM
COLLEGE STATION, TEXAS

Sponsored by the
Texas Commission
On Environmental Quality
June 2003

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TECHNICAL NOTE

Transportation Air Quality Technical Support Interagency Contract with Texas Commission on Environmental Quality

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TO: Mary McGarry-Barber, Project Manager
Texas Commission on Environmental Quality

DATE: 12 June 2003

FROM: Dennis G. Perkinson, Ph.D.,
Martin E. Boardman and
L.D. White
Texas Transportation Institute

SUBJECT: San Antonio Metropolitan Statistical Area On-Road Mobile Source Modeling Emissions Inventories: 1999, 2007, and 2012
(Umbrella Contract 3-60200-04: Task 01) - **Review Draft**

INTRODUCTION

This technical note documents the methods the Texas Transportation Institute (TTI) used to develop 1999, 2007 and 2012 September day-of-week hourly on-road mobile source emissions inventories (EIs) for the four San Antonio Metropolitan Statistical Area (SA/MSA) counties. These EIs are for the four ozone episode days, September 17 - 20, 1999 (a Friday, Saturday, Sunday, and Monday). The results are produced in the form of photochemical model-ready input as well as in tabular summaries. This task is in support of the SA/MSA Early Action Compact air quality analyses.

The four SA/MSA counties are Bexar, Comal, Guadalupe, and Wilson. The emissions basis for each county may be distinguished as either link or virtual link. Emissions are estimated on a transportation network link basis for counties with travel demand models (TDM) available (Bexar). Emissions are estimated on a "virtual" link basis, or Highway Performance Monitoring System (HPMS) functional class/area type level, for counties without complete TDMs available (Comal, Guadalupe, and Wilson).

The September 1999 episode day climate inputs were used for all evaluation years. Emissions estimates were developed based on September activity characteristic of the four day types: Weekday (average Monday through Thursday), Friday, Saturday, and Sunday.

Emissions of volatile organic compounds (VOC), carbon monoxide (CO), and oxides of nitrogen (NOx), are estimated for each county and day type on an hourly basis. Emissions are categorized by 28 vehicle types and 14 pollutant-specific emissions types. Geographical coordinates are provided for the TDM network links.

Documented in this technical note are the methods relating to calculating inventory elements including vehicle miles traveled (VMT), speeds, VMT mix, MOBILE6 emissions factors, and emissions estimates.

ACKNOWLEDGMENTS
Chris Kite, with the Texas Commission on Environmental Quality (TCEQ), and Martin Boardman and L.D. White, of TTI, contributed to the development of the MOBILE6 emissions factors input data parameter values. Boardman produced the MOBILE6 model set-ups used, and performed the emissions factors analyses. Dennis Perkinson, Ph.D., of TTI, developed VMT growth factors, seasonal day-of-week VMT adjustment factors, hourly VMT allocation factors, and VMT mix. White processed TDM-based VMT and modeled congested link speeds. Boardman processed HPMS-based VMT and modeled congested virtual link speeds and performed the emissions estimations. Each member of the assigned TTI staff contributed to the quality assurance of the EI elements. Dr. Perkinson was the principle investigator for this project. This work was performed by TTI under contract to TCEQ. Mary McGarry-Barber was the TCEQ project technical manager.

Deliverables
Interim deliverables are an informal Technical Note (a narrative in memorandum format that explains the task, the approaches used, and the findings) provided to the Project Manager in WordPerfect 6/7/8 format, and supported by electronic document files. All pertinent data are being submitted in specified electronic format. (There is no FORTRAN source code or executable files developed under this task.) CD-ROM is used to record the final data and supporting documentation. TTI is providing five copies of the final report. One of the copies is an unbound original suitable for copying. Electronic copies of all materials related to the task report to document results and conclusions (e.g., data, work files, text files, etc.), or developed as work products under this contract are provided as requested by the TCEQ staff.

SUMMARY OF VMT AND EMISSIONS
Table 1 through Table 4 summarize the SA/MSA episode day emissions results by day type — Weekday, Friday, Saturday, and Sunday — respectively. Each table summarizes the daily total VMT, average speed (24-hour VMT divided by vehicle hours traveled [VHT]), and VOC, CO, and NOx emissions (tons) for each of the three analysis years by county and for the MSA.

The full results of the emissions analyses include: 1) individual county hourly link-emissions files in the detailed disaggregate photochemical model preprocessor input format, and 2) summary EI data files with hourly and 24-hour county, vehicle type, and road type summaries of VMT, VHT, average speeds, and emissions estimates. These data files for each evaluation year and day type are provided on CD-ROM. The data files are described in Appendix A.

Table 1
SA/MSA September Weekday* On-road Mobile Source
VMT, Average Speed, and Emissions of VOC, CO, NOx (Tons)

Year	County	VMT	Speed	VOC	CO	NOx
1999	**Bexar**	35,568,471	28.7	82.09	936.22	121.87
	Comal	3,050,355	46.4	6.15	82.59	11.65
	Guadalupe	2,745,268	45.9	5.57	74.59	10.47
	Wilson	751,538	43.0	1.57	19.89	1.89
	Total	42,115,632	30.5	95.38	1,113.29	145.88

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2007	**Bexar**	40,117,156	30.5	45.48	523.43	69.10
	Comal	3,795,030	45.3	3.85	50.33	7.07
	Guadalupe	3,353,050	44.9	3.42	45.10	6.48
	Wilson	941,667	42.9	0.98	12.23	1.34
	Total	48,206,902	32.3	53.73	631.09	83.99
2012	**Bexar**	43,924,214	30.6	33.72	438.53	41.42
	Comal	4,298,309	44.4	2.99	43.04	4.26
	Guadalupe	3,736,338	44.3	2.61	38.23	3.90
	Wilson	1,057,777	42.8	0.75	10.54	0.84
	Total	53,016,637	32.3	40.07	530.34	50.42

* Average Monday through Thursday activity, September 20, 1999 meteorology.

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Table 2
SA/MSA September Friday* On-road Mobile Source
VMT, Average Speed, and Emissions of VOC, CO, NOx (Tons)

Year	County	VMT	Speed	VOC	CO	NOx
	Bexar	40,657,377	27.2	80.49	912.05	113.60
	Comal	3,486,780	46.1	5.88	80.62	10.55
	Guadalupe	3,138,043	45.7	5.32	73.02	9.55
	Wilson	859,063	43.0	1.49	19.26	1.84
1999	**Total**	48,141,263	29.0	93.17	1,084.95	135.54
	Bexar	45,856,541	29.0	44.43	527.84	64.96
	Comal	4,337,999	44.7	3.67	50.70	6.46
	Guadalupe	3,832,783	44.4	3.26	45.72	5.96
	Wilson	1,076,395	42.8	0.93	12.29	1.30
2007	**Total**	55,103,717	30.8	52.29	636.56	78.68
	Bexar	50,208,261	29.1	32.77	449.32	41.08
	Comal	4,913,283	43.6	2.85	43.93	4.09
	Guadalupe	4,270,909	43.8	2.48	39.39	3.77
	Wilson	1,209,116	42.7	0.71	10.68	0.87
2012	**Total**	60,601,568	30.8	38.82	543.33	49.81

* Friday activity inputs, September 17, 1999 meteorology.

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Table 3
SA/MSA September Saturday* On-road Mobile Source
VMT, Average Speed, and Emissions of VOC, CO, NOx (Tons)

Year	County	VMT	Speed	VOC	CO	NOx
	Bexar	31,589,162	32.4	51.71	640.23	70.13
	Comal	2,709,089	47.0	3.96	58.00	6.50
	Guadalupe	2,438,135	46.4	3.59	52.05	5.79
	Wilson	667,458	43.2	1.00	13.58	1.20
1999	**Total**	37,403,844	34.0	60.27	763.87	83.62
	Bexar	35,628,952	34.3	28.38	369.52	41.12
	Comal	3,370,452	46.2	2.44	36.33	4.13
	Guadalupe	2,977,919	45.8	2.17	32.24	3.68
	Wilson	836,316	43.0	0.62	8.60	0.84
2007	**Total**	42,813,639	35.7	33.62	446.69	49.77
	Bexar	39,010,090	34.3	20.94	315.42	26.52
	Comal	3,817,425	45.7	1.88	31.70	2.69
	Guadalupe	3,318,326	45.4	1.64	27.84	2.38
	Wilson	939,435	42.9	0.47	7.49	0.57
2012	**Total**	47,085,276	35.8	24.94	382.46	32.16

* Saturday activity inputs, September 18, 1999 meteorology.

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Table 4
SA/MSA September Sunday* On-road Mobile Source
VMT, Average Speed, and Emissions of VOC, CO, NOx (Tons)

Year	County	VMT	Speed	VOC	CO	NOx
	Bexar	24,986,143	34.3	41.96	534.32	50.22
	Comal	2,142,813	47.3	3.27	48.34	4.55
	Guadalupe	1,928,496	46.6	2.96	43.30	4.06
	Wilson	527,941	43.2	0.83	11.27	0.90
1999	**Total**	29,585,394	35.7	49.02	637.24	59.73
	Bexar	28,181,632	35.6	22.97	302.66	30.16
	Comal	2,665,934	46.7	2.00	29.72	2.97
	Guadalupe	2,355,450	46.1	1.77	26.25	2.63
	Wilson	661,502	43.1	0.51	7.00	0.63
2007	**Total**	33,864,519	37.0	27.25	365.62	36.39
	Bexar	30,856,026	35.7	16.95	257.52	19.93
	Comal	3,019,477	46.4	1.54	25.92	2.00
	Guadalupe	2,624,703	45.9	1.34	22.60	1.75
	Wilson	743,066	43.1	0.39	6.08	0.44
2012	**Total**	37,243,272	37.1	20.23	312.11	24.12

* Sunday activity inputs, September 19, 1999 meteorology.

OVERVIEW OF METHODOLOGY
To develop the emissions estimates by county, one of two methodologies were used depending on whether or not TDMs were available.

The main difference in the methodologies is in the level of disaggregation and the spatial allocation of the modeled VMT (and speeds). For the TDM-based counties, the method uses network links where emissions are estimated directionally at the link level for thousands of links where geographical coordinates are available. For counties without TDMs, emissions are estimated directionally at the HPMS functional classification and area type level for up to 21 functional class and area type combinations with no physical coordinates. The method for using HPMS for estimating on-road mobile source emissions is detailed in the TTI document, "Near Nonattainment Emissions Inventories - HPMS Estimation Method/Speed Model Refinement for Counties Without Link-Based Travel Demand Models," June, 2000.

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Aside from the differences in the methodologies associated with the VMT basis, the overall emissions estimation methods are basically analogous. The HPMS-based emissions inventories may be thought of as link-based for a virtual network consisting of larger and fewer links. For the purpose of further discussion in this report, the term "link" means both TDM network link and the HPMS "virtual" link (or HPMS functional class, area type combination). For this analysis, emissions are estimated directionally, at the link level, by hour-of-day, for each county, for each of the four episode days.

Emissions factors are modeled with the MOBILE6 model (October, 2002 release). The emissions factors are modeled by hour, MOBILE6 road type (or drive cycle), 28 vehicle types, and speed. Texas Low Emissions Diesel (LED) NOx benefits were modeled in the diesel vehicle class emissions factors via post-processing. The speed sensitive freeway and arterial drive cycle emissions factors were applied — freeway emissions factors to freeway functional classifications, and arterial emissions factors to non-freeway functional classifications (except for network links coded as ramp). The non-speed sensitive ramp emissions factors were applied to the TDM network ramp functional classification links.

The activity basis for the TDM counties are the Texas Department of Transportation (TxDOT) TDM network equilibrium traffic assignments and trip information for 1999, 2007, and 2015 networks. Intermediate evaluation year (i.e., 2012) VMT are estimated using growth rates with annual compounding based on the bounding assignment year VMT totals. For the HPMS-based counties, the activity basis were the county 1999 historical HPMS VMT and 2007 and 2012 VMT forecasts. The HPMS-county VMT forecasts were based on TxDOT HPMS-county VMT data for 1990 through 2000 and population statistics and projections.

TxDOT Automatic Traffic Recorder- (ATR) based September day-of-week VMT factors were developed and applied to the county base VMT estimates for each evaluation year to produce the four day type-specific, seasonally adjusted VMT estimates for each year. ATR-based hourly travel fractions were developed for each of the four September day types and used to allocate the VMT for each county by hour-of-day. Directional split factors were applied to allocate the hourly VMT by peak and off-peak direction. Based on the estimated hourly directional traffic volumes (and capacities and freeflow speeds), fleet-level, hourly, directional, average operational (congested) speeds were estimated. The link congested speed is estimated as the link freeflow speed reduced by the "delay" estimate, which is a function of the link's volume-to-capacity (v/c) ratio.

Vehicle classification count data were used with vehicle registration data and MOBILE6 default gasoline/diesel fractions to estimate 24-hour regional VMT mixes for apportioning fleetwide functional classification-specific VMT for three functional classification groups to the 28 U.S. Environmental Protection Agency (EPA) vehicle types. VMT mixes were estimated for each of the four day types.

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Link emissions by vehicle type were calculated by hour for each county and evaluation year. For each evaluation year, there were four sets of hourly emissions files (24 files per day type) produced for each county. These hourly emissions files are formatted for photochemical grid model preprocessor input. The hourly emissions estimates include emission type sub-components and total composites in grams of VOC, CO, and NOx. Tabular emissions summary files were also produced.

TTI previously developed a series of computer programs to produce detailed on-road mobile source EIs. These computer programs were used to produce and/or apply the EI elements (adjusted operational hourly link VMT and speeds, VMT mix, and MOBILE6 emissions factors) to calculate the emissions estimates for this analysis. Appendix B describes these applications.

ESTIMATION OF VMT

For each evaluation year and county, the main products of the VMT estimation process are estimates of seasonally adjusted, day type-specific, HPMS-consistent VMT by hour and direction for each link (i.e. of the TDM networks for Bexar County and the HPMS "virtual network" for Comal, Guadalupe, and Wilson counties).

Growth estimates were developed and applied to estimate VMT for evaluation years where historical VMT estimates, or modeled VMT estimates were not available. Seasonal (September), day type (Weekday, Friday, Saturday, Sunday) adjustment factors and hourly travel factors were also developed and used to characterize the seasonal and day type travel on an hourly basis. The directional split factors were applied for estimating directional VMT (or traffic volumes) for modeling directional congested link speeds (discussed later).

Data Sources

There are four traffic data sources used for developing the required adjustment factors and VMT estimates. These are the TDM data sets, ATR counts, HPMS VMT estimates, and vehicle classification counts (used to estimate VMT mix). The TDMs are developed by TxDOT, and the other three data sets are collected by TxDOT on a formal and on-going basis as part of the larger HPMS data collection program. U.S. Census and Texas State Data Center (TSDC) county population statistics and projections were used in the HPMS VMT forecasts.

The latest San Antonio 1999, 2007, and 2015 TDM networks and trip matrices were used for this analysis. The networks and trip matrices were intitialy in TRANPLAN format. Using a series of steps, these networks and trip matrices were converted to TRANSCAD and a user-equilibrium traffic assignment, with 24 iterations and 0.0001 convergence, was performed on each network. The zonal radii (assumed intrazonal trip length) was also calculated for each network from the TRANSCAD format. Because the estimated intrazonal trips are not assigned to the network, the intrazonal trips and zonal radii were needed to estimate the intrazonal VMT. The TDM VMT are modeled as annual non-summer weekday traffic (ANSWT, or average Monday through Thursday traffic excluding the months of June through August). The San Antonio TDM network links are categorized by up to 15 functional classifications, five area types, and three counties (Bexar, Comal, and Guadalupe). However, only one county (Bexar) is located entirely within the TDM area (i.e, Comal and Guadalupe counties do not play a role in the TDM VMT and speed estimation process).

HPMS VMT annual average daily traffic (AADT, or average Monday through Sunday, January through December traffic) estimates are based on traffic count data collected according to a statistical sampling procedure specified by the Federal Highway Administration (FHWA) designed to estimate VMT (as well as lane miles and centerline miles). A wide range of traffic data is collected under the HPMS program. HPMS VMT, centerline miles, and lane miles are applied in this analysis. The HPMS VMT is categorized by seven functional classifications and three area types.

ATR vehicle counts are collected by TxDOT at selected locations on a continuous basis throughout Texas. These counts are available by season, month, and weekday, as well as on an AADT basis. Since they are continuous, they are especially well-suited for making seasonal, day-of-week, and time-of-day comparisons (i.e., adjustment factors), even though there may be relatively few ATR data collection locations in any given area. The ATR counts may also may be aggregated within time periods (e.g., hours of day) and in the form of allocation factors, to distribute 24-hour VMT estimates, for example, to each hour of the day.

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Vehicle classification counts are collected at representative locations throughout Texas on a regular but periodic basis. Roadway functional classification is included as part of the data collected. Vehicle classification counts were used to estimate the relative proportion of VMT to be assigned to each type of vehicle (VMT mix is described later in this report).

HPMS VMT estimates are available for all counties. ATR and vehicle classification (VMT mix) data are available for most but not all counties. Consequently, these last two data sources were aggregated for the SA/MSA to provide adequate data for this analysis.

County-Level VMT Totals

This section discusses the seasonal adjustment factors, the HPMS adjustment for TDM future year VMT, development of the VMT totals for the TDM-based county, and development of the VMT totals for the HPMS-based counties.

Seasonal Day-of-Week Factors

Emissions estimates are required for the September Weekday, Friday, Saturday, and Sunday day types. Since the evaluation year base-VMT estimates are either in AADT form (HPMS-based) or ANSWT form (TDM-based), September day-type adjustment factors are needed to convert VMT from both of these forms of VMT. To develop the two September day type conversion factor sets for this analysis, three years (1999 through 2001) of SA/MSA ATR data are aggregated.

The two sets of SA/MSA level September day type factors include four ratios each, which are the September average Weekday, Friday, Saturday, and Sunday volumes to AADT volume, and the September average Weekday, Friday, Saturday, and Sunday volumes to ANSWT volume.

These MSA level factors are used for all evaluation years to convert either AADT VMT or ANSWT VMT to the selected seasonal day type form. The September Weekday, Friday, Saturday, and Sunday adjustment factors are shown in Table 5.

Table 5
SA/MSA-Level September Day-Type VMT Factors*

Day-Type	For Conversion from ANSWT	For Conversion from AADT
Weekday**	0.98018	1.03667
Friday	1.12041	1.18499
Saturday	0.87052	0.92069
Sunday	0.68856	0.72824

* Factors are based on SA/MSA county ATR data from 1999 through 2001.
** Average Monday through Thursday.

HPMS Adjustment for TDM Future Year VMT

For air quality analyses, TDM network traffic assignment VMT are adjusted to consistency with HPMS VMT. For TDM model analysis years where historical official HPMS VMT estimates are available, county HPMS VMT control totals are disaggregated to the network links proportionally to the model VMT (including the intrazonal estimate) on each link. A different adjustment must be made for the future years.

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The HPMS adjustment for the future year network (including intrazonal) VMT is performed using the TDM validation year (i.e. 1995 for the San Antonio network) HPMS factor. This factor is the ratio of 1995 HPMS ANSWT VMT (adjusted to ANSWT form with ATR-based "AADT to ANSWT factor" of 1.05581) to 1995 TDM ANSWT VMT (including the intrazonal estimate). Since Bexar County is the only county completely contained within the TDM area, the HPMS factor for Bexar County was developed and applied only to the future year link VMT for that county. The 1995 model validation year HPMS factor Bexar County is 1.01083779. The calculation of this factor and the actual values used in this calculation are shown below.

HPMS VMT (AADT) × ANSWT Adjustment Factor = HPMS VMT (ANSWT)

HPMS VMT (ANSWT) / Model VMT (ANSWT) = HPMS Factor

Bexar County: 1,351,818 × 1.02135 = 1,380,679.3 (HPMS ANSWT VMT)
1,380,679.3 / 1,849,830.0 = 0.74638173 (HPMS Factor)

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Estimation of TDM-Based County VMT Totals
To calculate the HPMS consistent TDM-based county VMT totals for each evaluation year and day type, three main steps were applied. First, the seasonal day-type specific 1999 and 2007 evaluation year VMT were estimated, as the TDM network assignments were available for these two evaluation years. Next, growth rates were estimated for use in factoring the 2015 network link VMT estimates to the 2012 intermediate year VMT values. Finally, the adjustment factor sets were applied to the appropriate networks to produce the September day-type link VMT for each county for the remaining evaluation years (hourly and directional factors are discussed later).

Since TDMs do not assign intrazonal VMT to the network links, intrazonal VMT is estimated and assigned a link (i.e. A-node = B-node = zone centroid). Each of the 24-hour TDM network data sets (1999, 2007, and 2015) were processed to produce link estimates for total ANSWT VMT to include both the network and intrazonal VMT (which is assumed to be a part of the "local" road type VMT estimate). The intrazonal VMT is estimated as the product of the number of intrazonal trips, the average intrazonal travel time, and the average of the zone's coded centroid connector link speeds.

For the 1999 evaluation year the official historical 1999 HPMS AADT VMT estimate is available. To estimate the 1999 link VMT, county-level seasonal day type-adjusted HPMS VMT control totals were used. These control totals were disaggregated to the 1999 TDM network assignment links proportionally to the unadjusted model (and added intrazonal) VMT on each link. The Bexar county 1999 seasonal day-type control totals are calculated by multiplying the Bexar county HPMS AADT VMT total by the seasonal day-type factor (for AADT, see Table 5 above). This calculation was performed for each of the four day types. Since Comal and Guadalupe counties are only partially within the TDM area, this process is not applied to the TDM link VMT for those counties and the assigned network VMT is assumed to be the control totals.

For the 2007 evaluation year, the link VMT estimates were calculated by multiplying the unadjusted TDM link (and intrazonal) VMT by two factors: the 1997 TDM validation year county-level HPMS factor (described above), and the SA/MSA level seasonal day type factor (for ANSWT, Table 5 above). Since Comal and Guadalupe counties are only partially contained within the TDM network, the HPMS factor and seasonal day type factor are assumed as 1.0 (i.e, the VMT for these counties are not considered in the TDM VMT estimation process).

To estimate the link VMT for the intermediate year (2012) a growth rate for Bexar County was developed. A growth rate was computed using the HPMS consistent link and intrazonal TDM VMT estimates from the 2007 and 2015 TDMs. The estimated annual growth rate for Bexar County is 1.01829773. This growth rate was then transformed to a factor used to convert the 2015 link VMT estimates to the 2012 link VMT estimates. This conversion factor is calculated as the annual growth rate to the power of the target year minus the base year (i.e. conversion factor = $[1.01829773]^{2012-2015}$). The conversion factor for Bexar County is 0.94705603.

The 2012 link-VMT estimates were calculated by multiplying the 2015 network and intrazonal unadjusted link VMT by the 1997 validation year HPMS factor, the 2015 to 2012 conversion factor, and the September day type factor. As with the previous TDM VMT adjustments, Comal and Guadalupe counties are exempt from these adjustments since they are not completely within the TDM area (i.e, all VMT factors are assumed as 1.0). This procedure was performed for each of the four September day type factors to produce the 2012 September Weekday, Friday, Saturday, and Sunday link-VMT estimates for each county.

The fully adjusted county-level evaluation year September Weekday, Friday, Saturday, and Sunday VMT totals are summarized in Tables 1 through 4, respectively.

HPMS Counties
The base link VMT for the HPMS-based counties is AADT. The 1999 evaluation year base-VMT estimate is the historical HPMS VMT total for each county. For the evaluation years with no historical HPMS AADT VMT estimates available, HPMS AADT forecasts were made.

TxDOT HPMS AADT VMT data for each county for 1990 through 2000, in combination with official (i.e., U.S. Census and TSDC) county population statistics and projections, were used to develop VMT forecasts. More specifically, there are conceptually two types of VMT, local and through. Local VMT is generated by the residents

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of the county. Through VMT is generated by persons and vehicles passing through the county. The relative importance varies by the proximity of the county to large urban areas (that generate substantial VMT of their own).

Theoretically, local VMT is more closely related to population, while through VMT is more closely related to historical VMT. Though these distinctions are not absolute (i.e., local VMT is not independent of historical patterns and through VMT is not independent of county population), they imply very different strategies for forecasting. Local VMT is likely to be a function of population, while through VMT is likely to be a function of historical VMT (i.e., growth). If used alone, however, each tends to err in a different direction. Population-based forecasts (i.e., VMT per capita) tend to under estimate future VMT, especially in small counties adjacent to large urban areas. Conversely, historical-based (i.e., growth trend) forecasts tend to over estimate future VMT, especially in areas where there has been recent atypical rapid growth.

Viewed differently, however, these two forecast strategies define the boundaries of the forecast, that is, defining a range that will produce credible results. Consequently, the strategy adopted for the HPMS-based counties (Comal, Guadalupe, and Wilson) was to use the midpoint of the two forecasts. In other words, both methods were used. First, a forecast was developed for each county with a per capita-based method using a VMT to population ratio (based on 1990 through 2000 population and VMT) applied to future official TSDC population projections. Next, a traditional regression analysis was performed on the historic HPMS VMT data from 1990 to 2000 to develop coefficients that were then used to forecast future VMT for each near nonattainment county. Then, the two forecasts were combined and the midpoint calculated. The midpoint of the two methods was used as the forecast VMT value for each county for each forecast year.

Table 6 shows the county level AADT VMT estimates, 1999 official historical and future year forecasts.

Table 6
County-Level HPMS Historical and Forecast AADT VMT Estimates

Year	Comal	Guadalupe	Wilson
1999	2,942,456	2,648,162	724,954
2007	3,660,790	3,234,444	908,357
2012	4,146,266	3,604,174	1,020,359

These AADT estimates were adjusted to each of the four September day type control total values (as shown in Tables 1 through 4) using the seasonal day type factors for conversion of VMT from the AADT form (Table 5). To allocate county control total VMT by the HPMS functional classifications, 1999 historical official HPMS functional class and area type (virtual link) AADT VMT proportions were used. By county, for each evaluation year and day type, the VMT control totals were disaggregated to the HPMS virtual links proportionally to the 2000 HPMS AADT VMT on each link.

Hourly Travel and Directional Factors
Emissions estimates are required by hour during September for each of the four day types. Since the VMT forecasts are 24-hour estimates, hourly travel factors are required to apportion the VMT to each hour of the day.

TxDOT continuous ATR data (for 1999 and 2001) from the SA/MSA counties were aggregated to develop MSA level hourly travel factors for application at the county level. Hourly travel factors were developed for each of the four day types. Using the September day type-specific volumes, these factors are the ratio of hourly volumes to 24-hour volume. Table 7 shows the hourly travel factors for the SA/MSA counties.

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The MSA-level hourly factors were applied to the 24-hour link VMT estimates for each county to produce the hourly link VMT estimates for each of the four day types. The same set of hourly factors were applied for all evaluation years.

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Table 7
Hourly Travel Factors* for the SA/MSA

Hour	Weekday**	Friday	Saturday	Sunday
12:00 a.m.	0.00922	0.00914	0.02178	0.02880
1:00 a.m.	0.00569	0.00607	0.01444	0.01928
2:00 a.m.	0.00522	0.00561	0.01331	0.01806
3:00 a.m.	0.00429	0.00419	0.00810	0.01083
4:00 a.m.	0.00637	0.00608	0.00732	0.00745
5:00 a.m.	0.01657	0.01496	0.01125	0.00917
6:00 a.m.	0.05101	0.04510	0.02109	0.01462
7:00 a.m.	0.07734	0.07028	0.03184	0.01981
8:00 a.m.	0.06463	0.05810	0.04166	0.02682
9:00 a.m.	0.04881	0.04591	0.04898	0.04041
10:00 a.m.	0.04764	0.04645	0.05564	0.05123
11:00 a.m.	0.05209	0.05177	0.06210	0.05792
12:00 p.m.	0.05429	0.05460	0.06636	0.06880
1:00 p.m.	0.05584	0.05603	0.06656	0.07280
2:00 p.m.	0.05933	0.05986	0.06688	0.07384
3:00 p.m.	0.06724	0.06671	0.06575	0.07282
4:00 p.m.	0.07663	0.07337	0.06388	0.07209
5:00 p.m.	0.08131	0.07476	0.06210	0.07028
6:00 p.m.	0.06384	0.06291	0.05990	0.06612
7:00 p.m.	0.04558	0.05092	0.05383	0.05577
8:00 p.m.	0.03732	0.04143	0.04672	0.04780
9:00 p.m.	0.03172	0.03724	0.04284	0.04000
10:00 p.m.	0.02285	0.03370	0.03812	0.03226
11:00 p.m.	0.01517	0.02481	0.02955	0.02302

* Based on 1999 through 2001 SA/MSA aggregate ATR count data.
** Average Monday through Thursday.

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Finally, the VMT were apportioned by direction to allow for differences in congestion levels based on the direction of traffic flow. Directional volumes are required for modeling directional operational speeds, discussed in the next section. The directional split ratio applied for the HPMS-based counties is 60/40 based on aggregate observed values for areas where data are available. The directional splits used for the TDM-based counties vary by network functional classification and area type and by peak and off-peak travel periods. The directional splits and their corresponding travel periods for the TDM-based analysis are listed in Appendix C.

Tables 8 and 9, respectively, show the San Antonio TDM network functional classes and area types. Table 10 shows the HPMS functional classes and area types.

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Table 8
San Antonio TDM Network Functional Classifications

Functional Class Code	Functional Class Name
0	Local Roads
1	Radial Freeway
2	Radial Parkway
3	Expressway
4	Primary Arterial Divided
5	Primary Arterial Undivided
6	Minor Arterial Divided
7	Minor Arterial Undivided
8	Collectors Divided
9	Collectors Undivided
10	Frontage Road
11	Ramp
12	Circumferential Freeway
13	Circumferential Parkway
14	Circumferential Arterial
35	HOV*
40	Intrazonal

* Only used 2015 network but classified as Radial Freeway due to lack of data for HOV.

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Table 9
San Antonio TDM Network Area Types

Area Type Code	Area Type Name
1	Central Business District (CBD)
2	Urban
3	Urban Residential
4	Suburban
5	Rural
6	Military

Table 10
HPMS Functional Classes and Area Types

HPMS Area Type*	HPMS Roadway Functional Classification						
Rural	Interstate	Freeway	Other Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local
Small Urban							
Urban							

* For this analysis, the Urban area type is for population of 50,000 +.

Hourly and 24-hour VMT summaries (by day type, road type, and vehicle type) are included with the EI data provided on CD-ROM. Appendix A lists the electronic data files with descriptions.

ESTIMATION OF SPEEDS

Speed is a critical parameter for estimating emissions. Similarly, capacity and freeflow speed (and traffic volume, as discussed in the previous section) are critical parameters for determining speed. Capacity is the maximum flow past a given point on a roadway. It varies by the type of roadway (i.e., by functional classification). Freeflow speed is the maximum speed that traffic will move along a given roadway if there are no impediments (e.g., congestion, bad weather).

To estimate a link's (or "virtual" link, in the case of HPMS-based analyses) directional, time-of-day congested speed, a speed model involving both the estimated freeflow speed and estimated directional delay as a function of volume and capacity for the link and time-period is applied. The model is applied to each link (except for TDM centroid connectors and the special intrazonal links) for each time period and direction. Development of the link capacities and freeflow speeds input to the speed model is first discussed, followed by the model delay and congested speed equations.

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Capacities and Freeflow Speeds for HPMS-based Analysis
The capacities and freeflow speeds used for the HPMS-based county analyses all come from the Highway Capacity Manual (HCM). For HPMS functional classifications 1 and 2 (interstate and freeway), both capacities and freeflow speeds are taken directly from the HCM (3-3). The capacity (2,200 passenger cars per hour per lane [pcphpl]) and freeflow speed (70 mph) for four-lane freeways was used for all interstates, regardless of area type. Similarly, a freeflow speed of 65 mph and capacity of 2,100 pcphpl was used for all freeways (HCM figure 3-2a).

HPMS functional classifications 3, 4, 5, 6, and 7 (principal arterial, minor arterial, major collector, minor collector, and local) have traffic control devices (i.e., signals or stop signs) that determine their capacities. The capacities of these signalized roadways were calculated based on signalized intersection capacity defined as shown (HCM 1994: 9-5, equation 9-3):

$$Ci = Si \times (gi/C)$$

Where:

Ci = capacity of lane group i, vehicles per hour (vph);
Si = saturation flow rate of lane group i, vehicles per hour of effective green time (vphg); and
gi/c = effective green ratio for lane group i.

The saturation flow rate (Si) is the flow in vph that could be accommodated by the lane group assuming that the green phase was always available to the lane group (i.e., green ratio = 1.0). Computation of the adjusted saturation flow rate begins with the ideal saturation flow rate of 1,900, which is adjusted to reflect variance from ideal conditions. The saturation flow rate was adjusted for area type using the following assumptions (HCM 1994: 9-14, equation 9-12):

$$S = N \times fw \times fhv \times fg \times fp \times fbb \times fa \times frt \times flt$$

Where:

S = saturation flow rate factor (rounded to two decimal places);
N = number of lanes in the lane group;
fw = lane width adjustment factor (12-foot lane for all area types assumed);
fhv = heavy vehicle adjustment factor (five percent heavy vehicles for all area types to adjust for passenger car equivalents, not to be confused with VMT mix);
fg = approach grade factor (level terrain assumed for all area types);
fp = parking lane adjustment (none for rural areas, one maneuver per hour for urban areas);
fbb = bus blocking factor (none for rural areas, 10 per hour for urban areas, mid-point for small urban areas);
fa = area type adjustment (0.9 for urban area, 1.0 for all other areas);
frt = right turn adjustment factor (shared lane for right turns for all area types, high pedestrian crossing for urban areas, moderate for small urban areas, and low for rural); and
flt = left turn adjustment factor (exclusive left turn lanes and protected phasing for rural areas, shared left turn lanes and protected plus permitted phasing for urban areas, mid-point for small urban areas).

Table 11 shows the saturation flow rate adjustment factors used for the three different area types.

Table 11
Saturation Flow Rate Adjust Factors by Area Type

Area Type	fw	fhv	fg	fp	fbb	fa	frt	flt

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Rural	1	0.95	1	1	1	1	0.98	0.95
Small Urban	1	0.95	1	0.98	0.98	1	0.94	0.90
Urban	1	0.95	1	0.95	0.96	0.90	0.90	0.85

Table 12 shows the effective green ratios used for different functional classes. The same ratios were used for all area types. (Interstates and freeways are unsignalized and do not require green ratios.)

Table 12
Effective Green Ratios (gi/C) by HPMS Roadway Functional Classification

Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local
0.60	0.55	0.50	0.40	0.30

Table 13 shows the adjusted saturation flow rate (expressed in pcphpl) for all signalized streets (i.e., not interstate or freeway) for the three area types.

Table 13
Adjusted Saturation Flow Rate (pcphpl) by Area Type

HPMS Area Type	Ideal Flow	Adjustment Factor	Adjusted Saturation Flow
Rural		0.88	1,672
Small Urban		0.77	1,463
Urban	1,900	0.59	1,121

The freeflow speed for rural and urban arterials (FC-3 and FC-4) were taken directly from HCM (HMC 1994: 7-10 and 11-6, respectively). The freeflow speed for other functional classes decreases from arterial freeflow speed by 5 mph increments. No freeflow speed is below 30 mph. Table 14 shows the hourly lane capacities for all functional classes and area types.

Table 14
Hourly Lane Capacities (vehicles per hour per lane [vphpl])

HPMS Area Type	HPMS Roadway Functional Classification						
	Interstate	Freeway	Other Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local
Rural	2,200	2,100	1,003	920	836	669	502

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Small Urban	2,200	2,100	878	805	732	585	439
Urban	2,200	2,100	673	617	561	448	336

Similarly, freeflow speeds are provided for each of the three area types and seven roadway functional classifications (or 21-HPMS virtual links). Table 15 shows the freeflow speeds.

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Table 15
Freeflow Speeds (mph)

HPMS Area Type	HPMS Roadway Functional Classification						
	Interstate	**Freeway**	**Other Principal Arterial**	**Minor Arterial**	**Major Collector**	**Minor Collector**	**Local**
Rural	70	65	55	50	40	35	30
Small Urban	70	65	45	40	35	30	30
Urban	70	65	40	35	30	30	30

V/C ratios were generated for each combination of time period, roadway functional classification, area type, and direction using these capacities and VMT. The following describes the calculation for this procedure:

- Volume: VMT was multiplied by each 24 hourly time period factors yielding VMT for each time period. VMT per time period was divided by centerline miles, yielding volume for each time period. This procedure was performed for each combination of time period, roadway functional classification, area type, and direction.

- Capacity: Lane miles were divided by centerline miles to produce lanes. Lanes were multiplied by the lane capacities (i.e., adjusted saturation flows) generated by the process described above, producing hourly lane capacities. Hourly lane capacities were multiplied by the number of hours in the time period to produce time period capacities. This procedure was performed for each combination of time period, roadway functional classification, and area type. (Capacity is the same for each direction.)

- V/C ratios: The speed model was applied to the resulting volumes and capacities for each functional classification and area type combination. This yields volumes adjusted for the impact of congestion-related delay for each combination of time period, functional classification, area type, and direction.

Capacities and Freeflow Speeds for the TDM-based Analysis
The San Antonio TDM network 24-hour equilibrium assignments were performed using nondirectional 24-hour capacities. Time-of-day (i.e., hourly) capacity factors were applied to nondirectional capacity (or service volume) for the 24-hour assignment time period. In computing the directional v/c ratio for estimating the directional speeds, the directional split for capacity is assumed at 50-50. The network was processed to compute the average capacity per lane by functional classification and area type. Appendix D summarizes the capacity factors, which are computed as follows:

$$Capacity\ Factor = \frac{(Hourly\ Capacity\ per\ Lane)(Length\ of\ the\ Time\ Period)}{24\text{-}hour\ Capacity\ per\ Lane}$$

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Freeflow speed factors are used to convert TDM level-of-service (LOS) C speeds to LOS A (i.e., freeflow) speeds. The freeflow speed factors for the San Antonio TDMs by area type and functional classification are shown in Appendix D.

With the freeflow speeds and hourly, directional volumes and capacities on each link, the congested speeds may be computed.

Estimation of Congested Speeds

The congested speed model first calculates delay on the link which it then applies to the link freeflow speed to

$$Delay = \text{Min}\ [A\ \ e^{B\ (\frac{V}{C})}, M]$$

compute the link operational congested speed estimate. The volume/delay equation is:

Where:

Delay	=	congestion delay (in minutes/mile);
A & B	=	volume/delay equation coefficients;
M	=	maximum minutes of delay per mile; and
V/C	=	time-of-day directional V/C ratio.

The delay model parameters (A, B, and M) were developed for the Dallas/Fort Worth area and verified by application in other Texas urban areas. There is a set of parameters for high-capacity facilities and a set for low-capacity facilities (see Table 16). The San Antonio network high-capacity facility types are Radial Freeway, Radial Parkway, Circular Freeway and Circular Parkway. The remaining facility types (except for centroid connector and intrazonal, which do not use capacity data) are low-capacity facilities. The HPMS high-capacity facilities are Interstate and Freeway classifications.

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Table 16
Volume/Delay Equation Parameters

Facility Category	A	B	M*
High Capacity Facilities (> 3,400 vph one way, e.g., Interstates and Freeways)	0.015	3.5	5.0
Low Capacity Facilities (≤ 3,400 vph, e.g., Arterials, Collectors and Locals)	0.050	3.0	10.0

* For HPMS, M values are 3.0 for high capacity and 5.0 for low capacity facilities.

Given the estimated directional delay (in minutes/mile) and the estimated freeflow speed, the directional congested speed is computed as follows:

$$Congested\ speed = \frac{60}{\frac{60}{Freeflow\ speed} + Delay}$$

This model is applied to each link, based on functional class and area type, for each time period and each direction.

TDM Centroid Connector and Intrazonal Speeds
For the centroid connector links and intrazonal links (intrazonal links are developed specifically for air emissions analyses), capacity data are not used. The centroid connector traffic assignment input speeds were used as the centroid connector operational speeds estimates. Operational speeds for the intrazonal trips category were estimated by zone as the average of the zone's centroid connector speeds.

The hourly and 24-hour VMT weighted speed summaries by county and road type are included in the set of data files provided to TCEQ on CD-ROM (see Appendix A for electronic data descriptions). Tables 1 through 4 summarize the San Antonio MSA county 24-hour average speeds calculated as total VMT divided by total VHT.

VMT MIX
VMT mix for 1999, 2007, and 2012 were estimated using TxDOT 1997 - 1999 vehicle classification data for 1999 and TxDOT 1997 - 2001 vehicle classification data for subsequent years. As was the case with the seasonal adjustment factor for the VMT estimation procedure, the four-county San Antonio area data were aggregated.

TxDOT classification counts classify vehicles into the standard FHWA vehicle classifications (based on vehicle length/number of axles) using best practice vehicle classification count methods.

C Passenger vehicles;
P Two-axle, four-tire single-unit trucks;
B Buses;
SU2 Six-tire, two-axle single-unit vehicles;
SU3 Three-axle single-unit vehicles;
SU4 Four or more axle single-unit vehicles;
SE4 Three or four axle single-trailer vehicles;
SE5 Five-axle single-trailer vehicles;
SE6 Six or more axle single-trailer vehicles;
SD5 Five or less axle multi-trailer vehicles;

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SD6 Six-axle multi-trailer vehicles; and
SD7 Seven or more axle multi-trailer vehicles.

EPA and MOBILE use a different vehicle classification scheme than the FHWA categories. The 28 EPA vehicle categories are defined as a function of gross vehicle weight rating (GVWR) and fuel type (see Table 17). The FHWA axle/vehicle length based classification categories must be converted into 28 MOBILE GVWR/fuel type based categories.

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Table 17
EPA Vehicle Types - 28 Categories

Category	Description	GVWR
LDGV	Light-duty gasoline vehicle	≤ 6,000
LDGT1	Light-duty gasoline truck	≤ 6,000
LDGT2	Light-duty gasoline truck	≤ 6,000
LDGT3	Light-duty gasoline truck	6,001 - 8,500
LDGT4	Light-duty gasoline truck	6,001 - 8,500
HDGV2b	Heavy-duty gasoline vehicle	8,501 - 10,000
HDGV3	Heavy-duty gasoline vehicle	10,001 - 14,000
HDGV4	Heavy-duty gasoline vehicle	14,001 - 16,000
HDGV5	Heavy-duty gasoline vehicle	16,001 - 19,500
HDGV6	Heavy-duty gasoline vehicle	19,501 - 26,000
HDGV7	Heavy-duty gasoline vehicle	26,001 - 33,000
HDGV8a	Heavy-duty gasoline vehicle	33,001 - 60,000
HDGV8b	Heavy-duty gasoline vehicle	> 60,000
HDGB	Heavy-duty gasoline bus	all
LDDV	Light-duty diesel vehicle	≤ 6,000
LDDT12	Light-duty diesel truck	≤ 6,000
LDDT34	Light-duty diesel truck	6,001 - 8,500
HDDV2b	Heavy-duty diesel vehicle	8,501 - 10,000
HDDV3	Heavy-duty diesel vehicle	10,001 - 14,000
HDDV4	Heavy-duty diesel vehicle	14,001 - 16,000
HDDV5	Heavy-duty diesel vehicle	16,001 - 19,500
HDDV6	Heavy-duty diesel vehicle	19,501 - 26,000
HDDV7	Heavy-duty diesel vehicle	26,001 - 33,000
HDDV8a	Heavy-duty diesel vehicle	33,001 - 60,000
HDDV8b	Heavy-duty diesel vehicle	> 60,000
HDDBS	Heavy-duty diesel school bus	all
HDDBT	Heavy-duty diesel transit bus	all
MC	Motorcycle	all

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The FHWA category counts (based on number of axles or vehicle length) are first converted into categories (based on GVWR). Vehicle classification counts are first aggregated into three intermediate groups.

Passenger Vehicles (PV)	C + P;
Heavy-Duty Vehicles (HDV)	SU2 + SU3 + SU4 + SE4; and
HDDV8b (HDX)	SE5 + SE6 + SD5 + SD6 + SD7.

This is followed by a second intermediate allocation that separates light-duty vehicles (LDV) into passenger cars and light-duty trucks (LDT) based on TxDOT registration data.

LDV	0.708 × PV (by county, 2002 Bexar registration data shown); and
LDT	0.292 × PV (by county, 2002 Bexar registration data shown).

A third intermediate allocation further separates LDTs into LDT1 and HLDT. (Note that LDT1 is itself intermediate and is further divided into LDGT1 and LDDT.)

LDT1	0.842 × LDT (by county, 2002 Bexar registration data shown); and
HLDT	0.158 × LDT (by county, 2002 Bexar registration data shown).

Next, the remaining FHWA categories are disaggregated into EPA vehicle groups, as shown. Note that TxDOT vehicle classification count procedures do not distinguish between gasoline and diesel LDTs. Consequently, MOBILE defaults for the year of interest are used. As before, actual TxDOT vehicle registration data are used to separate gasoline from diesel heavy-duty trucks. Note also that motorcycles are not counted separately and are included as a default (subtracted from LDGV).

LDGV	0.9972136 × LDV (MOBILE6 default for 1999 shown);
LDDV	0.0027864 × LDV (MOBILE6 default for 1999 shown);
LLDT	0.9936534 × LDT1 (MOBILE6 default for 1999 shown);
LDDT	0.0063466 × LDT1 (MOBILE6 default for 1999 shown);
HDGV	0.333 × HDV (by county, 2002 Bexar registration data shown);
HDDV	0.667 × HDV (by county, 2002 Bexar registration data shown); and
MC	0.001 of total (subtracted from LDGV).

This converts the FHWA axle count-based categories into GVWR categories. This part of the conversion procedure is summarized schematically in Table 18. Starting with the TxDOT vehicle classification data, these data themselves provide sufficient information to complete the first step in the conversion process, the allocation of vehicles into passenger vehicles (PV), heavy-duty vehicles (HDV), five axle heavy duty vehicles (HDDV8b), and buses (B). Steps 2 and 3 further allocate these categories using TxDOT registration data. Finally, Step 4 allocates light-duty vehicles by fuel type using EPA MOBILE diesel fractions and motorcycles are separated from light-duty gas vehicles using a nominal constant.

Table 18
Initial Vehicle Classification Conversion Procedure

Start	Step 1	Step 2	Step 3	Step 4
Total Vehicles	PV			MC
			LDGV	LDGV
		LDV	LDDV	
		LDT	LDT1	LLDT

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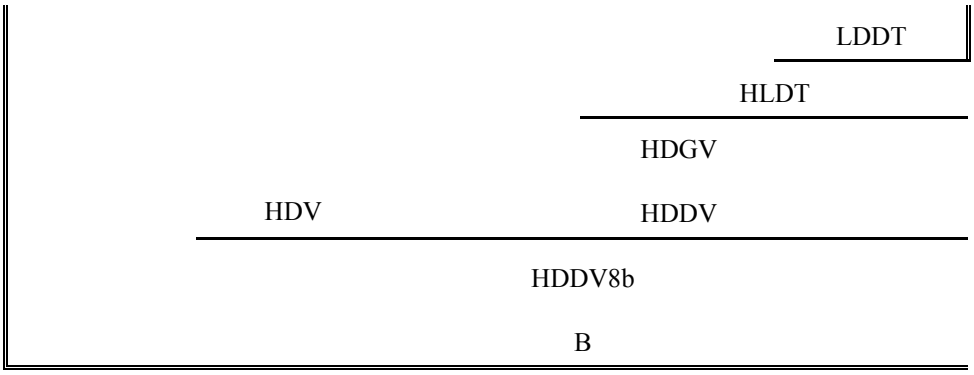

The MOBILE6 28-category typology is a subset of this typology. A combination of EPA MOBILE6 defaults and Texas vehicle registration data are used to expand these intermediate categories.

For the 28-category EPA scheme, heavy-duty vehicles (HDV) are separated into eight and seven categories respectively. HDDV8b vehicle are counted directly. The 15 HDV categories are separated from total HDV, which have been separated by fuel type (HDGV and HDDV) using TxDOT registration data. Each HDV category (HDGV and HDDV) is then divided into sub-categories based on detailed area wide TxDOT county vehicle registration data. Buses are treated separately.

The 28-category EPA scheme also further divides the two LDT categories based in part on assumed loading. The previous LDGT1 and LDGT2 categories (previously defined as GVWR $\leq$ 6,000 and GVWR > 6,000 to 8,500, respectively) are separated into subcategories in terms of adjusted loaded vehicle weight (ALVW). ALVW is the average of vehicle curb weight and GVWR. Thus, two new intermediate categories are introduced. These are light light-duty trucks (LLDT) and heavy light-duty trucks (HLDT), which are defined as:

- LLDT - any light-duty truck rated through 6,000 pounds GVWR, and
- HLDT - any light-duty truck rated greater than 6,000 pounds GVWR.

These two new intermediate categories are then used to define the four LDT categories using EPA MOBILE6 defaults for the year of interest. The four LDT categories are:

- LDGT1 - light light-duty trucks through 3,750 pounds loaded vehicle weight (LVW);
- LDGT2 - light light-duty trucks greater than 3,750 pounds LVW;
- LDGT3 - heavy light-duty trucks to 5,750 pounds ALVW; and
- LDGT4 - heavy light-duty trucks greater than 5,750 pounds ALVW.

Similarly, the LDDT category is sub-divided into two categories based on GVWR (less than or equal to 6,000 GVWR and 6,000 to 8,500 GVWR). This is accomplished using EPA MOBILE6 default values for the year of interest.

Finally the three bus categories are separated from the TxDOT classification counts bus category using EPA MOBILE6 default values. (Under MOBILE6 the HDV category does not include buses.)

Vehicle classification data is not forecast. For future VMT mix estimates, MOBILE6 default values consistent with the future year are used (i.e., 2007). For historical VMT mix estimates, the MOBILE6 default values consistent

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with the historical year are used (i.e., 1997 - 1999 for a 1999 analysis year). No other adjustments are made to alter the count data and conversion procedure to accommodate future years or historical years. Table 19 shows the VMT mix estimation procedure summary followed by explanatory notes. For this analysis, VMT mix estimates were developed for three functional classification groups (identified later in the "Emissions Estimation" section of this report).

This procedure is performed as described for weekdays. TxDOT vehicle classification data are only collected for weekdays (Monday through Thursday), consequently other data is used to estimate VMT mix for Fridays, Saturdays, and Sundays. The procedure used to estimate Friday, Saturday, and Sunday VMT mix relies on vehicle classification data collected over several years in urban areas. The ratio of weekday VMT mix to Friday, Saturday, and Sunday VMT mix is applied to the weekday VMT mix to produce region specific Friday, Saturday and Sunday VMT mix. (No seasonal changes are assumed.)

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Table 19
VMT Mix Estimation Procedure Summary

EPA-8	EPA-28	Conversion
LDGV	LDGV	.9972 × LDV
	LDGT1	.2310 × LLDT
LDGT1	LDGT2	.7690 × LLDT
	LDGT3	.6850 × HDLT
LDGT2	LDGT4	.3150 × HDLT
	HDGV2b	.430 × HDGV
	HDGV3	.203 × HDGV
	HDGV4	.081 × HDGV
	HDGV5	.048 × HDGV
	HDGV6	.153 × HDGV
	HDGV7	.049 × HDGV
	HDGV8a	.029 × HDGV
	HDGV8b	.007 × HDGV
HDGV	HDGB	.2045 × B
LDDV	LDDV	.0028 × LDV
	LDDT12	.1623 × LDDT
LDDT	LDDT34	.8377 × LDDT
	HDDV2b	.273 × HDDV
	HDDV3	.122 × HDDV
	HDDV4	.063 × HDDV
	HDDV5	.046 × HDDV
	HDDV6	.199 × HDDV
	HDDV7	.119 × HDDV
	HDDV8a	.178 × HDDV
	HDDV8b	HDX
	HDDBT	.3253 × B
HDDV	HDDBS	.4702 × B
MC	MC	MC

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Notes to VMT Mix Estimation Procedure Summary

Intermediate category factors and sources:

LDV	.708 × PV (by county, 2002 Bexar registration data shown)
LDT	.292 × PV (by county, 2002 Bexar registration data shown)
LDT1	.842 × LDT (by county, 2002 Bexar registration data shown)
HLDT	.158 × LDT (by county, 2002 Bexar registration data shown)
LLDT	.9937 × LDT1 (EPA MOBILE6 default)
LDDT	.0063 × LDT1 (EPA MOBILE6 default)
HDV	SU2+SU3+SU4+SE3+SE4
HDX	SE5+SE6+SD5+SD6+SD7
HDGV	.333 × HDV (by county, 2002 Bexar registration data shown)
HDDV	.667 × HDV (by county, 2002 Bexar registration data shown)

Category conversion factors and sources:

LDGV	.9972 × LDV (EPA MOBILE6 default, 1999 shown)
LDGT1	.2310 × LLDT (EPA MOBILE6 default, 1999 shown)
LDGT2	.7690 × LLDT (EPA MOBILE6 default, 1999 shown)
LDGT3	.6850 × HLDT (EPA MOBILE6 default, 1999 shown)
LDGT4	.3150 × HLDT (EPA MOBILE6 default, 1999 shown)
HDGV2a	.430 × HDGV (San Antonio area registration data)
HDGV3	.203 × HDGV (San Antonio area registration data)
HDGV4	.081 × HDGV (San Antonio area registration data)
HDGV5	.048 × HDGV (San Antonio area registration data)
HDGV6	.153 × HDGV (San Antonio area registration data)
HDGV7	.049 × HDGV (San Antonio area registration data)
HDGV8a	.029 × HDGV (San Antonio area registration data)
HDGV8b	.007 × HDGV (San Antonio area registration data)
HDGB	.2243 × B (EPA MOBILE6 default, 1999 shown)
LDDV	.0028 × LDV (EPA MOBILE6 default, 1999 shown)
LDDT12	.2723 × LDDT (EPA MOBILE6 default, 1999 shown)
LDDT34	.7277 × LDDT (EPA MOBILE6 default, 1999 shown)
HDDV2b	.273 × HDDV (San Antonio area registration data)
HDDV3	.122 × HDDV (San Antonio area registration data)
HDDV4	.063 × HDDV (San Antonio area registration data)
HDDV5	.046 × HDDV (San Antonio area registration data)
HDDV6	.199 × HDDV (San Antonio area registration data)
HDDV7	.119 × HDDV (San Antonio area registration data)
HDDV8a	.178 × HDDV (San Antonio area registration data)
HDDV8b	HDX (TxDOT classification counts)
HDDBT	.3240 × B (EPA MOBILE6 default, 1999 shown)
HDDBS	.4517 × B (EPA MOBILE6 default, 1999 shown)
MC	MC (default subtracted from LDGV, no conversion)

ESTIMATING EMISSIONS FACTORS

The MOBILE6 model (October 2002) was applied to calculate day-of-week-specific 1999, 2007 and 2012 emissions factors (in grams per mile [g/mi]) of VOC, CO, and NOx. Emissions factors are estimated by speed, emissions type (i.e., emissions factor sub-component), hour, MOBILE6 road type (or drive cycle), and vehicle type for the four-county MSA. The average emissions factors for each of the 28 vehicle types are developed by combining the MOBILE6 database output by-model-year emissions factors weighted by their corresponding travel fractions. The emissions factors are organized in the form of "look-up" tables.

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The MOBILE6 model is equipped with national (or EPA) default modeling values for a wide range of conditions that affect emissions factors. In fact, the only actual data parameters requiring user-input values to run the model are fuel Reid Vapor Pressure (RVP), temperature, and calendar year. Many MOBILE6 default modeling parameters may be overridden through the use of MOBILE6 commands and their associated inputs and options. For this analysis, particular MOBILE6 defaults were replaced by local input values that were developed to yield emissions factors characteristic of the September 1999 ozone episode climatic conditions, evaluation-specific vehicle fleets, activity, and emissions control programs.

The following emissions factors documentation discusses the MOBILE6 input/output files, summarizes the control programs modeled, details the aggregation level of the applied MOBILE6 emissions factors, and briefly describes all of the MOBILE6 commands that may affect emissions factor calculations. It also identifies the commands that were applied, explains the development of the locality-specific inputs, and describes the emissions factor post-processing procedure.

MOBILE6 Input and Output Files

The MOBILE6 commands and some model input data are entered in the MOBILE6 command file. Other input parameters (and in some cases, commands) are applied to MOBILE6 from external data files.

The POLFAC62 program (see program descriptions in Appendix B) was applied to run MOBILE6 with the user-input command and external data files to produce VOC, CO, and NOx emissions factor tables. (The RATEADJV6 program was applied to POLFAC62 output where post-processing of emissions factors was required, discussed later.) The final product of the emissions factor modeling is four hourly MSA-level emissions factor files (one per episode day) for each of the three evaluation years.

All of the MOBILE6 input files and output files (MOBILE6 emissions factor tables developed with POLFAC62, and RATEADJV62) are included in the set of data files provided on CD-ROM. Appendix A describes the electronic data submittal.

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Control Programs Modeled (And Emissions Factor Post Processing Summary)
All federal motor vehicle control programs, particular to evaluation year, were modeled (this is the MOBILE6 default). Also modeled were the federal programs to offset HDDV defeat device effects—the low emissions rebuild program, and the HDDV 2004 standard pull-ahead program (this is the MOBILE6 default). The Texas Regional Low Reid Vapor Pressure Gasoline Program and Texas LED Program were modeled as well. Emissions reduction estimates for the vehicle Anti-tampering Program (ATP), although administered statewide, are credited only to those counties with enforced Inspection and Maintenance (I/M) Programs, which excludes the San Antonio area counties.

Post-processing of MOBILE6 emissions factors was performed for modeling LED (required for 2007 and 2012) for the MSA. The procedures used to overcome the limits of MOBILE6 as related to the diesel fuel modeling requirements for this analysis are discussed in detail later in this section.

Aggregation Level of MOBILE6 Emissions Factors
The by-model-year emissions factors from the MOBILE6 database output format are condensed into average fleet emissions factors by vehicle class. This is performed by weighting (multiplying) each by-model-year emissions factor by its corresponding travel fraction and summing the resulting products. Each emissions factor table provides the MOBILE6 emissions factors by:

- 28 vehicle types,
- 4 road types,
- 14 speeds (except for two MOBILE6 road types, each with one average speed),
- 15 pollutant-specific emissions types, and
- 24 hourly time periods.

Tables 20 through 22 describe the MOBILE6 vehicle type, emissions type (pertaining to VOC, CO, and NOx pollutants only), and roadway type classifications. Tables 23 and 24 show the speeds and sequence for hourly time periods, respectively.

Table 20 shows the 28 MOBILE6 vehicle types as defined by fuel-type (gasoline or diesel) and GVWR category, in sequence by EPA vehicle type number.

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Table 20
Complete MOBILE6 Vehicle Classifications

Number	Abbreviation	Description
1	LDGV	Light-Duty Gasoline Vehicles (Passenger Cars)
2	LDGT1	Light-Duty Gasoline Trucks 1 (0-6,000 lbs. GVWR, 0-3,750 lbs. LVW)
3	LDGT2	Light-Duty Gasoline Trucks 2 (0-6,000 lbs. GVWR, 3,751-5,750 lbs. LVW)
4	LDGT3	Light-Duty Gasoline Trucks 3 (6,001-8,500 lbs. GVWR, 0-5,750 lbs. ALVW*)
5	LDGT4	Light-Duty Gasoline Trucks 4 (6,001-8,500 lbs. GVWR, 5,751 lbs. and greater
6	HDGV2b	Class 2b Heavy-Duty Gasoline Vehicles (8,501-10,000 lbs. GVWR)
7	HDGV3	Class 3 Heavy-Duty Gasoline Vehicles (10,001-14,000 lbs. GVWR)
8	HDGV4	Class 4 Heavy-Duty Gasoline Vehicles (14,001-16,000 lbs. GVWR)
9	HDGV5	Class 5 Heavy-Duty Gasoline Vehicles (16,001-19,500 lbs. GVWR)
10	HDGV6	Class 6 Heavy-Duty Gasoline Vehicles (19,501-26,000 lbs. GVWR)
11	HDGV7	Class 7 Heavy-Duty Gasoline Vehicles (26,001-33,000 lbs. GVWR)
12	HDGV8a	Class 8a Heavy-Duty Gasoline Vehicles (33,001-60,000 lbs. GVWR)
13	HDGV8b	Class 8b Heavy-Duty Gasoline Vehicles (>60,000 lbs. GVWR)
14	LDDV	Light-Duty Diesel Vehicles (Passenger Cars)
15	LDDT12	Light-Duty Diesel Trucks 1 and 2 (0-6,000 lbs. GVWR)
16	HDDV2b	Class 2b Heavy-Duty Diesel Vehicles (8,501-10,000 lbs. GVWR)
17	HDDV3	Class 3 Heavy-Duty Diesel Vehicles (10,001-14,000 lbs. GVWR)
18	HDDV4	Class 4 Heavy-Duty Diesel Vehicles (14,001-16,000 lbs. GVWR)
19	HDDV5	Class 5 Heavy-Duty Diesel Vehicles (16,001-19,500 lbs. GVWR)
20	HDDV6	Class 6 Heavy-Duty Diesel Vehicles (19,501-26,000 lbs. GVWR)
21	HDDV7	Class 7 Heavy-Duty Diesel Vehicles (26,001-33,000 lbs. GVWR)
22	HDDV8a	Class 8a Heavy-Duty Diesel Vehicles (33,001-60,000 lbs. GVWR)
23	HDDV8b	Class 8b Heavy-Duty Diesel Vehicles (>60,000 lbs. GVWR)
24	MC	Motorcycles (Gasoline)
25	HDGB	Gasoline Buses (School, Transit, and Urban)
26	HDDBT	Diesel Transit and Urban Buses
27	HDDBS	Diesel School Buses
28	LDDT34	Light-Duty Diesel Trucks 3 and 4 (6,001-8,500 lbs. GVWR)

* The adjusted loaded vehicle weight is the numerical average of the vehicle curb weight and the GVWR.
Source: MOBILE6 User's Guide (EPA, January 2002).

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Table 21 shows the eight MOBILE6 emissions type classifications (excluding the non-pertinent pollutants). Expanding these emissions types by individual pollutant yields 12 pollutant-specific emissions types. In addition to these 12 pollutant-specific emissions types, POLFAC62 emissions factor tables contain the three composite emissions factors (i.e., one for each pollutant). Thus, POLFAC62 calculates MOBILE6 emissions factors for up to 15 pollutant-specific emissions types. For this analysis, MOBILE6 emissions factors were calculated for all of the 15 pollutant-specific emissions types except for refueling emissions, which are classified as an area source emissions category.

Table 21
MOBILE6 Emission Type Classifications

Number	Abbreviation	Description	Pollutants	Vehicle Classes
1	Running	Exhaust Running Emissions	Hydrocarbon (HC),CO, NOx	All
2	Start	Exhaust Engine Start Emissions (trip start)	HC,CO,NOx	LD plus MC
3	Hot Soak	Evaporative Hot Soak Emissions (trip end)	HC	Gas, including MC
4	Diurnal	Evaporative Diurnal Emissions (heat rise)	HC	Gas, including MC
5	Resting	Evaporative Resting Loss Emissions (leaks and seepage)	HC	Gas, including MC
6	Run Loss	Evaporative Running Loss Emissions	HC	Gas, less MC
7	Crankcase	Evaporative Crankcase Emissions (blow-by)	HC	Gas, including MC
8	Refueling	Evaporative Refueling Emissions (fuel displacement and spillage)	HC	Gas, less MC

Source: MOBILE6 User's Guide (EPA, January 2002).

MOBILE6 calculates emissions factors reflective of driving cycles observed on four roadway types, as well as emissions factors for those emissions types that are not directly applicable to the driving cycles. Table 22 provides descriptions of the driving cycle (or roadway type). The fifth roadway type, according to MOBILE6 is "None." None, or roadway type number 5, is the index for the emissions types that do not apply to the driving cycles, and thus are not sensitive to, or do not vary by, roadway type or speed.

The POLFAC62 emissions factor table, however, categorizes all of the pollutant-specific emissions types by MOBILE6 roadway types one through four—Freeway, Arterial, Local, and Ramp. That is, in POLFAC62 tables, the MOBILE6 g/mi emissions factors corresponding to the "None" roadway type are tabulated as emissions factors under each of the four actual roadway types. This allocation of the MOBILE6 "None" road type emissions factors to the Freeway, Arterial, Local, and Ramp MOBILE6 road types is performed in POLFAC62 to facilitate the geographical allocation of the link-emissions estimates by the roadway link coordinates.

Table 22
MOBILE6 Roadway Classifications

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Number	Abbreviation	Description
1	Freeway	High-Speed, Limited-Access Roadways
2	Arterial	Arterial and Collector Roadways
3	Local	Urban Local Roadways
4	Fwy Ramp	Freeway on and off ramps
5	None	Not Applicable (for start and some evaporative emissions)

Source: MOBILE6 User's Guide (EPA, January 2002).

Table 23 shows the 14 speeds used for calculating and tabulating the MOBILE6 Freeway and Arterial emissions factors. Later in the emissions estimation process, emissions factors for average operational speeds that are not represented in the 14 speeds as tabulated, are calculated by interpolation (except for those speeds higher than the MOBILE6 maximum speed, and those lower than the MOBILE6 minimum speed, in which case the emissions factors corresponding to these bounding speeds are used, respectively). The MOBILE6 Local and Ramp road type emissions factors are not speed sensitive and are each characterized by one average speed.

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Table 23
Speeds for POLFAC62 Tabulated MOBILE6 Freeway and Arterial Emissions Factors*

Number	Speed
1	2.5 mph
2	5 mph
3	10 mph
4	15 mph
5	20 mph
6	25 mph
7	30 mph
8	35 mph
9	40 mph
10	45 mph
11	50 mph
12	55 mph
13	60 mph
14	65 mph

* The MOBILE6 Local and Ramp drive cycle emissions factor's fixed speeds are 12.9 and 34.6 mph, respectively.

MOBILE6 uses several hourly input parameters (e.g., hourly temperatures, hourly VMT fractions, etc.) to model hourly emissions factors. MOBILE6 requires that hourly input parameters be sequenced starting from the 6 a.m. hour. In some cases, however, particular overnight hours are grouped together as a single time period. Table 24 shows the MOBILE6 sequence for hourly inputs.

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Table 24
General Sequence for Calendar Day Hourly* Inputs to MOBILE6

Input Sequence Number	Abbreviation	Description
1	6 a.m.	6 a.m. through 6:59 a.m.
2	7 a.m.	7 a.m. through 7:59 a.m.
3	8 a.m	8 a.m. through 8:59 a.m.
4	9 a.m.	9 a.m. through 9:59 a.m.
5	10 a.m.	10 a.m. through 10:59 a.m.
6	11 a.m.	11 a.m. through 11:59 a.m.
7	12 Noon	12 p.m. through 12:59 p.m.
8	1 p.m.	1 p.m. through 1:59 p.m.
9	2 p.m.	2 p.m. through 2:59 p.m.
10	3 p.m.	3 p.m. through 3:59 p.m.
11	4 p.m.	4 p.m. through 4:59 p.m.
12	5 p.m.	5 p.m. through 5:59 p.m.
13	6 p.m.	6 p.m. through 6:59 p.m.
14	7 p.m.	7 p.m. through 7:59 p.m.
15	8 p.m.	8 p.m. through 8:59 p.m.
16	9 p.m.	9 p.m. through 9:59 p.m.
17	10 p.m.	10 p.m. through 10:59 p.m.
18	11 p.m.	11 p.m. through 11:59 p.m.
19	12 Midnight	12 a.m. through 12:59 a.m.
20	1 a.m.	1 a.m. through 1:59 a.m.
21	2 a.m.	2 a.m. through 2:59 a.m.
22	3 a.m.	3 a.m. through 3:59 a.m.
23	4 a.m.	4 a.m. through 4:59 a.m.
24	5 a.m.	5 a.m. through 5:59 a.m.

* For some MOBILE6 hourly input parameters, overnight hours are grouped. Hourly inputs are representative of the same day or day type, but are reordered for input to MOBILE6 to start at 6 a.m.

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Application of MOBILE6 Commands and Associated Input Parameters
Tables 25 through 31 lists and describes all of the MOBILE6 commands that may affect calculating emissions factors (excluding commands such as those that affect only the output format or content). Respectively, these seven tables are: MOBILE6 Pollutants and Emission Rates, MOBILE6 External Conditions, MOBILE6 Vehicle Fleet Characteristics, MOBILE6 Activity, MOBILE6 State Programs, MOBILE6 Fuels, and MOBILE6 Alternative Emissions Regulations and Control Measures. These tables identify the combinations of MOBILE6 commands and parameters used for this analysis.

Parameters associated with each MOBILE6 command are generally labeled as either EPA default, locality-specific, or NOT APPLIED. The commands where the associated input parameters are labeled only as "EPA default" are generally not input for this analysis.

The procedures used to develop the locality-specific inputs to MOBILE6 are detailed after the following seven MOBILE6 input category tables.

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Table 25
MOBILE6 Pollutants and Emission Rates

Command	Function/Description	Input Parameter Source/Value
POLLUTANTS	Defines the basic set of pollutants to report.	NOT APPLIED. (The MOBILE6 default is assumed: HC, CO, NOx.)
PARTICULATES	Enables computation of particulate matter (PM) an related emissions factors.	NOT APPLIED.
PARTICULATE EF	Specifies location of files that contain the particulate emissions factors when PARTICULATES command is used.	NOT APPLIED.
PARTICLE SIZE	Allows user to specify the maximum particulate size cutoff used by MOBILE.	NOT APPLIED.
EXPRESS HC AS VOC	One of five possible commands which allow the user to specify the particular HC species (NMHC, NMOG, THC, TOG, VOC) to report in the exhaust emissions output.	"VOC" command is applied. Only the command is required.
NO REFUELING	Directs MOBILE6 not to calculate refueling emissions factors.	This command is applied. Only the command is required.
AIR TOXICS	Enables the computation of air toxic emissions factors (six explicit pollutants) and specifies which to calculate.	NOT APPLIED.
ADDITIONAL HAPS	Allows entry of emissions factors or air toxic ratios for calculation of additional user-defined air toxic pollutant emissions factors.	NOT APPLIED.
MPG ESTIMATES	Allows entry of alternate fuel economy performance data by vehicle class and model year.	NOT APPLIED. (MOBILE6 default values are assumed.)

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Table 26
MOBILE6 External Conditions

Command	Function/Description	Input Parameter Source/Value
CALENDAR YEAR	Identifies calendar year for which emissions factors are to be calculated. (Required to run model).	1999, 2007, 2012.
EVALUATION MONTH	Provides option of calculating January 1 or July 1 emissions factors for calendar year of evaluation.	7 (for July)
MIN/MAX TEMPERATURE	Sets minimum and maximum daily temperatures. (Required to run model if the HOURLY TEMPERATURES command is not used.)	NOT APPLIED. (See HOURLY TEMPERATURES.)
HOURLY TEMPERATURES	Allows temperatures input for each hour of day. (Required to run model if MIN/ MAX TEMPERATURE command is not used.)	County-group-specific by episode day, developed by TCEQ. The hourly input sequence is 6 a.m. to 12 a.m. followed by 12 a.m. to 6 a.m. for the same day. See Appendix F.
ALTITUDE	Specifies high- or low-altitude for modeling area.	NOT APPLIED. (EPA default, low altitude, is assumed).
ABSOLUTE HUMIDITY	Used to specify daily average humidity (directly affects NOx emissions). MOBILE6 also converts absolute humidity to heat index which affects HC and CO emissions for the portion of the fleet that MOBILE6 determines is using air conditioning.	NOT APPLIED. (See RELATIVE HUMIDITY.)
Environmental Effects on Air Conditioning:	Commands used by MOBILE6 to model the extent of vehicle air-conditioning usage.	
CLOUD COVER	Specifies average percent cloud cover for given day.	NOT APPLIED. (EPA default assumed.)
PEAK SUN	Specifies Mid-day hours with peak sun intensity.	NOT APPLIED. (EPA default assumed.)
SUNRISE/SUNSET	Allows user to specify time of sunrise and sunset.	Region-specific, 7 a.m. 8 p.m., TCEQ.
RELATIVE HUMIDITY	Specifies use of 24 hourly relative humidity values entered by user. MOBILE6 will perform hour-specific calculations with hourly values rather than use single daily default absolute humidity value.	County-group-specific by episode day, developed by TCEQ. The hourly input sequence is 6 a.m. to 12 a.m. followed by 12 a.m. to 6 a.m. for the same day. See Appendix F.
BAROMETRIC PRES	Specifies use of user input daily average barometric pressure for use with hourly relative humidity to calculate hourly absolute humidity values.	Used MOBILE6 default, 29.92 inches Mercury.

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Table 27
MOBILE6 Vehicle Fleet Characteristics

Command	Function/Description	Input Parameter Source/Value
REG DIST	Allows the user to supply registration distributions by age for any of the 16 composite (combined gasoline and diesel) vehicle types.	Locality-Specific/EPA default. Developed by TTI. Mid-year 2002 TxDOT county-group registrations data are applied except for buses for which the MOBILE6 default is used. The age distributions are assumed to be the same for all evaluation years. See Appendix G.
DIESEL FRACTIONS	Permits user to supply locality-specific diesel fractions for 14 of the 16 composite vehicle categories by age.	Locality-Specific/EPA default. Developed by TTI. Beginning in 2002, TxDOT mid-year registrations specify gasoline and diesel fueled vehicles for the eight HDV classes. Mid-year 2002 TxDOT statewide registrations are used to develop the HDV diesel fractions (EPA defaults are applied for the remaining classes). For future year evaluations, the latest diesel fractions (2002) are used for each calendar year up to the future year of evaluation (e.g., 2003, 2004, 2005, 2006, 2007). For 1999, diesel fractions are produced by dropping the 2000 and newer model year fractions from the 2002 diesel fractions data set, then applying the earliest model year fractions to each prior year back to the 25 years old and older category.
MILE ACCUM RATE	Allows the user to supply the annual mileage accumulation rates by vehicle type and age.	NOT APPLIED. (EPA defaults are assumed — see technical report M6FLT.007.)
NGV FRACTION	Lets user specify percent of natural gas vehicles (NGV) in the fleet by type and age certified to operate on either compressed or liquefied natural gas.	NOT APPLIED. (The EPA default percentage of NGV vehicles in the fleet, zero, is assumed.)
NGV EF	Permits the user to enter alternate NGV emissions factors for each of the 28 vehicle types, for running and start emissions.	NOT APPLIED. (The EPA default, none, is assumed.)

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Table 28
MOBILE6 Activity

Command	Function/Description	Input Parameter Source/Value
VMT FRACTIONS	Used in MOBILE6 to weight the emissions of various vehicle types into average rates for groupings of vehicle classes.	NOT APPLIED. (EPA default assumed, used for aggregate results with no impact on this analysis. VMT mix is applied to link VMT outside MOBILE6 later in the process to calculate emissions by the 28 vehicle types.)
VMT BY FACILITY	VMT fractions by MOBILE6 road type combine the four road type emissions factors into the "all road types" emissions factors.	NOT APPLIED. (EPA default assumed, used for aggregate results with no impact on this analysis.)
VMT BY HOUR	Allows VMT fractions allocation by hour-of-day; applied in conversion of grams per hour (g/hr) to g/mi, as well as in weighting of hourly g/mi rates to obtain daily emissions factors.	Region-specific. The hourly travel fractions (same as those used to distribute 24-hour link-VMT by hour of day) are based on 1999 through 2001, September, SA/MSA ATR counts. One set each is applied for Weekday, Friday, Saturday, and Sunday. The same fractions are used for all years. See Table 7.
SPEED VMT	Allows user to allocate VMT by average speed (14 pre-selected: 2.5 and 5 through 65 at 5 mph increments) for arterials and freeways for each hour of the day.	Generic input. Same for all counties. Inputs are set up to calculate emissions factors by 14 MOBILE6 speed bin speed scenarios for MOBILE6 freeway and arterial road types.
AVERAGE SPEED	Allows a single average speed for combined freeways and arterials for the entire day.	NOT APPLIED.
STARTS PER DAY	Lets user specify the average number of engine starts per vehicle per day by vehicle types for weekend days and weekdays.	NOT APPLIED. (Used EPA weekday and weekend day-specific defaults — see technical report M6FLT.003.)
START DIST	Allows user to allocate engine starts by hour of the day for weekend days and weekdays.	NOT APPLIED. (Used EPA weekday and weekend day-specific defaults — see technical report M6FLT.003.)
SOAK DISTRIBUTION	Allows use of alternate vehicle soak duration distributions for weekend days and weekdays.	NOT APPLIED. (Used EPA weekday and weekend day-specific defaults — see technical reports M6FLT.003 and 004.)
HOT SOAK ACTIVITY	Allows users to specify a hot soak duration distribution for each of 14 daily time periods for weekend days and for weekdays.	NOT APPLIED. (Used EPA weekday and weekend day-specific defaults — see technical reports M6FLT.003 and 004.)
DIURN SOAK ACTIVITY	Allows user set diurnal soak time distributions for each of 18 daily time periods.	NOT APPLIED. (The EPA defaults are assumed. — see technical report M6FLT.006.)
WE DA TRI LEN DI	Specifies alternate fractions of VMT that occur during trips of various durations at each hour of the average weekday.	NOT APPLIED. (The EPA defaults are assumed. — see technical report M6FLT.005.)
WE EN TRI LEN DI	Specifies hourly alternate fractions of VMT for trips of various lengths for weekend days.	NOT APPLIED.
WE VEH US	Directs MOBILE6 to use weekend activity data for calculating emissions factors.	Applied command for weekend day analyses (i.e.,September 18, 19).

Table 29

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MOBILE6 State Programs

Command	Function/Description	Input Parameter Source/Value
STAGE II REFUELING	Allows modeling of at-the-pump refueling emissions.	NOT APPLIED. Accounted for as an area source category.
ANTI-TAMP PROG	Allows user to model impacts of an ATP.	NOT APPLIED. (Although Texas administers a statewide ATP, ATP credit is only taken in those counties which also administer an enforced I/M program.)
<u>I/M Commands</u>:		
I/M PROGRAM	Required for exhaust/evaporative I/M programs.	
I/M MODEL YEARS	Required for exhaust/evaporative I/M programs.	
I/M VEHICLES	Required for exhaust/evaporative I/M programs.	
I/M STRINGENCY	Required for exhaust. Do not use for evaporative.	
I/M COMPLIANCE	Required for exhaust. Optional for evaporative.	
I/M WAIVER RATES	Required for exhaust. Optional for evaporative.	
I/M CUTPOINTS	Optional for exhaust (but required for IM240). Do not use with evaporative.	
I/M EXEMPTION AGE	Optional for both exhaust and evaporative.	
I/M GRACE PERIOD	Optional for both exhaust and evaporative.	
NO I/M TTC CREDITS	Optional for exhaust. Do not use with evaporative.	
I/M EFFECTIVENESS	Optional for exhaust. Do not use with evaporative.	
I/M DESC FILE	Optional for both.	NOT APPLIED.

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Table 30
MOBILE6 Fuels

Command	Function/Description	Input Parameter Source/Value
FUEL PROGRAM	Allows specification of one of four options: 1) Conventional Gasoline East Tier2 sulfur phase-in schedule (includes Texas), 2) Reformulated Gasoline (RFG), 3) Conventional Gasoline West Tier2 sulfur geographical phase-in area schedule, or 4) Sulfur content for gasoline after 1999.	Option 1: Applied for all counties and evaluation years.
SULFUR CONTENT	(or GASOLINE SULFUR) Allows use of alternate sulfur content for conventional gasoline through calendar year 1999.	Actual estimated value for 1999: 447 ppm, based on AAMA summer 1999 San Antonio sample survey data (ERG, October 2002).
DIESEL SULFUR	Allows use of ave. diesel fuel sulfur level for all calendar years. Required if PARTICULATES command is used. No affect on HC, CO, NOx, air toxics (except if calculated as ratio to PM).	NOT APPLIED.
OXYGENATED FUELS	Allows modeling of oxygenated gasoline effects on exhaust for all gasoline-fueled vehicle types. Not for use with AIR TOXICS command.	NOT APPLIED.
FUEL RVP	Allows user to specify fuel RVP for area being modeled (required to run model).	Actual estimated value for 1999, based on AAMA summer 1999 San Antonio sample survey data (ERG, October 2002). Regulated limit (7.8 psi) less 0.2 compliance safety margin is applied for 2002 + analysis years 1999: 7.6 psi (survey based) 2002 +: 7.6 psi (regulated limit with 0.2 safety margin)
SEASON	Identifies effective season for RFG calculation regardless of month modeled.	NOT APPLIED.
GAS AROMATIC%	Only when AIR TOXICS command is used.	NOT APPLIED.
GAS OLEFIN%	Only when AIR TOXICS command is used.	NOT APPLIED.
GAS BENZENE%	Only when AIR TOXICS command is used.	NOT APPLIED.
E200	Only when AIR TOXICS command is used.	NOT APPLIED.
E300	Only when AIR TOXICS command is used.	NOT APPLIED.
OXYGENATE	Only when AIR TOXICS command is used.	NOT APPLIED.
RVP OXY WAIVER	Only when AIR TOXICS command is used.	NOT APPLIED.

Table 31

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MOBILE6 Alternative Emissions Regulations and Control Measures

Command	Function/Description	Input Parameter Source/Value
NO CLEAN AIR ACT	Models vehicle emissions as if the Federal Clean Air Act Amendments of 1990 had not been implemented.	Applied for Pre-90 control analyses for all years except 1990.
HDDV NOx Off-Cycle Emissions Effects:		
NO DEFEAT DEVICE	Turns off the effects of the HDD vehicle NOx off-cycle emissions effects (defeat device emissions).	NOT APPLIED.
NO NOX PULL AHEAD	Turns off HDD NOx emissions reduction effects of Pull- Ahead program.	NOT APPLIED.
NO REBUILD	Turns off HDD NOx emissions reduction effects of Rebuild program.	NOT APPLIED.
REBUILD EFFECTS	Allows user change Rebuild program effectiveness rate.	1999: 0.01 (TCEQ 2001 estimate is assumed), 2007, 2012: 0.90 (EPA default is assumed).
Tier 2 Emission Standards and Fuel Requirements:	Allow the overriding of the default Tier 2 emissions standards and fuel requirements settings.	
NO TIER2	Disables Tier 2 requirements.	
T2 EXH PHASE-IN	Allows alternate Tier 2 exhaust standard phase-in schedules.	
T2 EVAP PHASE-IN	Allows alternate Tier 2 evaporative standard phase-in schedules.	
T2 CERT	Allows user to specify alternate Tier 2 50,000-mile certification standards.	NOT APPLIED.
94+ LDG IMPLEMENTATON	Allows use of alternate 1994 and later fleet penetration fractions for LDGVs under the Tier 1, NLEV (or California LEV 1), and Tier 2 emissions standard programs.	NOT APPLIED.
NO 2007 HDDV RULE	Disables 2007 HDV emissions standards.	NOT APPLIED.

External Conditions
MOBILE6 local inputs for hourly temperatures, daily average humidity, and sunrise and sunset times were developed from September 1999 ozone episode data and applied based on "local time." TCEQ developed the values and TTI formatted them for input to MOBILE6.

Temperatures (HOURLY TEMPERATURES Command)
TCEQ developed one set of ambient hourly temperatures (degrees Fahrenheit) for input to

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MOBILE6 for the four-county MSA based on weather data averaged from five Bexar County monitoring stations. The data sources are the EPA Aerometric Information Retrieval System (http://www.epa.gov/airs), and the National Weather Service (http://www.nws.noaa.gov). Hourly temperatures from the stations for the modeling period were averaged within each hour.

The ozone episode modeling period for the SA/MSA is September 13, 1999 through September 20, 1999. Since the emissions estimation method calls for emissions estimates for four day types as opposed to for individual episode days, temperature data were selected from the modeling period to correspond with the day-type being modeled. The average weekday episode day was chosen as September 20 (a Monday). The Friday, Saturday, and Sunday episode days were chosen as September 17, September 18 and September 19, respectively.

The temperatures were sequenced as required for input to MOBILE6 starting with the 6 a.m. hour. The temperatures are a MOBILE6 command file input. The same hourly temperatures were used for all analysis years. A summary of the temperature inputs are in Appendix F.

Relative Humidity (RELATIVE HUMIDITY Command)
The RELATIVE HUMIDITY command was applied to specify local hourly percent relative humidity values for the MSA.

The hourly relative humidity inputs were developed following the same procedure as described above for the hourly temperature input development, except that humidity data were used from only one Bexar County weather station (San Antonio International Airport). The humidity parameter is input in the MOBILE6 command file. The humidity values used (one set for each episode day for the MSA for all evaluation years) are summarized in Appendix F.

Sunrise and Sunset Times (SUNRISE/SUNSET Command)
The SUNRISE/SUNSET command allows the user to specify the time of sunrise and sunset. This feature affects only the air-conditioning correction. TCEQ provided the sunrise and sunset times, which are the same for the MSA for all evaluations. The times were developed using data from the city of San Antonio. The data source is the U.S. Naval Observatory Astronomical Applications Department Internet site (http://aa.usno.navy.mil/). The times are 7 a.m. and 8 p.m. local time.

Vehicle Fleet Characteristics
Vehicle registration (age) distributions and diesel fractions inputs to MOBILE6 were developed from TxDOT mid-year 2002 county vehicle registration data for those vehicle types where TxDOT registrations data were available. EPA defaults were used where necessary. Due to sparse registration data for some vehicle classes resulting from the increased disaggregation level of the vehicle classifications in MOBILE6 (28 vehicle types versus the previous eight vehicle class scheme), the registrations data are grouped for the four-county MSA for developing the age distributions input, and grouped for the state for developing the diesel fractions inputs.

The application of local registration distributions and diesel fractions for these EI forecasts follows guidance in Technical Guidance on the Use of MOBILE6 for Emission Inventory Preparation (EPA, January 2002). Namely, this analysis uses the latest available registration data for estimating vehicle class age distributions, and uses the most recent diesel fractions available as the projected fractions for future years.

Vehicle Registration Distributions (REG DIST Command)
Table 32 shows the user-supplied vehicle registration distributions input to MOBILE6 by vehicle age for any of the 16 composite (combined gas and diesel) vehicle types. EPA default distributions are internally applied by MOBILE6 for vehicle classes where the user does not provide alternate values. The input values for each vehicle class are 25 age fractions representing the fraction of vehicles by age for that particular vehicle class as of July of the evaluation year. These age fractions start with the evaluation year as the 1st age fraction and work back in annual increments to end with the 25th fraction, which represents the fraction of vehicles of age 25 years and older. The fractions are calculated as the model year-specific registrations in a class divided by the total vehicles registered in that class.

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Table 32
Composite Vehicle Classes for Vehicle Registration Data
(REG DIST Command)

Number	Abbreviation	Description
1	LDV	Light-Duty Vehicles (Passenger Cars)
2	LDT1	Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3,750 lbs. LVW)
3	LDT2	Light-Duty Trucks 2 (0-6,000 lbs. GVWR, 3,751-5,750 lbs. LVW)
4	LDT3	Light-Duty Trucks 3 (6,001-8,500 lbs. GVWR, 0-5,750 lbs. ALVW)
5	LDT4	Light-Duty Trucks 4 (6,001-8,500 lbs. GVWR, 5,751 lbs. and greater ALVW)
6	HDV2B	Class 2b Heavy-Duty Vehicles (8,501-10,000 lbs. GVWR)
7	HDV3	Class 3 Heavy-Duty Vehicles (10,001-14,000 lbs. GVWR)
8	HDV4	Class 4 Heavy-Duty Vehicles (14,001-16,000 lbs. GVWR)
9	HDV5	Class 5 Heavy-Duty Vehicles (16,001-19,500 lbs. GVWR)
10	HDV6	Class 6 Heavy-Duty Vehicles (19,501-26,000 lbs. GVWR)
11	HDV7	Class 7 Heavy-Duty Vehicles (26,001-33,000 lbs. GVWR)
12	HDV8A	Class 8a Heavy-Duty Vehicles (33,001-60,000 lbs. GVWR)
13	HDV8B	Class 8b Heavy-Duty Vehicles (>60,000 lbs. GVWR)
14	HDBS	School Buses
15	HDBT	Transit and Urban Buses
16	MC	Motorcycles (All)

Source: MOBILE6 User's Guide (EPA, January 2002).

TTI developed MOBILE6 age distributions fractions input from TxDOT data for all vehicle types except for the two bus categories. EPA defaults were used for the two bus categories. To develop these distributions, TTI used two county-level data sets provided by TxDOT. The TxDOT registrations data provided are summarized as:

- July 2002 registrations for:
  LDV, LDT12, LDT34, MC, HDGT, HDDT; and

- July 2002 registrations for:
  Gas: HDV2B, HDV3, HDV4, HDV5, HDV6, HDV7, HDV8A, HDV8B; and
  Diesel: HDV2B, HDV3, HDV4, HDV5, HDV6, HDV7, HDV8A, HDV8B.

The July 2002 registrations are for: automobiles, light-duty trucks (LDT12, corresponding to MOBILE6 classes LDT1 and LDT2), heavier light-duty trucks (LDT34, corresponding to MOBILE6 classes LDT3 and LDT4), motorcycles, heavy-duty gas trucks (> 8,500 lbs. GVWR), and heavy-duty diesel trucks (> 8,500 lbs. GVWR). The July 2002 gasoline and diesel HDV classes (eight each) comprise the July 2002 HDGT and HDDT classes represented in the July 2002 data set, respectively, and correspond to the eight HDV weight classes for numbers six through 13 in Table 32.

First the county registrations data for the four MSA counties were combined. There are three main steps to developing the MOBILE6 registration distributions input for the 14 non-bus vehicle classes. The first step in the process develops the July 2002 registrations by the 25 age groups for 12 of the 16 composite (by fuel) vehicle

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classes (eight HDV, LDV, LDT12, LDT34, MC). The second step converts the registrations from numbers of vehicles registered, to fractions registered by age for each of these 12 classes. The registrations are then expanded from 12 to 14 vehicle classes.

The 16 HDV class registrations were combined into the MOBILE6 eight composite (gas and diesel) classes by summing the individual fuel type registrations by age within each weight category. The 1978 and older registrations were summed to yield the "age 25 and older" registrations for each of the 12 composite vehicle classes (i.e., the eight HDV classes plus LDV, LDT12, LDT34, and MC).

The conversion of the registrations from numbers of vehicles to fractions of vehicles by age was made for each vehicle class by dividing the registrations for each age by the total registrations. MOBILE6 requires that the age distribution fractions for each vehicle class sum to one. In this step the age distribution fractions for each class were summed. For sums not equal to one (due to rounding error), the largest registration fraction was adjusted to make the fractions sum to one.

The resulting July 2002 estimated SA/MSA registration distribution fractions for the 12 composite classes were then expanded to 14 classes. This was accomplished by using the LDT12 age fractions, for both the MOBILE6 LDT1 and LDT2 classes and the LDT34 age fractions for both the MOBILE6 LDT3 and LDT4 classes. The MOBILE6 vehicle registration distributions are input from external data files. The external data files are on CD-ROM. Appendix A lists the data files. Appendix G shows the registration distributions input.

Diesel Fractions (DIESEL FRACTIONS Command)
The DIESEL FRACTIONS command allows the user to specify diesel fractions for 14 of the 16 composite (gasoline and diesel) vehicle categories by vehicle age. MOBILE6 assumes that urban/transit buses are 100 percent diesel, and that motorcycles are all gasoline fueled, so these two categories do not require diesel fractions. The diesel fraction represents the portion of diesels in a composite (gasoline and diesel) vehicle class for any vehicle age. When the user enters diesel fractions, all 14 sets of fractions are required. Each set of fractions contains the diesel fractions for 25 vehicle ages from the evaluation year back through the 25th fraction, which represents vehicle ages of 25 years and older.

The MOBILE6 default fractions vary by age for model years 1972 through 1996. For 1971 and earlier model years, the default diesel fractions are assumed the same as the 1972 model year fractions. For the 1997 and later model years, the default diesel fractions are assumed the same as the 1996 model year fractions.

TTI developed evaluation-year specific, state-level diesel fractions inputs for the analysis. One individual state-level set of diesel fractions was developed for each evaluation year. TTI used a combination of estimated TxDOT diesel fractions and EPA default diesel fractions for modeling the emissions factors. Table 33 shows the MOBILE6 diesel fractions input categories with corresponding data sources. The diesel fraction estimates were calculated based on TxDOT individual diesel and gasoline vehicle registrations for the eight HDV (HDV2b through HDV8b) weight classes. To produce the HDV diesel fractions by model year, the diesel registrations were divided by the sum of the gasoline and diesel registrations, by HDV composite vehicle class, and model year.

The HDV diesel fractions were forecast from 2002 to 2007 (and to 2012) by applying the latest diesel fraction (2002) to each of the future years (e.g., 2003 through 2012). To estimate the 1999 base year diesel fractions, the diesel fractions for 2000, 2001, and 2002 model years were dropped from the data set; the fractions for oldest model year in the data set, 1978, were applied to each of the older model years to complete the data set for 25 model years. The 1999, 2007 and 2012 estimated HDV diesel fractions were then combined with the corresponding evaluation year specific July EPA default diesel fractions for the remaining vehicle classes to produce the complete input data set for each evaluation year. Diesel fractions are entered in the MOBILE6 command file. Appendix G shows the diesel fractions input for each evaluation year.

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Table 33
Source of Diesel Fractions for Composite Vehicle Types
(DIESEL FRACTIONS Command)

Number	Abbreviation	Description	Source of Fractions
1	LDV	Light-Duty Vehicles	EPA MOBILE6 Evaluation Year Default
2	LDT1	Light-Duty Trucks 1	EPA MOBILE6 Evaluation Year Default
3	LDT2	Light-Duty Trucks 2	EPA MOBILE6 Evaluation Year Default
4	LDT3	Light-Duty Trucks 3	EPA MOBILE6 Evaluation Year Default
5	LDT4	Light-Duty Trucks 4	EPA MOBILE6 Evaluation Year Default
6	HDV2B	Class 2b Heavy-Duty Vehicles	TxDOT July, 2002 Statewide Registrations
7	HDV3	Class 3 Heavy-Duty Vehicles	TxDOT July, 2002 Statewide Registrations
8	HDV4	Class 4 Heavy-Duty Vehicles	TxDOT July, 2002 Statewide Registrations
9	HDV5	Class 5 Heavy-Duty Vehicles	TxDOT July, 2002 Statewide Registrations
10	HDV6	Class 6 Heavy-Duty Vehicles	TxDOT July, 2002 Statewide Registrations
11	HDV7	Class 7 Heavy-Duty Vehicles	TxDOT July, 2002 Statewide Registrations
12	HDV8A	Class 8a Heavy-Duty Vehicles	TxDOT July, 2002 Statewide Registrations
13	HDV8B	Class 8b Heavy-Duty Vehicles	TxDOT July, 2002 Statewide Registrations
14	HDBS	School Buses	EPA MOBILE6 Evaluation Year Default

Activity
The locality-specific activity parameters used to develop the hourly emissions factors are fleet hourly VMT fractions (through the VMT BY HOUR command).

Additional non-default activity inputs to the model were hourly fractions of VMT by the 14 speeds for Arterials and Freeways (SPEED VMT command). Weekend day hourly vehicle usage rates (MOBILE6 defaults) for particular activity input parameters (through the WE VEH US command) were applied for the Saturday and Sunday episode days.

VMT Fractions (Also Known as VMT mix)
These sets of fractions (VMT fractions attributable to individual vehicle classes) are an input to MOBILE6, however, the method for this study calls for the application of the VMT mix (or mixes) later in the emissions calculation process. VMT mix development was discussed previously in this documentation.

Total VMT by Hour (VMT BY HOUR Command)
Hourly fleet total VMT distributions are input to MOBILE6 by using the VMT BY HOUR command. These fractions are used by MOBILE6 to convert the units of the non travel-related hourly emissions factors (e.g., hot soak, diurnal, start, etc.) to units of g/mi. (The VMT by hour fractions are also used to produce the daily emissions factors as composites of the hourly emissions factors.)

Development of the hourly travel fractions for the TxDOT SA/MSA were previously discussed in the "Hourly Travel and Directional Factors" section. These same hourly fractions, used to distribute HPMS VMT by hour of day, are applied as input to MOBILE6. The only differences are in sequence (MOBILE6 hourly input starts with the 6 a.m. fraction) and format.

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To summarize, TxDOT continuous ATR data (for 1999 and 2001) are aggregated within the SA/MSA for developing the San Antonio area hourly travel factors. Hourly travel factors are developed for each of the four day types. Using the day type-specific volumes, these factors are the ratio of hourly volumes to 24-hour volume.

These fractions are input to MOBILE6 as an external data file. There is one set of four day type-specific hourly VMT fractions files used for all evaluation years. Table 7 shows the hourly travel factors. The MOBILE6 external data files are included on CD-ROM, as described in Appendix A.

VMT Distribution by Average Speed on Freeways and Arterials (SPEED VMT Command)
The VMT distributions by average speed inputs are called by the SPEED VMT command, but are accommodated internally by the POLFAC62 program (that is, no user speed input commands or data parameter values are required when producing MOBILE6 emissions factors tables with POLFAC62). POLFAC62 uses the SPEED VMT inputs to produce the individual Freeway and Arterial emissions factors indexed by the 14 MOBILE6 speed bin speeds.

There are 14 scenarios, each with 100 percent of Freeway and Arterial VMT set to one of the 14 MOBILE speed bin speeds. Each scenario produces a set of Arterial and Freeway emissions factors corresponding to one of the 14 speeds.

Weekend Day Vehicle Usage (WE VEH US Command)
MOBILE6 supplies default weekend day hourly vehicle usage rates for start distributions, soak distributions, hot soak activity, and trip length distributions. For Saturday and Sunday day types the WE VEH US command was applied to model the EPA default weekend usage rates for these parameters (MOBILE6 uses only the default weekday trip length distributions for both weekday and weekend day types).

State Programs
There are no MOBILE6 State Programs descriptive inputs (i.e., I/M, ATP, and stage II refueling programs) modeled.

Fuels – Locality-Specific Inputs to MOBILE6
User input for fuel effects modeling for the SA/MSA evaluations are the FUELS PROGRAM, FUEL RVP and GASOLINE SULFUR commands and associated input parameters and options. These inputs are entered in the MOBILE6 command file. The MSA is modeled with conventional gasoline.
Fuel Program (FUEL PROGRAM Command)
The MOBILE6 FUEL PROGRAM command provides the user four options for modeling fuels effects. The conventional gasoline east option (option 1) is used for this analysis. This option supplies post-1999 gasoline sulfur levels by year under the Tier 2 rule phase-in schedule for most states (including Texas).

Gasoline RVP (FUEL RVP Command)
Gasoline RVP is a required user-input to MOBILE6 with the FUEL RVP command. For developing modeling emissions inventories, estimated actual RVPs from gasoline sample survey data from the modeling area and episode day are used when available.

MSA-specific gasoline sample survey data were available for developing estimated actual gasoline RVP inputs for this analysis. Actual RVP estimates developed by Eastern Research Group, Inc. (ERG) for the purpose of updating existing EPA National Toxic Inventory (NTI) estimates (see County-Specific Fuel Parameters for 1990, 1996, and 1999 Toxic Emissions Modeling [Preparation for MOBILE6.2 model Runs], ERG, October 2002) were available for 1999. The summer 1999 estimated RVP value, 7.6 psi, is based on Alliance Automobile Manufacturers North American (AAM) Gasoline and Diesel Fuel Survey data from summer 1999 gasoline sample surveys conducted in the city of San Antonio. This 7.6 psi estimated actual RVP value was used for the SA/MSA for all evaluation years.

The 7.6 psi value was used for 2007 and 2012 analysis years assuming a compliance safety margin of 0.2 psi (value of actual RVP below the regulated RVP limit, which is 7.8 psi starting in 2000). This compliance safety margin for the future year analyses is a conservative estimate in comparison to the 1999 compliance safety margin estimate (9.0 psi regulated limit minus 7.6 psi estimated actual equals 1.4 psi under the limit). It would be

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unreasonable to assume the 1999 1.4 psi estimated compliance safety margin under the new 7.8 psi limit, which would result in a 6.4 psi estimated actual RVP value. Thus, based on these data, the conservative assumption was made that the future year RVP under the 7.8 psi limit should be at least as low as the 1999 estimated actual RVP value under the 9.0 psi limit.

Gasoline Sulfur Content (GASOLINE SULFUR Command)
For 1999 and earlier evaluation years, MOBILE6 allows alternate input for gasoline sulfur content through use of the GASOLINE SULFUR command. The MOBILE6 default is 300 parts per million (ppm) sulfur for 1999 and earlier years.

For the summer 1999 analysis, the estimated actual gasoline sulfur content, 447 ppm, was input to MOBILE6 with the GASOLINE SULFUR command. This summer 1999 estimated actual gasoline sulfur content value is from the fuel parameters input data developed by ERG for updating the EPA 1999 NTI. The values are based on summer 1999 AAM San Antonio gasoline sample survey data.

For 2007 and 2012 evaluation years, the MOBILE6 default gasoline sulfur content values are used. These values correspond to the Tier 2 sulfur phase-in schedule (set by using the FUEL PROGRAM command with Option 1, discussed above).

MOBILE6 Alternative Emissions Regulations and Control Measures
The only user-input value applied within this section of MOBILE6 commands, is related to the HDDV NOx off-cycle emissions effects.

In the late 1980s and most of the 1990s, HDDV engines were built with "defeat devices" allowing in-use engine emissions to be higher than emissions as specified under Federal Test Procedure conditions. MOBILE6 includes estimates of these excess HDDV emissions as well as the emissions offsetting effects of two programs—early pull-ahead of 2004 HDDV emissions standards, and low emissions rebuilds of existing engines.

Information from EPA led to the conclusion that the best estimate for the low NOx emissions rebuilds program effectiveness rate for the 1999 evaluation is 1.0 percent. The EPA information showed that the number of low NOx rebuild kits installed (as of January, 2002) in the affected population was 0.97 percent. The 1.0 percent effectiveness rate is assumed for 1999, however, no information was available to justify a non-default rebuild effects input value for 2007, and 2012.

Thus, for each evaluation year, the effectiveness rates were set as follows:

- 1999 Rebuild Program effectiveness rate: 1.0 percent; and
- 2007+ Rebuild Program effectiveness rate: 90.0 percent.

The 90 percent effectiveness value used for the 2007 and 2012 evaluations is the EPA's estimate, which is applied as the MOBILE6 default. This value and its associated command, REBUILD EFFECTS, are inputs to the MOBILE6 command file.

Emissions Factor Post-Processing Requirements and Procedures
There is one limitation of the MOBILE6 model that results in an emissions factors post-processing requirement for this analysis — MOBILE6 user-specified alternate diesel fuel parameters are not available for computing the VOC, CO, and NOx emissions factors.

To model the impacts of Texas LED, MOBILE6 diesel vehicle emissions factors were post-processed (with the RATADJV6 program, described in Appendix B). The NOx adjustment factor of 0.943 was multiplied by all of the diesel-fueled vehicle MOBILE6 2007 and 2012 NOx emissions factors. This adjustment corresponds to a reduction in NOx emissions factors of 5.7 percent. Development of this value is documented in the ERG report, Revised SIP

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Modeling Procedures for the HGA Nonattainment Area, included as Appendix G of Houston/Galveston Attainment Demonstration and Post-1999 Rate-of-Progress SIP, TNRCC, October 2001.

On completion of the post-processing for LED, the emissions factors are ready for input to the emissions estimation program. The emissions factors output files are included on the CD-ROM. See Appendix A for file names and descriptions.

EMISSIONS CALCULATIONS

Hourly emissions were calculated by county for each of the four episode days using the IMPSUM62 program (see description in Appendix B). With the day-of-week-specific VMT and emissions factors (g/mi) for each hour, emissions were calculated for each of the 28 vehicle types and each of 14 pollutant-specific emissions types by direction on each link (i.e. TDM network links and HPMS virtual links).

For each evaluation year and day, 108 files were output from the emissions calculations: 96 hourly link-emissions files (24 hours multiplied by four counties), four summary files of county-level hourly and 24-hour emissions estimates cross classified by vehicle type and road type (one for the TDM network county and one each for the three HPMS-based counties), a tab-delimited version of each of the four emissions summary files, and an emissions calculation program execution log file corresponding to each of the four emissions summary files. These files are included on the CD-ROM (see Appendix A).

Hourly Link Emissions

For each county and analysis day type, the emissions were calculated by hour for each link using the following basic inputs:

- MOBILE6 hourly Freeway, Arterial, and Ramp emissions factors indexed by speed for 28 vehicle types, developed with POLFAC62 (and RATEADJV6 program for post-processed rates);
- records associating the MOBILE6 Freeway emissions factors to the freeway links, and the MOBILE6 Arterial emissions factors to the non-freeway links (excluding Ramps), and MOBILE6 Ramp emissions factors to the TDM network links coded as Ramp;
- link-specific operational VMT and speed estimates as developed (for each hour) for TDM network and added intrazonal links (or HPMS virtual links) using the PREPIN program to include: A-node (HPMS area type code), B-node (HPMS functional class code), county number, functional classification code (HPMS area type and functional class cross combination code), link length (HPMS center lane miles), congested speed, and VMT; and
- VMT mix (to allocate link VMT by each of the 28 vehicle types) by time period and roadway type.

For each hour, the emissions estimates were computed by vehicle type for each link. The emissions factors, discussed previously, were tabulated in look-up tables by hour, road type (drive cycle), vehicle type, and 14 speeds (2.5 mph and 5 mph to 65 mph at 5 mph intervals) for the four-county SA/MSA. MSA-level, 24-hour VMT mix correlated to day type and functional classification group, were multiplied by the fleet total link VMT to produce hourly link VMT estimates by the 28 vehicle types. Emissions factors were then matched with link-level VMT based on county, speed, road type, hour, and vehicle class. Emissions factors for link speeds that are not represented in the set of 14 MOBILE6 speed bin speeds were calculated by interpolation (see example calculation, Appendix B). For link speeds greater than or less than the MOBILE6 bounding speeds of 65 mph and 2.5 mph, the emissions factors corresponding to those bounding speeds were used, respectively. The link VMT were then multiplied by the emissions factors to produce the link-level emissions estimates in grams.

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Tables 34 and 35 show the correlation of the functional classes to the MOBILE6 drive cycles and to the VMT mix functional classification groups, as used in the emissions calculations for the TDM network counties and the HPMS-based counties, respectively.

Table 34
San Antonio TDM Network Functional Class Groupings for Allocation of VMT Mix and MOBILE6 Drive Cycle Emissions Factors

MOBILE6 Drive Cycle	Functional Class Name	VMT Mix Functional Group
Freeway	Radial Freeway	Freeway
	Expressway	
	Circular Freeway	
	HOV*	
Ramp	Ramp	Arterial
Arterial	Radial Parkway	
	Primary Arterial Divided	
	Primary Arterial Undivided	
	Minor Arterial Divided	
	Minor Arterial Undivided	
	Circular Parkway	
	Circular Arterial Undivided	
	Collectors Divided	Collector/Local
	Collectors Undivided	
	Centroid Connector	
	Intrazonal	

* Used only for 2015 network (2012 emissions analysis).

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Table 35
HPMS Functional Class Groupings for
Allocation of VMT Mix and MOBILE6 Drive Cycle Emissions Factors

MOBILE6 Drive Cycle	HPMS Functional Class	VMT mix Functional Group
	Interstate	
Freeway	Freeway	Freeway
	Other Principal Arterial	
	Minor Arterial	Arterial
	Major Collector	
	Minor Collector	
Arterial	Local	Collector

For each evaluation year and episode day, county-level, hourly link-emissions files were produced. The link-emissions file data elements for each TDM network (and intrazonal) link are: A-node, B-node, functional class code, pollutant-specific emissions type label, and emissions estimates (grams) for each of the 28 vehicle types. The HPMS-based county link-emissions output data elements are the same except for the first three, which are: HPMS functional classification number, HPMS area type number, and HPMS area type and functional class cross combination code (See Appendix A).

Day-of-Week Hourly and 24-hour Emissions Summaries
For each analysis day, by individual county, the link-emissions estimates were summed for each hour, and the hourly emissions were summed for each day. The resulting composite VOC, CO, and NOx emissions estimates are summarized in pounds by road type, vehicle type, and road type and vehicle type cross classification. VMT, VHT, VMT-weighted speeds, and other inventory data are included with the emissions summaries. These files (*.LST and a tab delimited version, *.TAB) are included with the set of data files provided on CD-ROM (see Appendix A).

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APPENDIX A
ELECTRONIC SUBMITTAL DATA SET NAMES AND DESCRIPTIONS

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SA/MSA 1999, 2002, 2005, 2007, AND 2012 COUNTY EMISSIONS INVENTORIES ELECTRONIC SUBMITTAL DATA SET NAMES AND DESCRIPTIONS

The emissions inventories (EI) for the SA/MSA include one TDM network-based county (Bexar), and three HPMS-based counties (Comal, Guadalupe, and Wilson). The EIs are for four September 1999 episode days (a Weekday [average Monday through Thursday], Friday, Saturday, and Sunday) for each county and evaluation year. This appendix describes the EI data set files that are provided on CD-ROM along with this Technical Note.

Although the HPMS-based EIs are not network link-based, the hourly emissions files are produced in the network link-emissions file format, and are referred to as link-emissions files. Network link coordinates are provide for the TDM-based counties; no coordinates are provided for the HPMS-based county data.

CD-ROMs

The EI data are contained on seven CD-ROMs. There are six CD-ROMs that contain the link-emissions files and EI summary files; and one CD-ROM that contains the MOBILE6 input/output files, the network link coordinates and a copy of this electronic submittal data description.

Link-Emissions File Formats and Data Definitions

Tables 36 through 42 show the link emissions file format and data definitions. Emissions are not gridded; coordinates are included for the travel demand model network links.

TDM Network Node Coordinates

The TDM network node coordinate files are zipped (in coord.zip) on the CD-ROM named "SA_EF_XY". The specifications of the coordinates when imported into TRANSCAD are:

- Class - North America NAD27 (U.S. State Plane); and
- Zone - TxDOT : Texas Statewide Mapping System.

The node ID, Longitude, and Latitude are provided for the 1999, 2007, and 2015 network nodes (link ends) in the following files:

- 1999 network: SanAnt99coord.txt;
- 2007 network: SanAnt07coord.txt; and
- 2015 network: SanAnt15coord.txt.

Emissions Data:

There are two CD-ROMs (a and b) for each analysis year (six CD-ROMs total). Each CD-ROM contains one zip file with about half of the data for a particular evaluation year. The CD-ROM names are "SA***YY***#_EM", where ***YY*** = 99, 07, 12 corresponding to analysis year; # = a, b corresponding to half a year's data. Each set of CD-ROMs (i.e., a and b) includes:

- county level hourly link-emissions files (24 hours for each of the four counties for each of the four days = 384 ASCII files, with .T01, .T02.... T24 extensions);
- IMPSUM62 county-level hourly emissions inventory data summaries to include VMT mix, VMT, VHT, average speed, and emissions cross classified by vehicle type and road type; SUMALL62 county-level 24-hour emissions inventory data summaries (one ASCII file per TDM network and one ASCII file per HPMS-based county for each of the four day types = 16 files, with .LST extension);
- tab-delimited version of second bullet above (16 ASCII files with .TAB extension); and
- log of emissions estimation program runs (16 ASCII files with .LOG extension).

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Data set file names are:

countyname_sep***yyddd***_emis.T***hr***;
SAsep***yyddd***_ntwk.LOG;
Hcountyname_sep***yyddd***.LOG;
SAsep***yyddd***_ntwk.LST;
Hcountyname_sep***yyddd***.LST;
SAsep***yyddd***_ntwk.TAB; and
Hcountyname_sep***yyddd***.TAB.

Where:

countyname is the county name;
yy is the last two digits of the evaluation year;
ddd is the day-type: WKD, FRI, SAT, or SUN;
hr is 01... 24 representing the hours 12 a.m. through 11 p.m. (local time);
SA stands for the San Antonio area TDM network; and
Hcountyname is the county name for HPMS-based counties (Comal, Guadalupe, and Wilson).

Emissions Factor Data:
The four-county SA/MSA emissions factors input/output files are on the CD "SA_EF_XY." One zip file, SA_EF99_12.zip, contains 43 files that comprise all of the emissions factor inputs an outputs. The files include MOBILE6 command and external data files, interim and final hourly emissions factors, interim and final daily emissions factors, modeling run logs and MOBILE6 descriptive output listings.

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File Naming Conventions

Input files are:

ddsep***yyDT***_SA.in	(12 command input files);
SAmsa02.rgd	(one MSA-level registration distribution file); and
SA_***dd***.vhr	(four MSA-level hourly VMT files, one per day type).

Final hourly emissions factor table output files are:

ddsep***fyDT***_SA.rat	(four files, one per day type for 1999); and
ddsep***lyDT***_SA_led.rat	(eight files, one per day type each for 2007 and 2012 adjusted for LED).

Interim hourly emissions factor table output files are:

ddsep***lyDT***_SA.rat	(eight hourly tables, one per day type each for 2007 and 2012 prior to low-emissions diesel fuel adjustment procedure).

Daily emissions factor tables output files are:

same as above (20) hourly files, except with the ".rtd" extension in place of ".rat."

LOG and LST output files:

saEAC_sep***yy***_RT.LOG	(three emissions factor run log files, one per evaluation year); and
saEAC_sep***yy***_RT.LST	(three files with MOBILE6 scenario descriptive output**).

Where:

yy is the last two digits for each of the three evaluation years;
dd is the day date for each of the four episode days;
fy is the last two digits of the first evaluation year: 1999;
ly is the last two digits of the last two evaluation years: 2007, 2012; and
DT is day-type represented by: WK, FR, SA, and SU.

* Note that the "Daily ALL" emissions factors (network average daily emissions factors) in the .rtd files are meaningless for this analysis (because they are composited based on the MOBILE6 default VMT BY FACILITY). From the daily emissions factor files, only the road type-specific (i.e., individual drive cycle) daily emissions factors (FRWY, ART, LOC, and RAMP) are valid.
**The descriptive MOBILE6 output is useful as a check of inputs (some of which are listed in the descriptive output) but not for the emissions factors themselves which composites based on MOBILE6 default VMT BY FACILITY values.

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Table 36
Link Emissions Data Fields for HPMS-based Counties

Abbreviation	Columns	Format Type	Description
HPMS Area Type	1 - 6	I6	HPMS Area Type Code (1-3) (see Table 39).
HPMS Functional Class	7 - 12	I6	HPMS Functional Class Code (1-7) (see Table 40).
FC	13 - 15	I3	Functional Classification of Link (see Table 41).
EMISS	17 - 19	A3	"VOC," or "CO," or "NOx"
ETYPE	21 - 31	A11	Emissions sub-component type (see Table 44).
LDGV	32 - 41	F10.?*	LDGV link emissions in grams
LDGT1	42 - 51	F10.?	LDGT1 link emissions in grams
LDGT2	52 - 61	F10.?	LDGT2 link emissions in grams
LDGT3	62 - 71	F10.?	LDGT3 link emissions in grams
LDGT4	72 - 81	F10.?	LDGT4 link emissions in grams
HDGV2B	82 - 91	F10.?	HDGV2B link emissions in grams
HDGV3	92 - 101	F10.?	HDGV3 link emissions in grams
HDGV4	102 - 111	F10.?	HDGV4 link emissions in grams
HDGV5	112 - 121	F10.?	HDGV5 link emissions in grams
HDGV6	122 - 131	F10.?	HDGV6 link emissions in grams
HDGV7	132 - 141	F10.?	HDGV7 link emissions in grams
HDGV8A	142 - 151	F10.?	HDGV8A link emissions in grams
HDGV8B	152 - 161	F10.?	HDGV8B link emissions in grams
LDDV	162 - 171	F10.?	LDDV link emissions in grams
LDDT12	172 - 181	F10.?	LDDT12 link emissions in grams
HDDV2B	182 - 191	F10.?	HDDV2B link emissions in grams
HDDV3	192 - 201	F10.?	HDDV3 link emissions in grams
HDDV4	202 - 211	F10.?	HDDV4 link emissions in grams
HDDV5	212 - 221	F10.?	HDDV5 link emissions in grams
HDDV6	222 - 231	F10.?	HDDV6 link emissions in grams
HDDV7	232 - 241	F10.?	HDDV7 link emissions in grams
HDDV8A	242 - 251	F10.?	HDDV8A link emissions in grams
HDDV8B	252 - 261	F10.?	HDDV8B link emissions in grams
MC	262 - 271	F10.?	MC link emissions in grams
HDGB	272 - 281	F10.?	HDGB link emissions in grams
HDDBT	282 - 291	F10.?	HDDBT link emissions in grams
HDDBS	292 - 301	F10.?	HDDBS link emissions in grams
LDDT34	302 - 311	F10.?	LDDT34 link emissions in grams

* The F10? format is either F10.0, F10.1, F10.2, F10.3, or F10.4. The format selected for a field is based on the value of the field.

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Table 37
HPMS Area Type Codes

HPMS Area Type Code	Description
1	Rural
2	Small Urban
3	Urban

Table 38
HPMS Functional Classification Codes

HPMS Functional Class Code	Description
1	Interstate
2	Freeway
3	Other Principal Arterial
4	Minor Arterial
5	Major Collector
6	Minor Collector
7	Local

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Table 39
Link Functional Classification* Codes for HPMS-based Counties

Functional Class*	Description
0	Rural Interstate
2	Rural Other Principal Arterial
3	Rural Minor Arterial
4	Rural Major Collector
5	Rural Minor Collector
6	Rural Local
7	Small Urban Interstate
8	Small Urban Freeway
9	Small Urban Other Principal Arterial
10	Small Urban Minor Arterial
11	Small Urban Major Collector
12	Small Urban Minor Collector
13	Small Urban Local
14	Urban Interstate
15	Urban Freeway
16	Urban Other Principal Arterial
17	Urban Minor Arterial
18	Urban Major Collector
20	Urban Local

* "Virtual link"codes for each of the up to 21 HPMS Functional Class and Area Type combinations.

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Table 40
TDM Network Link Emissions Data File Format

Abbreviation	Columns	Format Type	Description
A Node	1 - 6	I6	A-Node of link
B Node	7 - 12	I6	B-Node of link
FC	13 - 15	I3	Functional Classification Code of Link (see Table 43)
EMISS	17 - 19	A3	"VOC," or "CO," or "NOx"
ETYPE	21 - 31	A11	Emissions Sub-Component Type (see Table 44)
LDGV	32 - 41	F10.?*	LDGV link emissions in grams
LDGT1	42 - 51	F10.?	LDGT1 link emissions in grams
LDGT2	52 - 61	F10.?	LDGT2 link emissions in grams
LDGT3	62 - 71	F10.?	LDGT3 link emissions in grams
LDGT4	72 - 81	F10.?	LDGT4 link emissions in grams
HDGV2B	82 - 91	F10.?	HDGV2B link emissions in grams
HDGV3	92 - 101	F10.?	HDGV3 link emissions in grams
HDGV4	102 - 111	F10.?	HDGV4 link emissions in grams
HDGV5	112 - 121	F10.?	HDGV5 link emissions in grams
HDGV6	122 - 131	F10.?	HDGV6 link emissions in grams
HDGV7	132 - 141	F10.?	HDGV7 link emissions in grams
HDGV8A	142 - 151	F10.?	HDGV8A link emissions in grams
HDGV8B	152 - 161	F10.?	HDGV8B link emissions in grams
LDDV	162 - 171	F10.?	LDDV link emissions in grams
LDDT12	172 - 181	F10.?	LDDT12 link emissions in grams
HDDV2B	182 - 191	F10.?	HDDV2B link emissions in grams
HDDV3	192 - 201	F10.?	HDDV3 link emissions in grams
HDDV4	202 - 211	F10.?	HDDV4 link emissions in grams
HDDV5	212 - 221	F10.?	HDDV5 link emissions in grams
HDDV6	222 - 231	F10.?	HDDV6 link emissions in grams
HDDV7	232 - 241	F10.?	HDDV7 link emissions in grams
HDDV8A	242 - 251	F10.?	HDDV8A link emissions in grams
HDDV8B	252 - 261	F10.?	HDDV8B link emissions in grams
MC	262 - 271	F10.?	MC link emissions in grams
HDGB	272 - 281	F10.?	HDGB link emissions in grams
HDDBT	282 - 291	F10.?	HDDBT link emissions in grams
HDDBS	292 - 301	F10.?	HDDBS link emissions in grams
LDDT34	302 - 311	F10.?	LDDT34 link emissions in grams

* The F10? format is either F10.0, F10.1, F10.2, F10.3, or F10.4. The format selected for a field is based on the value of the field.

Table 41
San Antonio TDM Network Functional Classifications

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Functional Class Code	Functional Class Name
0	Local Roads
1	Radial Freeway
2	Radial Parkway
3	Expressway
4	Primary Arterial Divided
5	Primary Arterial Undivided
6	Minor Arterial Divided
7	Minor Arterial Undivided
8	Collectors Divided
9	Collectors Undivided
10	Frontage Road
11	Ramp
12	Circumferential Freeway
13	Circumferential Parkway
14	Circumferential Arterial
35	HOV*
40	Intrazonal

*Only used 2015 network but classified as Radial Freeway due to lack of data for HOV.

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Table 42
Emissions* Sub-component Type

Sub-Component Abbreviation	Description
Composite	Total emissions
Exh Running	Exhaust running emissions
Start	Start emissions
Hot Soak	Hot Soak VOC emissions
Diurnal	Diurnal VOC emissions
Rest Loss	Resting loss VOC emissions
Run Loss	Running loss VOC emissions
Crankcase	Crankcase VOC emissions
Refueling	Refueling loss VOC emissions

* VOC, CO, and NOx.

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APPENDIX B
EMISSIONS ESTIMATION PROGRAMS

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TTI EMISSIONS ESTIMATION PROGRAMS

The following is a summary of programs developed by TTI that may be used to produce TDM network link-based and HPMS "virtual link"-based, hourly, on-road mobile source emissions estimates for air quality analyses.

For the TDM-based analyses the emissions estimates are made at the TDM network link level (for thousands of links) where geographical coordinates are associated.

For the HPMS-based analyses, emissions estimates are made at the functional classification/area type level which constitutes a 21-cell array defined by seven functional classifications and three area types, or road-type "cells." These road-type cells may be viewed as a roadway network (analogous to the TDM network, but with larger and fewer links) consisting of up to 21 links (or, with directionality included, 42 links).

Hereafter, for the purpose of this discussion, the term "link" may be used to mean either a TDM network link or an HPMS "virtual link."

The main emissions estimation programs are: PREPIN (2BW for TDM network analyses and 254HPMS for HPMS analyses), POLFAC62, RATEADJ62, RATEADJV62, IMPSUM62, and SUMALL62. PREPIN prepares activity input, POLFAC62 prepares emissions factor input, the RATEADJ programs make special adjustments to emissions factors when required, IMPSUM62 calculates emissions by time period, and SUMALL62 summarizes emissions and other EI data at various levels by 24-hour period.

PREPIN

The PREPIN2BW program post-processes travel model output to produce time-of-day-specific, on-road vehicle fleet, link VMT and speed estimates for emissions inventory applications. The PREPIN2BW program was developed for use in urban areas that do not have all of the time-of-day assignments and operational speeds available as may be required for air quality analyses of particular temporal scales (e.g., hourly).

For example, PREPIN2BW reads a travel demand model traffic assignment data set from a directional four period time-of-day assignment (another common assignment read by PREPIN2BW is the nondirectional or directional 24-hour assignment). PREPIN2BW initially scales the assignment volumes on each link to the appropriate VMT (seasonal, day-of-week specific, for instance). Time-of-day (hourly, for example) factors (and directional split factors, in the case of a nondirectional assignment) are applied to the adjusted assignment results on each link to estimate the directional time-of-day travel on the link. Speed models, originally developed for the Dallas/Fort Worth Region or optionally the Houston/Galveston Region, are used to estimate the operational time-of-day speeds by direction on the links. Special intrazonal links are defined (as intrazonal links are not a feature of travel demand models), and the VMT and speeds for intrazonal trips are estimated. These VMT and speeds by link are subsequently input to the IMPSUM6 program for the application of MOBILE6 emissions factors.

PREPIN254HPMS

The PREPIN254HPMS program processes the Statewide HPMS county AADT VMT, centerline miles, and lane miles by functional classification and area type to produce hourly, on-road vehicle fleet, seasonal and day-of-week-specific, actual or forecast VMT and directional speed estimates for EI applications. These estimated VMT and speeds are produced for 21 HPMS functional classification/area type combinations, or "links." The program was developed for use in areas that do not have TDM networks, and for EI applications where network link-based detail is not required. However, the HPMS link speeds are developed analogous to those produced from network travel model-based input data, except with a much smaller set of "links." The main inputs are:

- TxDOT statewide HPMS data set at the county level which includes AADT VMT, centerline miles, and lane miles by HPMS area type and functional class;
- county-level VMT control totals;

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- list of Texas county names;
- hourly VMT distributions; and
- Dallas/Fort Worth speed modeling inputs to include volume/delay equation parameters adapted for HPMS, and freeflow speeds and lane capacities by HPMS functional classification and area type.

The program initially allocates the county control total VMT (VMT adjusted for season, etc.) to the link, proportional HPMS AADT VMT on each link. Hourly factors and directional split factors are applied to the adjusted VMT on each link to estimate the hourly directional VMT (and volumes) by HPMS link. Speed models, originally developed for the Dallas/Fort Worth Region, are used to estimate the hourly operational speeds by direction for each link. The operational speeds are based on v/c derived directional delay (minutes/mile) applied to the estimated freeflow speeds for each link. These HPMS link-VMT and speed estimates are subsequently input to the IMPSUM62 program for the application of MOBILE6 emissions factors.

POLFAC62

The POLFAC62 program is used to apply the EPA's MOBILE6 program (October 2002 version with additional pollutant capabilities) to calculate the on-road mobile emissions factors. The MOBILE6 emissions factors may be produced for each of the pollutant-specific emissions types (e.g., depending on the pollutant and vehicle type, the total composite, exhaust running, exhaust start, plus the six sub-component evaporative rates), 28 vehicle types, four MOBILE6 functional classifications (or drive cycles, i.e., Freeway, Arterial/Collector, Local, and Ramp), 14 speeds (i.e., 2.5 mph, and 5 mph through 65 mph at 5 mph increments for Freeway and Arterial functional classifications—MOBILE6 Local and Ramp functional classification rates are single speed only, 12.9 mph, and 34.6 mph, respectively), and each of the 24 hours of the day.

The POLFAC62 emissions factors are average vehicle class rates calculated from the MOBILE6 database output by weighting the by-model-year emissions rates within each vehicle class by its corresponding travel fraction. These emissions factors are tabulated individually by geographical area (county or county group) and analysis day for the evaluation year. These emissions factors are output to an ASCII file for subsequent input to the IMPSUM62 program. The IMPSUM62 program is then used to apply the hourly emissions factors to hourly VMT estimates by link. (POLFAC62 also optionally produces a set of daily emissions factors.) POLFAC62 also calculates the additional pollutant emissions factors provided by the MOBILE6 October 2002 version.

RATEADJ62

RATEADJ62 is a special utility program that produces a new set of emissions factors by linearly combining the emissions factors from multiple applications of POLFAC62. There is one set of linear factors. Each factor is applied to all emissions rates in a single data set.

A practical application of the RATEADJ program is the combining of two sets of emissions factors, where each set has different control program credits, into one set including the combined credits. For example, this program may be used to combine different ATP credits from two separate POLFAC62 runs into one set of emissions factors that includes the credits for both ATPs.

RATEADJV62

RATEADJV62 is a special utility program that produces a new set of emissions factors by linearly combining the emissions factors from multiple applications of POLFAC62 or RATEADJ62. There is a separate set of factors (that may be different for each pollutant-specific emissions type and vehicle type combination) for each of the input emissions factor data sets.

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A practical application of RATEADJV62 is the application of emissions factor credits by individual vehicle class and/or individual pollutant. For example, for analyses requiring the effects of the Texas Low-Emissions Diesel Fuel Program in MOBILE6 emissions factors, RATEADJV62 is used to apply reduction factors to only the NOx emissions factors for diesel-fueled vehicle classes only.

IMPSUM62

The IMPSUM62 program applies the emissions factors obtained from POLFAC62 (or from one of the RATEADJ programs, when used) and VMT mixes (fractions of fleet VMT attributable to each vehicle classification in the study) to the time-of-day fleet VMT and speed estimates to calculate emissions by the specified time periods. The five primary inputs to IMPSUM62 are:

- MOBILE6 emissions factors developed with POLFAC62 (or a RATEADJ6, if used);
- link-based hourly VMT and speeds developed using a PREPIN program. For each link, the following information is input to IMPSUM: county number, roadway type number, VMT on link, operational link-speed estimate, and link distance;
- VMT mix by time period, county and roadway type;
- X-Y coordinates (optional for gridded emissions); and
- data records associating the MOBILE6 drive cycle (Freeway, Arterial, Local, Ramp) emissions factors (or percentages thereof) to specific travel model functional classifications. These MOBILE6 drive cycle emissions factor percentages (valid from zero to 100) must sum to 100 percent for each travel model functional classification.

Using these input data, the VMT for each link is stratified by MOBILE6 drive cycle and the 28 vehicle types. The MOBILE6 emissions factors are matched to link VMT by drive cycle, speed, and vehicle type and are interpolated (for the speed that falls between the 14 MOBILE6 speeds, see the MOBILE6 interpolation methodology below) and multiplied by the link VMT to estimate the mobile source emissions for that link. Emissions factors for 65 mph are used for links with speeds greater than 65 mph and emissions factors for 2.5 mph are used for links with speeds lower than 2.5 mph. The emissions for the county and emissions type are reported by both roadway type and vehicle type for each of the subject time periods. A data set is produced for subsequent input to the SUMALL62 program. Also, link emissions may be written by county at the pollutant-specific emissions type sub-component level and 28 vehicle types level.

A tab-delimited output is optionally produced. This output includes all 28 vehicle types (or eight vehicle types in the compressed format) across a single output line. Each field in the output is separated by a tab character.

Example Emissions Factor Interpolation

To calculate emissions factors for average operational speeds that fall between two of the 14 MOBILE6 speed bin speeds, MOBILE6 interpolates each emissions factor using a factor developed from the inverse link speed and the inverse high and low bounding speed bin speeds (Section 5.3.4, MOBILE6 User's Guide, January 2002).

Using the MOBILE6 emissions factors tabulated by the 14 speeds, the IMPSUM62 program uses the MOBILE6 method to interpolate emissions factors as shown in the following example. This example interpolates an emissions factor corresponding to an average speed of 41.2 mph.

The interpolated emissions factor (EF_{Interp}) is expressed as:

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$$EF_{Interp} = EF_{LowSpeed} - FAC_{Interp} \times (EF_{LowSpeed} - EF_{HighSpeed})$$

Where:

$EF_{LowSpeed}$ = emission factor (EF) corresponding to tabulated speed below the average link speed,

$EF_{HighSpeed}$ = EF corresponding to tabulated speed above the average link speed, and

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$FAC_{Interp} =$

Given that:

$EF_{LowSpeed}$ = 0.7413 g/mi,
$EF_{HighSpeed}$ = 0.7274 g/mi,
$Speed_{lnk}$ = 41.2 mph,
$Speed_{low}$ = 40 mph, and
$Speed_{high}$ = 45 mph.

$FAC_{Interp} =$ = = 0.26214,

EF_{Interp} = 0.7413 g/mi - (0.26214) × (0.7413 g/mi - 0.7274 g/mi)

= 0.7377 g/mi

SUMALL62

The SUMALL62 program is used to sum the emissions estimates for the time-of-day periods (e.g., 24 periods in the case of hourly analyses) to develop 24-hour emissions estimates. The emissions by pollutant type are reported by roadway type and 28 vehicle types (or optionally condensed to eight vehicle types).

A tab-delimited output is optionally produced. This output includes all 28 vehicle types (or eight vehicle types in the compressed format) across a single output line. Each field in the output is separated by a tab character.

The overall emissions estimate process flow is shown in the diagram below.

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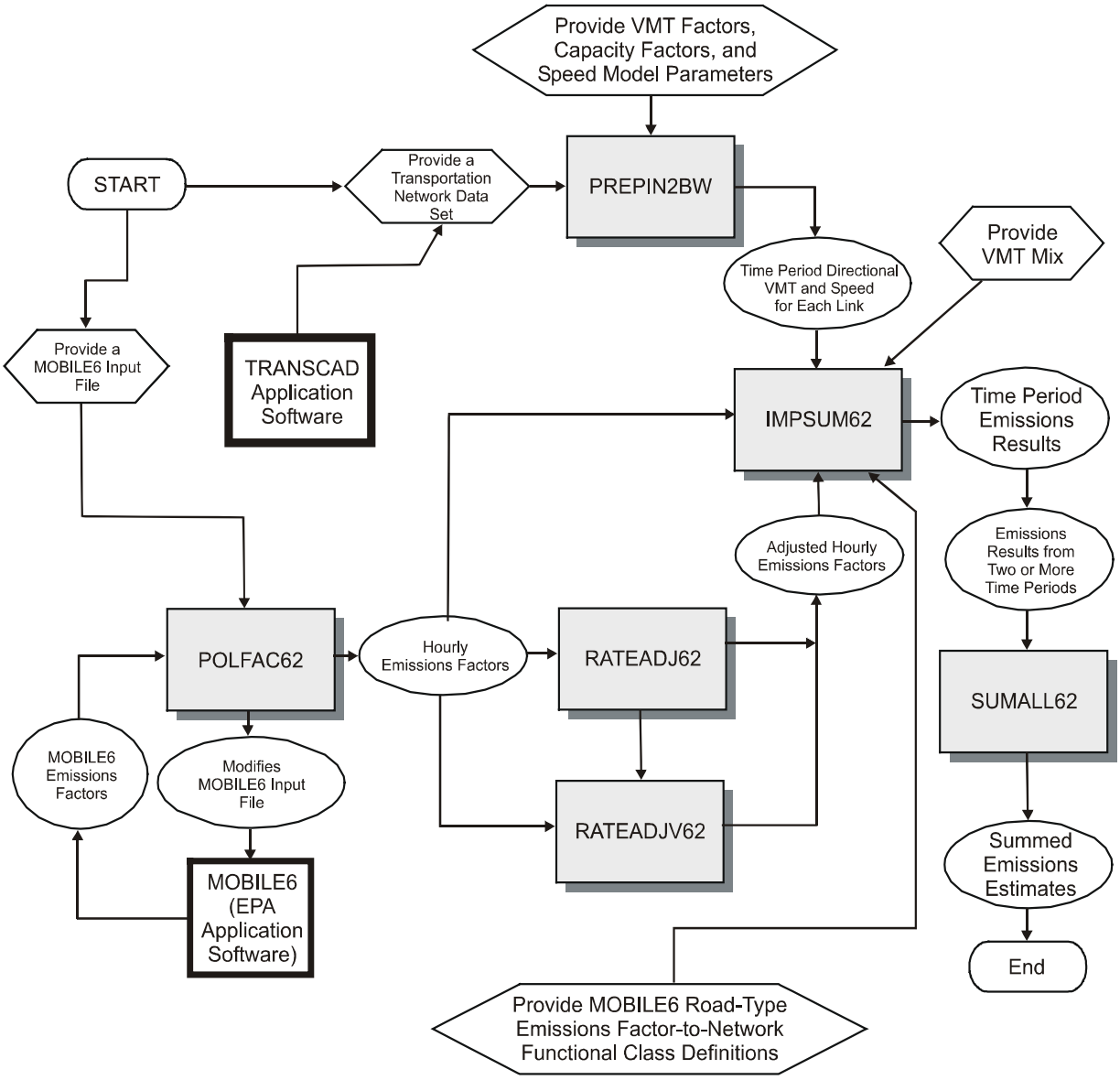
General Process Flow

Travel Demand Model Network Link-Based Hourly MOBILE6 Emissions Estimates with Texas Mobile Source Emissions Software



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APPENDIX C
DIRECTIONAL SPLIT ESTIMATES

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San Antonio Network Directional Split Factors - AM Peak Period

Functional Class	Area Type*					
	1	2	3	4	5	6
Local Roads	50.00000	50.00000	50.00000	50.00000	50.00000	50.00000
Radial Freeway	53.37670	53.37670	74.13610	61.25710	61.73610	74.13610
Radial Parkway	53.37670	53.37670	74.13610	61.25710	61.73610	74.13610
Expressway	53.37670	53.37670	74.13610	61.25710	61.73610	74.13610
Primary Arterial Divided	68.72790	68.72790	68.03360	56.38190	61.73610	68.03360
Primary Arterial Undivided	68.72790	68.72790	68.03360	56.38190	61.73610	68.03360
Minor Arterial Divided	68.72790	68.72790	68.03360	56.38190	61.73610	68.03360
Minor Arterial Undivided	68.72790	68.72790	68.03360	56.38190	61.73610	68.03360
Collectors Divided	65.87060	65.87060	65.87060	65.87060	65.57410	65.87060
Collectors Undivided	65.87060	65.87060	65.87060	65.87060	65.57410	65.87060
Frontage Road	68.72790	68.72790	68.03360	56.38190	61.73610	68.03360
Ramp	68.72790	68.72790	68.03360	56.38190	61.73610	68.03360
Circumferential Freeway	53.37670	53.37670	74.13610	61.25710	61.73610	74.13610
Circumferential Parkway	53.37670	53.37670	74.13610	61.25710	61.73610	74.13610
Circumferential Arterial	68.72790	68.72790	68.03360	56.38190	61.73610	68.03360

* Area Type codes are listed at the end of this appendix.

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San Antonio Network Directional Split Factors - Mid-Day Period

Functional Class	Area Type*					
	1	2	3	4	5	6
Local Roads	50.00000	50.00000	50.00000	50.00000	50.00000	50.00000
Radial Freeway	51.85418	51.85418	58.91482	58.91482	56.18798	58.91482
Radial Parkway	51.85418	51.85418	58.91482	58.91482	56.18798	58.91482
Expressway	51.85418	51.85418	58.91482	58.91482	56.18798	58.91482
Primary Arterial Divided	59.80851	59.80851	57.87852	57.87852	56.18798	57.87852
Primary Arterial Undivided	59.80851	59.80851	57.87852	57.87852	56.18798	57.87852
Minor Arterial Divided	59.80851	59.80851	57.87852	57.87852	56.18798	57.87852
Minor Arterial Undivided	59.80851	59.80851	57.87852	57.87852	56.18798	57.87852
Collectors Divided	59.53949	59.53949	59.53949	59.53949	58.27722	59.53949
Collectors Undivided	59.53949	59.53949	59.53949	59.53949	58.27722	59.53949
Frontage Road	59.80851	59.80851	57.87852	54.04745	56.18798	57.87852
Ramp	59.80851	59.80851	57.87852	57.87852	56.18798	57.87852
Circumferential Freeway	51.85418	51.85418	58.91482	58.91482	56.18798	58.91482
Circumferential Parkway	51.85418	51.85418	58.91482	58.91482	56.18798	58.91482
Circumferential Arterial	59.80851	59.80851	57.87852	57.87852	56.18798	57.87852

* Area Type codes are listed at the end of this appendix.

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San Antonio Network Directional Split Factors - PM Peak Period

Functional Class	Area Type*					
	1	**2**	**3**	**4**	**5**	**6**
Local Roads	50.00000	50.00000	50.00000	50.00000	50.00000	50.00000
Radial Freeway	52.62830	52.62830	69.38360	56.48830	58.00540	69.38360
Radial Parkway	52.62830	52.62830	69.38360	56.48830	58.00540	69.38360
Expressway	52.62830	52.62830	69.38360	56.48830	58.00540	69.38360
Primary Arterial Divided	63.81940	63.81940	60.33020	56.78330	58.00540	60.33020
Primary Arterial Undivided	63.81940	63.81940	60.33020	56.78330	58.00540	60.33020
Minor Arterial Divided	63.81940	63.81940	60.33020	56.78330	58.00540	60.33020
Minor Arterial Undivided	63.81940	63.81940	60.33020	56.78330	58.00540	60.33020
Collectors Divided	60.07770	60.07770	60.07770	60.07770	57.38310	60.07770
Collectors Undivided	60.07770	60.07770	60.07770	60.07770	57.38310	60.07770
Frontage Road	63.81940	63.81940	60.33020	56.78330	58.00540	60.33020
Ramp	63.81940	63.81940	60.33020	56.78330	58.00540	60.33020
Circumferential Freeway	52.62830	52.62830	69.38360	56.48830	58.00540	69.38360
Circumferential Parkway	52.62830	52.62830	69.38360	56.48830	58.00540	69.38360
Circumferential Arterial	63.81940	63.81940	60.33020	56.78330	58.00540	60.33020

* Area Type codes are listed at the end of this appendix.

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San Antonio Network Directional Split Factors - Overnight Period

Functional Class	Area Type*					
	1	2	3	4	5	6
Local Roads	50.00000	50.00000	50.00000	50.00000	50.00000	50.00000
Radial Freeway	52.89322	52.89322	57.80462	58.35028	60.92629	57.80462
Radial Parkway	52.89322	52.89322	57.80462	58.35028	60.92629	57.80462
Expressway	52.89322	52.89322	57.80462	58.35028	60.92629	57.80462
Primary Arterial Divided	64.07599	64.07599	60.11187	58.87167	60.92629	60.11187
Primary Arterial Undivided	64.07599	64.07599	60.11187	58.87167	60.92629	60.11187
Minor Arterial Divided	64.07599	64.07599	60.11187	58.87167	60.92629	60.11187
Minor Arterial Undivided	64.07599	64.07599	60.11187	58.87167	60.92629	60.11187
Collectors Divided	63.07224	63.07224	63.07224	63.07224	60.48731	63.07224
Collectors Undivided	63.07224	63.07224	63.07224	63.07224	60.48731	63.07224
Frontage Road	64.07599	64.07599	60.11187	58.87167	60.92629	60.11187
Ramp	64.07599	64.07599	60.11187	58.87167	60.92629	60.11187
Circumferential Freeway	52.89322	52.89322	57.80462	58.35028	60.92629	57.80462
Circumferential Parkway	52.89322	52.89322	57.80462	58.35028	60.92629	57.80462
Circumferential Arterial	64.07599	64.07599	60.11187	58.87167	60.92629	60.11187

* Area Type codes are listed at the end of this appendix.

San Antonio Time-of-Day Travel Periods

Period	Hours
AM Peak	7 a.m. - 8 a.m.
Mid-Day	8 a.m. - 5 p.m.
PM Peak	5 p.m. - 6 p.m.
Overnight	6 p.m. - 7 a.m.

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San Antonio TDM Network Area Types

Area Type Code	Area Type Name
1	Central Business District (CBD)
2	Urban
3	Urban Residential
4	Suburban
5	Rural
6	Military

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APPENDIX D
CAPACITY FACTORS AND SPEED FACTORS

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San Antonio Network Capacity Factors

Roadway Type	Area Type*					
	1	2	3	4	5	6
Local Roads	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
Radial Freeway	0.0750	0.0684	0.0693	0.1054	0.1527	0.1054
Radial Parkway	0.1043	0.0946	0.0959	0.1660	0.2632	0.1660
Expressway	0.0698	0.0777	0.0788	0.0878	0.1333	0.0878
Primary Arterial Divided	0.0659	0.0800	0.0915	0.1160	0.1818	0.1160
Primary Arterial Undivided	0.0662	0.0809	0.0938	0.1205	0.1859	0.1205
Minor Arterial Divided	0.0759	0.0923	0.1136	0.1728	0.2941	0.1728
Minor Arterial Undivided	0.0758	0.0924	0.1139	0.1667	0.2813	0.1667
Collectors Divided	0.0726	0.0856	0.1075	0.1642	0.3194	0.1642
Collectors Undivided	0.0702	0.0833	0.1047	0.1587	0.3088	0.1587
Frontage Road	0.0407	0.0444	0.0463	0.0933	0.1364	0.0933
Ramp	0.0638	0.0614	0.0639	0.1191	0.1974	0.1191
Circumferential Freeway	0.1000	0.0539	0.0564	0.1054	0.1000	0.1054
Circumferential Parkway	0.1000	0.1000	0.0852	0.1013	0.1039	0.1013
Circumferential Arterial	0.1000	0.1000	0.0839	0.1115	0.1280	0.1115

* Area Type codes are listed at the end of this appendix.

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San Antonio Network Speed Factors

Roadway Type	Area Type*					
	1	2	3	4	5	6
Local Roads	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
Radial Freeway	1.70588	1.61111	1.59459	1.42857	1.42000	1.59459
Radial Parkway	1.61111	1.56757	1.68571	1.39535	1.39216	1.68571
Expressway	1.25000	1.25926	1.25000	1.24324	1.27660	1.25000
Primary Arterial Divided	1.25000	1.26087	1.26667	1.24242	1.25000	1.26667
Primary Arterial Undivided	1.25000	1.27273	1.25000	1.26471	1.22222	1.25000
Minor Arterial Divided	1.27273	1.26316	1.24000	1.26667	1.13636	1.24000
Minor Arterial Undivided	1.30000	1.26316	1.24000	1.25000	1.25000	1.24000
Collectors Divided	1.22222	1.27778	1.26087	1.24000	1.12500	1.25926
Collectors Undivided	1.25000	1.25000	1.27273	1.24000	1.18421	1.25926
Frontage Road	1.25000	1.23529	1.26087	1.24000	1.41026	1.24000
Ramp	1.26316	1.25714	1.25714	1.26190	1.20000	1.26190
Circumferential Freeway	1.00000	1.34884	1.31111	1.25000	1.00000	1.31111
Circumferential Parkway	1.00000	1.00000	1.22917	1.20000	1.33962	1.11321
Circumferential Arterial	1.00000	1.00000	1.26190	1.24444	1.26087	1.26190

* Area Type codes are listed at the end of this appendix.

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San Antonio TDM Network Area Types

Area Type Code	Area Type Name
1	Central Business District (CBD)
2	Urban
3	Urban Residential
4	Suburban
5	Rural
6	Military

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APPENDIX E
VMT MIX

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San Antonio MSA 1999 VMT Mix — Weekday

OBS	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	Art	0.6290023	0.0557666	0.1856440	0.0373889	0.0171938	0.0067002	0.0031631	0.0012621	0.0007479
2	Col	0.6072001	0.0564317	0.1878580	0.0387901	0.0178382	0.0100068	0.0047242	0.0018850	0.0011170
3	Fway	0.6129354	0.0497536	0.1656269	0.0312253	0.0143594	0.0061916	0.0029230	0.0011663	0.0006912

OBS	P_HDGV_6	P_HDGV_7	P_HDGV8A	P_HDGV8B	P_LDDV	P_LDDT12	P_HDDV2B	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.0023840	0.0007635	0.0004519	0.0001091	0.0017603	0.0004199	0.0074391	0.0033244	0.0017167	0.0012535
2	0.0035606	0.0011403	0.0006749	0.0001629	0.0016994	0.0004249	0.0092483	0.0041329	0.0021342	0.0015583
3	0.0022030	0.0007056	0.0004176	0.0001008	0.0017154	0.0003746	0.0096595	0.0043167	0.0022291	0.0016276

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0054227	0.0032427	0.0048504	0.0225568	0.0010000	0.0011921	0.0017219	0.0024001	0.0011220
2	0.0067414	0.0040313	0.0060300	0.0249436	0.0010000	0.0012406	0.0017920	0.0024978	0.0011354
3	0.0070412	0.0042106	0.0062982	0.0691096	0.0010000	0.0006992	0.0010099	0.0014077	0.0010010

San Antonio MSA 1999 VMT Mix — Friday

OBS	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	Art	0.6777393	0.0512406	0.1705772	0.0346307	0.0159254	0.0038187	0.0018028	0.0007193	0.0004263
2	Col	0.6598377	0.0522938	0.1740833	0.0362349	0.0166631	0.0057520	0.0027155	0.0010835	0.0006421
3	Fway	0.6707293	0.0464275	0.1545545	0.0293722	0.0135072	0.0035838	0.0016919	0.0006751	0.0004001

OBS	P_HDGV_6	P_HDGV_7	P_HDGV8A	P_HDGV8B	P_LDDV	P_LDDT12	P_HDDV2B	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.0013588	0.0004352	0.0002575	0.0000622	0.0018909	0.0003864	0.0049683	0.0022203	0.0011465	0.0008372
2	0.0020466	0.0006555	0.0003879	0.0000936	0.0018411	0.0003944	0.0062293	0.0027838	0.0014375	0.0010496
3	0.0012752	0.0004084	0.0002417	0.0000583	0.0018714	0.0003501	0.0065517	0.0029279	0.0015119	0.0011039

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0036216	0.0021657	0.0032394	0.0150649	0.0010000	0.0006794	0.0011500	0.0016029	0.0010326
2	0.0045407	0.0027153	0.0040616	0.0168009	0.0010000	0.0007131	0.0012070	0.0016824	0.0010538
3	0.0047758	0.0028559	0.0042718	0.0468745	0.0010000	0.0004047	0.0006850	0.0009548	0.0009356

San Antonio MSA 1999 VMT Mix — Saturday

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OBS	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	Art	0.7020505	0.0504038	0.1677915	0.0319885	0.0147103	0.0024051	0.0011354	0.0004530	0.0002685
2	Col	0.6869315	0.0516971	0.1720968	0.0336377	0.0154688	0.0036408	0.0017188	0.0006858	0.0004064
3	Fway	0.7036198	0.0462488	0.1539599	0.0274755	0.0126350	0.0022858	0.0010791	0.0004306	0.0002552

OBS	P_HDGV_6	P_HDGV_7	P_HDGV8A	P_HDGV8B	P_LDDV	P_LDDT12	P_HDDV2B	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.0008558	0.0002741	0.0001622	0.0000392	0.0019609	0.0003790	0.0031288	0.0013982	0.0007220	0.0005272
2	0.0012954	0.0004149	0.0002455	0.0000593	0.0019187	0.0003888	0.0039425	0.0017618	0.0009098	0.0006643
3	0.0008133	0.0002605	0.0001542	0.0000372	0.0019653	0.0003478	0.0041783	0.0018672	0.0009642	0.0007040

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0022807	0.0013638	0.0020400	0.0094871	0.0010000	0.0004279	0.0007242	0.0010094	0.0010128
2	0.0028738	0.0017185	0.0025706	0.0106333	0.0010000	0.0004514	0.0007639	0.0010648	0.0010388
3	0.0030457	0.0018213	0.0027243	0.0298939	0.0010000	0.0002581	0.0004368	0.0006089	0.0009293

San Antonio MSA 1999 VMT Mix — Sunday

OBS	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	Art	0.6625404	0.0600917	0.2000420	0.0365996	0.0168308	0.0016245	0.0007669	0.0003060	0.0001813
2	Col	0.6482896	0.0616353	0.2051807	0.0384877	0.0176991	0.0024592	0.0011610	0.0004632	0.0002745
3	Fway	0.6721112	0.0558089	0.1857847	0.0318185	0.0146322	0.0015627	0.0007377	0.0002944	0.0001744

OBS	P_HDGV_6	P_HDGV_7	P_HDGV8A	P_HDGV8B	P_LDDV	P_LDDT12	P_HDDV2B	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.0005780	0.0001851	0.0001096	0.0000264	0.0018542	0.0004503	0.0021134	0.0009445	0.0004877	0.0003561
2	0.0008750	0.0002802	0.0001659	0.0000400	0.0018144	0.0004619	0.0026632	0.0011901	0.0006146	0.0004487
3	0.0005560	0.0001781	0.0001054	0.0000254	0.0018809	0.0004182	0.0028567	0.0012766	0.0006592	0.0004813

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0015406	0.0009212	0.0013780	0.0064083	0.0010000	0.0002890	0.0004892	0.0006819	0.0012033
2	0.0019413	0.0011609	0.0017364	0.0071828	0.0010000	0.0003049	0.0005160	0.0007193	0.0012342
3	0.0020823	0.0012452	0.0018626	0.0204383	0.0010000	0.0001765	0.0002987	0.0004163	0.0011176

San Antonio MSA 2007 VMT Mix — Weekday

OBS	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	Art	0.6072705	0.0569770	0.1896723	0.0387251	0.0178087	0.0072051	0.0034015	0.0013572	0.0008043

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2	Col	0.5875105	0.0591617	0.1969452	0.0415232	0.0190955	0.0085071	0.0040161	0.0016025	0.0009496
3	Fway	0.6027468	0.0515961	0.1717599	0.0326162	0.0149993	0.0068825	0.0032492	0.0012965	0.0007683

OBS	P_HDGV_6	P_HDGV_7	P_HDGV8A	P_HDGV8B	P_LDDV	P_LDDT12	P_HDDV2B	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.0025637	0.0008210	0.0004859	0.0001173	0.0006097	0.0000434	0.0099603	0.0044511	0.0022985	0.0016783
2	0.0030269	0.0009694	0.0005737	0.0001385	0.0005899	0.0000451	0.0112687	0.0050358	0.0026005	0.0018987
3	0.0024489	0.0007843	0.0004642	0.0001120	0.0006051	0.0000393	0.0094061	0.0042035	0.0021706	0.0015849

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0072604	0.0043417	0.0064943	0.0281741	0.0010000	0.0004873	0.0016947	0.0030500	0.0012465
2	0.0082141	0.0049120	0.0073473	0.0254421	0.0010000	0.0005897	0.0020509	0.0036911	0.0012943
3	0.0068565	0.0041001	0.0061329	0.0700486	0.0010000	0.0002794	0.0009715	0.0017485	0.0011287

San Antonio MSA 2007 VMT Mix — Friday

OBS	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	Art	0.6593832	0.0527567	0.1756233	0.0361451	0.0166222	0.0041382	0.0019536	0.0007795	0.0004619
2	Col	0.6411429	0.0550551	0.1832744	0.0389516	0.0179129	0.0049105	0.0023182	0.0009250	0.0005482
3	Fway	0.6611050	0.0482579	0.1606471	0.0307512	0.0141417	0.0039929	0.0018850	0.0007522	0.0004457

OBS	P_HDGV_6	P_HDGV_7	P_HDGV8A	P_HDGV8B	P_LDDV	P_LDDT12	P_HDDV2B	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.0014724	0.0004716	0.0002791	0.0000674	0.0006600	0.0000403	0.0067035	0.0029957	0.0015470	0.0011295
2	0.0017472	0.0005596	0.0003312	0.0000799	0.0006417	0.0000420	0.0076221	0.0034062	0.0017590	0.0012843
3	0.0014207	0.0004550	0.0002693	0.0000650	0.0006617	0.0000369	0.0063946	0.0028576	0.0014757	0.0010775

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0048864	0.0029220	0.0043707	0.0189617	0.0010000	0.0002799	0.0011406	0.0020527	0.0011560
2	0.0055561	0.0033225	0.0049697	0.0172090	0.0010000	0.0003404	0.0013872	0.0024967	0.0012063
3	0.0046612	0.0027874	0.0041693	0.0476209	0.0010000	0.0001621	0.0006605	0.0011887	0.0010574

San Antonio MSA 2007 VMT Mix — Saturday

OBS	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	Art	0.6865163	0.0521591	0.1736339	0.0335572	0.0154321	0.0026195	0.0012367	0.0004934	0.0002924
2	Col	0.6693255	0.0545779	0.1816860	0.0362601	0.0166751	0.0031168	0.0014714	0.0005871	0.0003479
3	Fway	0.6942790	0.0481245	0.1602030	0.0287968	0.0132429	0.0025495	0.0012036	0.0004802	0.0002846

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OBS	P_HDGV_6	P_HDGV_7	P_HDGV8A	P_HDGV8B	P_LDDV	P_LDDT12	P_HDDV2B	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.0009321	0.0002985	0.0001767	0.0000426	0.0006878	0.0000397	0.0042430	0.0018961	0.0009791	0.0007149
2	0.0011090	0.0003552	0.0002102	0.0000507	0.0006706	0.0000416	0.0048374	0.0021618	0.0011163	0.0008151
3	0.0009071	0.0002905	0.0001719	0.0000415	0.0006956	0.0000366	0.0040825	0.0018244	0.0009421	0.0006879

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0030929	0.0018495	0.0027665	0.0120018	0.0010000	0.0001772	0.0007219	0.0012993	0.0011396
2	0.0035262	0.0021086	0.0031541	0.0109218	0.0010000	0.0002161	0.0008804	0.0015845	0.0011925
3	0.0029759	0.0017796	0.0026619	0.0304029	0.0010000	0.0001035	0.0004217	0.0007589	0.0010515

San Antonio MSA 2007 VMT Mix — Sunday

OBS	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	Art	0.6476337	0.0621609	0.2069291	0.0383799	0.0176499	0.0017686	0.0008350	0.0003332	0.0001974
2	Col	0.6297313	0.0648703	0.2159487	0.0413608	0.0190208	0.0020988	0.0009908	0.0003954	0.0002343
3	Fway	0.6617437	0.0579459	0.1928980	0.0332761	0.0153028	0.0017391	0.0008210	0.0003276	0.0001941

OBS	P_HDGV_6	P_HDGV_7	P_HDGV8A	P_HDGV8B	P_LDDV	P_LDDT12	P_HDDV2B	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.0006293	0.0002015	0.0001193	0.0000288	0.0006502	0.0000472	0.0028650	0.0012803	0.0006611	0.0004827
2	0.0007468	0.0002392	0.0001415	0.0000342	0.0006322	0.0000492	0.0032577	0.0014558	0.0007518	0.0005489
3	0.0006188	0.0001982	0.0001173	0.0000283	0.0006643	0.0000440	0.0027851	0.0012446	0.0006427	0.0004693

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0020884	0.0012488	0.0018680	0.0081039	0.0010000	0.0001196	0.0004875	0.0008773	0.0013534
2	0.0023746	0.0014200	0.0021240	0.0073550	0.0010000	0.0001455	0.0005929	0.0010671	0.0014124
3	0.0020302	0.0012140	0.0018159	0.0207411	0.0010000	0.0000706	0.0002877	0.0005177	0.0012617

San Antonio MSA 2012 VMT Mix — Weekday

OBS	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	Art	0.6073419	0.0548293	0.1918788	0.0387259	0.0178079	0.0072051	0.0034015	0.0013572	0.0008043
2	Col	0.5875795	0.0569317	0.1992363	0.0415241	0.0190946	0.0085071	0.0040161	0.0016025	0.0009496
3	Fway	0.6028176	0.0496513	0.1737581	0.0326168	0.0149987	0.0068825	0.0032492	0.0012965	0.0007683

OBS	P_HDGV_6	P_HDGV_7	P_HDGV8A	P_HDGV8B	P_LDDV	P_LDDT12	P_HDDV2B	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.0025637	0.0008210	0.0004859	0.0001173	0.0005383	0.0000000	0.0099603	0.0044511	0.0022985	0.0016783

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2	0.0030269	0.0009694	0.0005737	0.0001385	0.0005208	0.0000000	0.0112687	0.0050358	0.0026005	0.0018987
3	0.0024489	0.0007843	0.0004642	0.0001120	0.0005343	0.0000000	0.0094061	0.0042035	0.0021706	0.0015849

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0072604	0.0043417	0.0064943	0.0281741	0.0010000	0.0002423	0.0016960	0.0032936	0.0012310
2	0.0082141	0.0049120	0.0073473	0.0254421	0.0010000	0.0002933	0.0020526	0.0039859	0.0012782
3	0.0068565	0.0041001	0.0061329	0.0700486	0.0010000	0.0001389	0.0009723	0.0018881	0.0011148

San Antonio MSA 2012 VMT Mix — Friday

OBS	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	Art	0.6594446	0.0507669	0.1776621	0.0361450	0.0166211	0.0041381	0.0019536	0.0007795	0.0004619
2	Col	0.6411992	0.0529783	0.1854011	0.0389513	0.0179115	0.0049104	0.0023182	0.0009250	0.0005481
3	Fway	0.6611733	0.0464382	0.1625137	0.0307514	0.0141409	0.0039929	0.0018850	0.0007521	0.0004457

OBS	P_HDGV_6	P_HDGV_7	P_HDGV8A	P_HDGV8B	P_LDDV	P_LDDT12	P_HDDV2B	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.0014724	0.0004716	0.0002791	0.0000674	0.0005827	0.0000000	0.0067033	0.0029956	0.0015469	0.0011295
2	0.0017472	0.0005596	0.0003312	0.0000799	0.0005666	0.0000000	0.0076219	0.0034061	0.0017589	0.0012843
3	0.0014207	0.0004550	0.0002693	0.0000650	0.0005842	0.0000000	0.0063945	0.0028576	0.0014756	0.0010775

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0048863	0.0029219	0.0043706	0.0189612	0.0010000	0.0001392	0.0011414	0.0022166	0.0011416
2	0.0055559	0.0033224	0.0049696	0.0172085	0.0010000	0.0001693	0.0013883	0.0026960	0.0011913
3	0.0046612	0.0027873	0.0041693	0.0476202	0.0010000	0.0000806	0.0006610	0.0012836	0.0010443

San Antonio MSA 2012 VMT Mix — Saturday

OBS	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	Art	0.6865863	0.0501923	0.1756512	0.0335574	0.0154312	0.0026195	0.0012366	0.0004934	0.0002924
2	Col	0.6693915	0.0525197	0.1837962	0.0362602	0.0166740	0.0031167	0.0014714	0.0005871	0.0003479
3	Fway	0.6943542	0.0463101	0.1620652	0.0287971	0.0132422	0.0025494	0.0012036	0.0004802	0.0002846

OBS	P_HDGV_6	P_HDGV_7	P_HDGV8A	P_HDGV8B	P_LDDV	P_LDDT12	P_HDDV2B	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.0009321	0.0002985	0.0001767	0.0000426	0.0006073	0.0000000	0.0042429	0.0018961	0.0009791	0.0007149
2	0.0011090	0.0003552	0.0002102	0.0000507	0.0005921	0.0000000	0.0048373	0.0021617	0.0011163	0.0008151
3	0.0009071	0.0002905	0.0001719	0.0000415	0.0006142	0.0000000	0.0040825	0.0018244	0.0009421	0.0006879

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0030928	0.0018495	0.0027664	0.0120017	0.0010000	0.0000881	0.0007225	0.0014030	0.0011255
2	0.0035261	0.0021086	0.0031540	0.0109216	0.0010000	0.0001074	0.0008811	0.0017111	0.0011777
3	0.0029759	0.0017795	0.0026618	0.0304026	0.0010000	0.0000515	0.0004220	0.0008195	0.0010384

San Antonio MSA 2012 VMT Mix — Sunday

OBS	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	Art	0.6477029	0.0598172	0.2093342	0.0383803	0.0176490	0.0017686	0.0008350	0.0003332	0.0001974
2	Col	0.6297972	0.0624243	0.2184581	0.0413612	0.0190197	0.0020988	0.0009908	0.0003953	0.0002343
3	Fway	0.6618173	0.0557614	0.1951408	0.0332765	0.0153020	0.0017391	0.0008210	0.0003276	0.0001941

OBS	P_HDGV_6	P_HDGV_7	P_HDGV8A	P_HDGV8B	P_LDDV	P_LDDT12	P_HDDV2B	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.0006293	0.0002015	0.0001193	0.0000288	0.0005741	0.0000000	0.0028649	0.0012803	0.0006611	0.0004827
2	0.0007468	0.0002392	0.0001415	0.0000342	0.0005582	0.0000000	0.0032576	0.0014558	0.0007518	0.0005489
3	0.0006188	0.0001982	0.0001173	0.0000283	0.0005866	0.0000000	0.0027851	0.0012446	0.0006427	0.0004693

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0020884	0.0012488	0.0018680	0.0081038	0.0010000	0.0000595	0.0004878	0.0009474	0.0013366
2	0.0023746	0.0014200	0.0021240	0.0073549	0.0010000	0.0000723	0.0005934	0.0011523	0.0013949
3	0.0020302	0.0012140	0.0018159	0.0207410	0.0010000	0.0000351	0.0002879	0.0005591	0.0012460

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APPENDIX F
TEMPERATURE, HUMIDITY, SUNRISE/SUNSET TIME — MOBILE6 INPUTS

US EPA ARCHIVE DOCUMENT

TEMPERATURE, PERCENT RELATIVE HUMIDITY, SUNRISE, AND SUNSET TIMES (TO NEAREST HOUR)

Hourly temperatures and hourly relative humidity inputs start with the 6 a.m. hour and are from the same calendar day (i.e., order is 6 a.m. to 12 a.m. followed by 12 a.m. to 6 a.m.). Data are in MOBILE6 input format.

* Bexar climate data for SA/MSA (M6 default Bar. Pres.); Friday 9/17/99 (CDT)
HOURLY TEMPERATURES: 63.8 63.9 68.9 75.5 80.4 83.2 85.4 87.4 89.1 90.2 91.3 91.1 89.8 86.5 82.3 79.3 77.2 75.5 71.4 69.1 67.5 66.6 65.4 64.5
SUNRISE/SUNSET: 7 8
BAROMETRIC PRES: 29.92
RELATIVE HUMIDITY: 75.0 75.0 63.0 54.0 41.0 35.0 33.0 32.0 28.0 27.0 26.0 27.0 29.0 31.0 35.0 38.0 41.0 52.0 53.0 48.0 53.0 61.0 65.0 70.0

* Bexar climate data for SA/MSA (M6 default Bar. Pres.); Saturday 9/18/99 (CDT)
HOURLY TEMPERATURES: 67.2 67.2 70.8 76.6 80.3 83.0 85.3 86.7 88.1 89.2 90.3 90.1 88.9 86.3 82.7 80.2 78.5 76.3 74.1 72.8 72.2 70.9 69.4 67.9
SUNRISE/SUNSET: 7 8
BAROMETRIC PRES: 29.92
RELATIVE HUMIDITY: 84.0 87.0 74.0 64.0 44.0 37.0 36.0 33.0 32.0 31.0 31.0 32.0 32.0 34.0 34.0 36.0 41.0 47.0 56.0 64.0 71.0 76.0 79.0 82.0

* Bexar climate data for SA/MSA (M6 default Bar. Pres.); Sunday 9/19/99 (CDT)
HOURLY TEMPERATURES: 66.4 66.3 70.4 77.0 80.9 83.8 86.3 88.5 90.4 92.2 93.5 93.2 92.5 88.3 84.1 81.1 78.7 76.8 74.9 73.5 71.9 70.9 69.2 67.7
SUNRISE/SUNSET: 7 8
BAROMETRIC PRES: 29.92
RELATIVE HUMIDITY: 84.0 84.0 69.0 54.0 39.0 36.0 33.0 29.0 30.0 26.0 26.0 27.0 28.0 32.0 35.0 38.0 43.0 47.0 62.0 66.0 69.0 73.0 76.0 79.0

* Bexar climate data for SA/MSA (M6 default Bar. Pres.); Monday 9/20/99 (CDT)
HOURLY TEMPERATURES: 67.8 67.1 72.5 78.8 83.4 87.6 90.7 93.0 94.9 96.5 97.5 97.5 96.0 92.1 89.1 87.6 86.0 83.8 75.0 73.5 71.8 70.2 69.0 68.9
SUNRISE/SUNSET: 7 8
BAROMETRIC PRES: 29.92
RELATIVE HUMIDITY: 78.0 87.0 69.0 61.0 46.0 37.0 32.0 27.0 26.0 25.0 24.0 24.0 27.0 29.0 32.0 32.0 35.0 39.0 54.0 62.0 67.0 71.0 73.0 76.0

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APPENDIX G
MOBILE6 REGISTRATIONS DISTRIBUTIONS AND DIESEL FRACTIONS INPUTS

US EPA ARCHIVE DOCUMENT

Registration Distributions

```
*  San Antonio MSA - Bexar, Comal, Guadalupe, and Wilson Counties
*  Calculated from Mid-Year (July) 2002 Registration data
*  LDV
    1  0.07135 0.08938 0.08968 0.07735 0.06933 0.06588 0.05988 0.06941 0.05871 0.05433
       0.04447 0.04189 0.03407 0.03091 0.02503 0.02027 0.01845 0.01590 0.01275 0.00787
       0.00550 0.00439 0.00353 0.00460 0.02507
*  LDT1
    2  0.07443 0.09358 0.07900 0.06645 0.06143 0.06423 0.04977 0.05758 0.06127 0.04696
       0.03865 0.03487 0.02773 0.02841 0.02482 0.01980 0.02518 0.02164 0.01915 0.01222
       0.01268 0.01129 0.00673 0.00935 0.05278
*  LDT2
    3  0.07443 0.09358 0.07900 0.06645 0.06143 0.06423 0.04977 0.05758 0.06127 0.04696
       0.03865 0.03487 0.02773 0.02841 0.02482 0.01980 0.02518 0.02164 0.01915 0.01222
       0.01268 0.01129 0.00673 0.00935 0.05278
*  LDT3
    4  0.11333 0.14514 0.10770 0.13323 0.05019 0.07680 0.05311 0.05483 0.04096 0.03410
       0.02417 0.01819 0.01627 0.01601 0.01331 0.00796 0.01413 0.01305 0.01182 0.00708
       0.00727 0.00445 0.00546 0.00673 0.02471
*  LDT4
    5  0.11333 0.14514 0.10770 0.13323 0.05019 0.07680 0.05311 0.05483 0.04096 0.03410
       0.02417 0.01819 0.01627 0.01601 0.01331 0.00796 0.01413 0.01305 0.01182 0.00708
       0.00727 0.00445 0.00546 0.00673 0.02471
*  HDV2
    6  0.14791 0.15513 0.09707 0.08581 0.04381 0.06170 0.03035 0.04622 0.03658 0.03376
       0.02512 0.02291 0.01527 0.01487 0.01668 0.01085 0.02834 0.02452 0.01608 0.00945
       0.01929 0.00844 0.00904 0.00945 0.03135
*  HDV3
    7  0.04338 0.09347 0.08318 0.10823 0.03667 0.08184 0.04651 0.07335 0.05769 0.05903
       0.03265 0.03399 0.03309 0.02370 0.01834 0.01655 0.01208 0.02057 0.01297 0.00850
       0.01342 0.00671 0.00805 0.00984 0.06619
*  HDV4
    8  0.05387 0.08325 0.11949 0.12731 0.04603 0.09403 0.08913 0.05583 0.04310 0.03820
       0.02351 0.02057 0.02253 0.01469 0.01371 0.01273 0.00392 0.00686 0.01273 0.00588
       0.01175 0.00392 0.00881 0.01273 0.07542
*  HDV5
    9  0.05772 0.05195 0.12410 0.15004 0.05339 0.04185 0.04185 0.04329 0.02309 0.02165
       0.01732 0.01876 0.02020 0.02165 0.02309 0.02597 0.01587 0.03175 0.01443 0.01299
       0.03030 0.02309 0.01732 0.02165 0.09668
*  HDV6
   10  0.04549 0.08437 0.09391 0.08914 0.09832 0.03999 0.04182 0.07667 0.04072 0.04549
       0.02531 0.02788 0.02971 0.02128 0.02201 0.02384 0.02348 0.02531 0.02091 0.01394
       0.02201 0.01614 0.00990 0.01614 0.04622
*  HDV7
   11  0.03975 0.08020 0.10530 0.07113 0.06555 0.05300 0.04951 0.05718 0.03835 0.04881
       0.04045 0.05927 0.04463 0.02999 0.02859 0.02999 0.03138 0.02859 0.02301 0.01813
       0.01325 0.00837 0.00628 0.01116 0.01813
*  HDV8A
   12  0.05428 0.04737 0.05482 0.05801 0.04311 0.02874 0.03938 0.06919 0.05535 0.05907
       0.03459 0.05269 0.04577 0.04843 0.04417 0.04045 0.03938 0.03885 0.02714 0.00958
       0.02501 0.01916 0.01384 0.02182 0.02980
*  HDV8B
   13  0.02781 0.08217 0.12261 0.09482 0.03919 0.07206 0.06068 0.03919 0.08976 0.09229
       0.01391 0.03666 0.01138 0.00759 0.00759 0.00506 0.02655 0.03540 0.04678 0.02528
       0.01391 0.03161 0.00632 0.00759 0.00379
*   HDBS is MOBILE6 default
*   HDBT is MOBILE6 default
*  MC
   16  0.14608 0.13659 0.10664 0.08183 0.05739 0.04316 0.04029 0.03574 0.03002 0.02400
       0.01908 0.01321 0.01328 0.01468 0.01204 0.01211 0.02385 0.02327 0.01563 0.01930
       0.02606 0.01761 0.01563 0.01064 0.06187
```

1999 Statewide Diesel Sales Fractions Estimates

```
Diesel Fractions:

 0.00090 0.00090 0.00090 0.00090 0.00060 0.00010 0.00030 0.00060 0.00130 0.00040
 0.00040 0.00010 0.00270 0.00320 0.00970 0.01620 0.02410 0.05100 0.07060 0.03900
 0.02690 0.01140 0.00930 0.01370 0.01550
 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
 0.00000 0.00000 0.00070 0.00330 0.00480 0.01200 0.02230 0.06560 0.06160 0.04390
```


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```
0.03160 0.02590 0.00000 0.01870 0.10380
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00070 0.00330 0.00480 0.01200 0.02230 0.06560 0.06160 0.04390
0.03160 0.02590 0.00000 0.01870 0.10380
0.01260 0.01260 0.01260 0.01260 0.01150 0.01110 0.01450 0.01150 0.01290 0.00960
0.00830 0.00720 0.00820 0.01240 0.01350 0.01690 0.02090 0.02560 0.00130 0.00060
0.00110 0.00010 0.00000 0.00000 0.00000
0.01260 0.01260 0.01260 0.01260 0.01150 0.01110 0.01450 0.01150 0.01290 0.00960
0.00830 0.00720 0.00820 0.01240 0.01350 0.01690 0.02090 0.02560 0.00130 0.00060
0.00110 0.00010 0.00000 0.00000 0.00000
0.66232 0.57703 0.47784 0.45121 0.20063 0.39808 0.37552 0.32844 0.35352 0.27226
0.22309 0.17730 0.14483 0.20196 0.17056 0.19074 0.17148 0.14044 0.00323 0.00000
0.00382 0.00303 0.00303 0.00303 0.00303
0.64013 0.51450 0.57439 0.54389 0.32661 0.55020 0.58601 0.62333 0.51890 0.51653
0.46856 0.35294 0.25512 0.29752 0.17664 0.22368 0.21759 0.16066 0.03297 0.01508
0.00373 0.00406 0.00406 0.00406 0.00406
0.63857 0.67967 0.73075 0.66667 0.44671 0.70203 0.69632 0.65581 0.65789 0.57317
0.60350 0.35745 0.24855 0.13542 0.12313 0.18852 0.13253 0.17797 0.14583 0.05000
0.03185 0.01034 0.01034 0.01034 0.01034
0.88016 0.75422 0.72991 0.80476 0.45659 0.67857 0.72535 0.65432 0.70483 0.60383
0.59509 0.41699 0.33654 0.25337 0.30960 0.25418 0.28244 0.20767 0.23790 0.14394
0.12340 0.03350 0.03350 0.03350 0.03350
0.86169 0.81933 0.74312 0.78239 0.54923 0.77170 0.75818 0.57117 0.66954 0.72241
0.69427 0.56318 0.62198 0.54717 0.46968 0.43758 0.40440 0.37461 0.43137 0.18953
0.14992 0.04644 0.04644 0.04644 0.04644
0.88593 0.84672 0.75646 0.81899 0.48829 0.82916 0.84387 0.84789 0.85788 0.83389
0.82784 0.81143 0.81176 0.78571 0.74359 0.73051 0.70909 0.63052 0.70608 0.36715
0.27615 0.20888 0.20888 0.20888 0.20888
0.94685 0.94189 0.86917 0.90694 0.67588 0.96360 0.95187 0.94895 0.93046 0.94083
0.94469 0.95000 0.94092 0.91551 0.91340 0.92834 0.91875 0.91908 0.88970 0.56726
0.56641 0.55152 0.55152 0.55152 0.55152
0.98288 0.98189 0.95390 0.99119 0.78746 0.96058 0.98670 0.96262 1.00000 0.95333
0.97500 0.95238 0.92424 0.92958 0.98969 0.95455 0.97143 0.94286 0.96296 0.40000
0.44444 0.51064 0.51064 0.51064 0.51064
0.95850 0.95850 0.95850 0.95850 0.88570 0.85250 0.87950 0.99000 0.91050 0.87600
0.77100 0.75020 0.73450 0.67330 0.51550 0.38450 0.32380 0.32600 0.26390 0.05940
0.04600 0.02910 0.02400 0.00860 0.00870
```

* HDV fractions are estimated from TxDOT registration data (mid-year July 2002);
* LDV, LDT, and Bus fractions are EPA defaults

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2007 Statewide Diesel Sales Fractions Estimates

```
Diesel Fractions:

 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090
 0.00090 0.00090 0.00060 0.00010 0.00030 0.00060 0.00130 0.00040 0.00040 0.00010
 0.00270 0.00320 0.00970 0.01620 0.02410
 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
 0.00070 0.00330 0.00480 0.01200 0.02230
 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
 0.00070 0.00330 0.00480 0.01200 0.02230
 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260
 0.01260 0.01260 0.01150 0.01110 0.01450 0.01150 0.01290 0.00960 0.00830 0.00720
 0.00820 0.01240 0.01350 0.01690 0.02090
 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260
 0.01260 0.01260 0.01150 0.01110 0.01450 0.01150 0.01290 0.00960 0.00830 0.00720
 0.00820 0.01240 0.01350 0.01690 0.02090
 0.81361 0.81361 0.81361 0.81361 0.81361 0.81361 0.75050 0.61397 0.66232 0.57703
 0.47784 0.45121 0.20063 0.39808 0.37552 0.32844 0.35352 0.27226 0.22309 0.17730
 0.14483 0.20196 0.17056 0.19074 0.17148
 0.68374 0.68374 0.68374 0.68374 0.68374 0.68374 0.64723 0.65615 0.64013 0.51450
 0.57439 0.54389 0.32661 0.55020 0.58601 0.62333 0.51890 0.51653 0.46856 0.35294
 0.25512 0.29752 0.17664 0.22368 0.21759
 0.75174 0.75174 0.75174 0.75174 0.75174 0.75174 0.71334 0.72152 0.63857 0.67967
 0.73075 0.66667 0.44671 0.70203 0.69632 0.65581 0.65789 0.57317 0.60350 0.35745
 0.24855 0.13542 0.12313 0.18852 0.13253
 0.92205 0.92205 0.92205 0.92205 0.92205 0.92205 0.86775 0.89367 0.88016 0.75422
 0.72991 0.80476 0.45659 0.67857 0.72535 0.65432 0.70483 0.60383 0.59509 0.41699
 0.33654 0.25337 0.30960 0.25418 0.28244
 0.92645 0.92645 0.92645 0.92645 0.92645 0.92645 0.87176 0.86671 0.86169 0.81933
 0.74312 0.78239 0.54923 0.77170 0.75818 0.57117 0.66954 0.72241 0.69427 0.56318
 0.62198 0.54717 0.46968 0.43758 0.40440
 0.93134 0.93134 0.93134 0.93134 0.93134 0.93134 0.87037 0.90479 0.88593 0.84672
 0.75646 0.81899 0.48829 0.82916 0.84387 0.84789 0.85788 0.83389 0.82784 0.81143
 0.81176 0.78571 0.74359 0.73051 0.70909
 0.95095 0.95095 0.95095 0.95095 0.95095 0.95095 0.93265 0.93355 0.94685 0.94189
 0.86917 0.90694 0.67588 0.96360 0.95187 0.94895 0.93046 0.94083 0.94469 0.95000
 0.94092 0.91551 0.91340 0.92834 0.91875
 0.98020 0.98020 0.98020 0.98020 0.98020 0.98020 0.98603 0.99167 0.98288 0.98189
 0.95390 0.99119 0.78746 0.96058 0.98670 0.96262 1.00000 0.95333 0.97500 0.95238
 0.92424 0.92958 0.98969 0.95455 0.97143
 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850
 0.95850 0.95850 0.88570 0.85250 0.87950 0.99000 0.91050 0.87600 0.77100 0.75020
 0.73450 0.67330 0.51550 0.38450 0.32380
```

* HDV fractions are estimated from TxDOT registration data (mid-year July 2002);
* LDV, LDT, and Bus fractions are EPA defaults

2012 Statewide Diesel Sales Fractions Estimates

```
Diesel Fractions:

 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090
 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00060 0.00010 0.00030
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0.00060 0.00130 0.00040 0.00040 0.00010
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000
0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260
0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01150 0.01110 0.01450
0.01150 0.01290 0.00960 0.00830 0.00720
0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260
0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01150 0.01110 0.01450
0.01150 0.01290 0.00960 0.00830 0.00720
0.81361 0.81361 0.81361 0.81361 0.81361 0.81361 0.81361 0.81361 0.81361 0.81361
0.81361 0.75050 0.61397 0.66232 0.57703 0.47784 0.45121 0.20063 0.39808 0.37552
0.32844 0.35352 0.27226 0.22309 0.17730
0.68374 0.68374 0.68374 0.68374 0.68374 0.68374 0.68374 0.68374 0.68374 0.68374
0.68374 0.64723 0.65615 0.64013 0.51450 0.57439 0.54389 0.32661 0.55020 0.58601
0.62333 0.51890 0.51653 0.46856 0.35294
0.75174 0.75174 0.75174 0.75174 0.75174 0.75174 0.75174 0.75174 0.75174 0.75174
0.75174 0.71334 0.72152 0.63857 0.67967 0.73075 0.66667 0.44671 0.70203 0.69632
0.65581 0.65789 0.57317 0.60350 0.35745
0.92205 0.92205 0.92205 0.92205 0.92205 0.92205 0.92205 0.92205 0.92205 0.92205
0.92205 0.86775 0.89367 0.88016 0.75422 0.72991 0.80476 0.45659 0.67857 0.72535
0.65432 0.70483 0.60383 0.59509 0.41699
0.92645 0.92645 0.92645 0.92645 0.92645 0.92645 0.92645 0.92645 0.92645 0.92645
0.92645 0.87176 0.86671 0.86169 0.81933 0.74312 0.78239 0.54923 0.77170 0.75818
0.57117 0.66954 0.72241 0.69427 0.56318
0.93134 0.93134 0.93134 0.93134 0.93134 0.93134 0.93134 0.93134 0.93134 0.93134
0.93134 0.87037 0.90479 0.88593 0.84672 0.75646 0.81899 0.48829 0.82916 0.84387
0.84789 0.85788 0.83389 0.82784 0.81143
0.95095 0.95095 0.95095 0.95095 0.95095 0.95095 0.95095 0.95095 0.95095 0.95095
0.95095 0.93265 0.93355 0.94685 0.94189 0.86917 0.90694 0.67588 0.96360 0.95187
0.94895 0.93046 0.94083 0.94469 0.95000
0.98020 0.98020 0.98020 0.98020 0.98020 0.98020 0.98020 0.98020 0.98020 0.98020
0.98020 0.98603 0.99167 0.98288 0.98189 0.95390 0.99119 0.78746 0.96058 0.98670
0.96262 1.00000 0.95333 0.97500 0.95238
0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850
0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.88570 0.85250 0.87950
0.99000 0.91050 0.87600 0.77100 0.75020
```

* HDV fractions are estimated from TxDOT registration data (mid-year July 2002);
* LDV, LDT, and Bus fractions are EPA defaults

US EPA ARCHIVE DOCUMENT

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APPENDIX D

1999 BASE CASE MODELING EMISSIONS INVENTORY DEVELOPMENT

SAN ANTONIO EAC REGION ATTAINMENT DEMONSTRATION

MARCH 2004

AACOG
Alamo Area Council
Of Governments

Appendix D

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INTRODUCTION

Four South Texas near nonattainment areas[1] (NNA) and Texas Commission on Environmental Quality (TCEQ) sponsored the development of a computer model simulating the high-ozone episode that occurred between September 15th and 20th, 1999. The intent of developing the 1999 simulation was to provide a means of projecting air quality conditions to the year 2007 so that pollution control measures could be modeled and analyzed for their effectiveness in that future time period.

Environmental Protection Agency (EPA) draft guidance provides a detailed process for developing and analyzing model simulations from the planning stages through control strategy development and evaluation. These steps were followed in developing an air quality simulation for the September 1999 episode.

The following is a list of county regions this appendix, as well as Appendix F, will refer to in the body as well as various tables, charts, or figures.

- AACOG 12-county region: Atascosa, Bandera, Bexar, Comal, Frio, Gillespie, Guadalupe, Karnes, Kendall, Kerr, Medina, & Wilson counties.
- 4-county San Antonio Early Action Compact Region (SAER): Bexar, Comal, Guadalupe, & Wilson counties.
- AACOG Rural Counties: Atascosa, Bandera, Frio, Gillespie, Karnes, Kendall, Kerr, & Medina counties.
- Austin 3-county region: Hays, Travis, & Williamson counties.
- Austin 5-county MSA: Bastrop, Caldwell, Hays, Travis, & Williamson counties.
- Capital Area Planning Council (CAPCO) 10-county region: Bastrop, Blanco, Burnet, Caldwell, Fayette, Lee, Llano, Travis, & Williamson counties.
- CAPCO non-MSA counties: Burnet, Blanco, Fayette, Lee, & Llano counties.
- Corpus Christi 2-county Region: Nueces & San Pratricio counties.
- Houston/Galveston 8-county (non-attainment) region: Brazonia, Chambers, Fort Bend, Galveston, Harris Liberty, Montgomery, & Waller counties.
- Beaumont/Port Arthur (BPA) 3-county region: Hardin, Orange, and Jefferson counties.
- Tyler/Longview 2-county region: Smith & Gregg counties.
- Victoria 7-county region: Calhoun, De Witt, Goliad, Jackson, Lavaca, Refugio, & Victoria counties.

GENERAL REFINEMENTS TO THE 1999 EMISSION INVENTORY (EI) INPUTS

During the March 6, 2003 Texas Near Nonattainment Areas meeting, ENVIRON, TCEQ and NNA stakeholders recommended refining the following list of input categories to improve the 1999 episode base case:

- On-road data for urban areas of Texas – refinements to be calculated using MOBILE6 (Replacing MOBILE5 on-road files with MOBILE6 files in urban areas is also a requirement of the Early Action Compact)
- Texas stationary point source data
- Texas area and non-road data
- Louisiana Emission Inventory data

Other changes

[1] The regions of Austin, Corpus Christi, San Antonio, and Victoria.

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- National Emission Trends (NET) data for regional inputs to the model
- New Regional Emission Inventory (EI) – includes Area, Non-road, On-road, and Point sources.

The air quality model methodologies are based on a nested grid, discussed further in Appendix E. This appendix will focus on the development or origin of the files used in the 1999 Emissions Inventory photochemical model base case development.

Adjustments to Temporal Input Data
All values were provided by ENVIRON, TCEQ, EPA, or were local-survey based. EPA default data can be found online.[2] Local weekly and monthly adjustment values were based on survey results from the 1999 NET Emissions Inventories for AACOG and CAPCO. All hourly data were either provided by ENVIRON or extracted from TCEQ files; survey data were not used for adjustment of the hourly data. The temporal adjustments for tank truck unloading, Source Classification Codes (SCC) 2501060053, were provided by the EPA. These temporal allocations are contained in the following files:

- month_prof_042902.db
- temporal.pdf
- tprl_xref_030701.dbf
- tprl_xref_0307 01.xls
- week_prof_121400.dbf
- wkd_diurnal_prof_121400.dbf[3]

BIOGENIC SOURCE EMISSIONS FOR 1999 BASE CASE
Emission rates that result from natural processes in vegetation and soils were developed for the year 1999 by ENVIRON, "Final Report Emissions Processing for the Joint Comprehensive Air Quality Model with Extensions (CAMx) Photochemical Modeling of Four Southern Texas Near Non-Attainment Areas" (p. 10 & p. 17). The emissions were calculated for all regions in the 36-km grid.

POINT SOURCE EMISSSIONS FOR 1999 BASE CASE
An additional modeling consideration for point sources is spatially allocating emissions to the correct vertical layer. Plants and facilities that emit pollutants through stacks present spatial allocation challenges since stacks can release emissions many meters above the surface. Depending on wind speed and other climatic conditions, this may allow the plants effluent to travel much greater distances than pollutants released at the surface. Point sources are sub-divided between electric generating units (EGUs) and non-electric generating units (NEGUs).

Regional
Emissions for all states, within the 36-km grid except Texas and Louisiana, used data from EPA's National Emission Inventory for 1999 (NEI99) version 2. Louisiana emissions were originally from the Louisiana EI which contained updated local data processed by ENVIRON (2002). Texas offshore point source emissions were also processed by ENVIRON. Emissions data for Texas were gathered from several sources are explained in more detail by region.

[2] Available at: http://www.epa.gov/ttn/chief/emch/temporal/
[3] University of Texas at Austin (UT), email from Gary McGaughy received on 2/9/04, "Fwd: latest draft 2007 files."

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San Antonio Region

The photochemical model's EGU point source file was updated for the local San Antonio area with information from City Public Service (CPS), the utility provider for the City of San Antonio and portions of surrounding counties. This is in keeping with a recommendation from the EPA that "use of local speciation information, especially for major emitters, is preferable to national default profiles." [EPA, 1991a]

CPS provided emission rates in tons/day by power plant stack for the September 13 – 20, 1999 episode.[4] Table D-1 lists the refined NOx emission rates and table D-2 lists the refined VOC emission rates, by power plant stack, for each of the ramp-up and episode days. These emissions were spatially allocated based on the geographic locations of the plants.

Plant acronyms on the following tables are defined as:

JKS -	JK Spruce	VHB -	VH Brauning
JTD -	JT Deely	WBT -	WB Tuttle
AVR -	A. von Rosenburg	LCP -	Leon Creek Plant
OWS -	OW Sommers		

Table D-1. NOx Emissions from CPS Power Plant Units in Bexar County, Tons per Day September 13 – 20, 1999 episode.

Unit	9/13/99	9/14/99	9/15/99	9/16/99	9/17/99	9/18/99	9/19/99	9/20/99
JKS1	13.1	13.5	13.4	14.4	17.8	13.7	14.0	16.7
JTD2	13.6	14.0	14.4	13.6	13.8	25.6	25.4	26.1
JTD1	13.6	14.0	14.4	13.6	13.8	25.6	25.4	26.1
AVR1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OWS1	5.8	5.0	4.7	4.8	5.2	4.4	3.6	4.6
OWS2	5.7	2.7	0.0	0.0	5.5	3.7	3.1	4.6
VHB3	17.1	14.7	14.9	15.9	18.8	15.6	11.7	14.0
VHB1	5.2	4.9	4.5	5.2	5.3	4.3	3.9	3.1
VHB2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WBT	6.3	4.7	4.2	3.8	4.1	2.3	2.6	2.6
LCP	4.1	1.5	1.2	1.0	1.1	0.0	0.0	0.0
Total	84.5	61.5	71.7	72.4	85.4	69.7	64.2	71.9

Source: City Public Service

[4] City Public Service (CPS), email from Joe Fulton received 04/14/03, "AACOG submittal of CPS emissions.xls CONFIDENTIAL DATA."

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Table D-2. VOC Emissions from CPS Power Plant Units in Bexar County, Tons per Day September 13 – 20, 1999 Episode.

Unit	9/13/99	9/14/99	9/15/99	9/16/99	9/17/99	9/18/99	9/19/99	9/20/99
JKS1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1
JTD2	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2
JTD1	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2
AVR1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OWS1	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
OWS2	0.2	0.1	0.0	0.0	0.2	0.1	0.1	0.2
VHB3	0.8	0.7	0.7	0.7	0.8	0.7	0.5	0.6
VHB1	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1
VHB2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WBT	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
LCP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	2.1	1.9	1.8	1.8	2.2	1.8	1.5	1.7

Source: City Public Service

Houston/Galveston & Beaumont/Port Arthur Regions

The emissions for the 8-county and 3-county regions were obtained from the TCEQ point source database, described below in the *Other Texas Urban Counties and Texas Rural Counties* section. These NEGU and EGU emissions were not backcast from 2000 to 1999. The 2000 emission estimates were preserved to avoid possible adjustment errors. Use of the 2000 emission rates is also justified due to the small change in these emissions from one year to the next. TCEQ performed extensive quality assurance (QA) on the Houston point source data after refinements to emissions were made. The data are considered accurate and were used in the Houston SIP.

Victoria Region

Emissions for the Victoria 7-county region were processed using local data by UT and were obtained from the Texas Near Non-Attainment (txnna) server.[5]

Other Texas Urban Counties and Texas Rural Counties

TCEQ maintains a point source database (PSDB) for the State of Texas. The database, which contains emission rates and spatial allocation information for EGUs and NEGUs, underwent re-evaluation and refinement in the spring of 2003 in preparation for use in the 1999 Dallas-Fort Worth (DFW) modeling episode. The data are available in model-ready files from TCEQ's file ftp web site.[6] These emission rates were incorporated into the refined 1999 photochemical model with the exception of the Bexar County EGUs, for which AACOG had received data from the source and the Victoria region's point sources, as described previously. This is the same data used in the DFW State Implementation Plan (SIP).

[5] Available on txnna server: air.tamuk.edu/data/VCT/1999/emiss/VCT_1999_emiss_02262004.tar.gz

[6] Available: ftp://ftp.tceq.state.tx.us/pub/OEPAA/TAD/Modeling/DFWAQSE/Modeling/EI (Accessed: 05/22/03.)

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Table D-3. Photochemical Model Jobs & Files for 1999 Development of Point Sources.

Counties/Regions	Job Script	Input Files	Description
Regional: Outside Texas (no Louisiana)	pts.regional.net99.a	nei99ver2_point.afs	Processing the hourly egu & negu point sources for the region.[7]
		ctl.zero.louisiana	Removes Louisiana emissions (In another script).
Regional: Louisiana		emiss.pt.LA_EI99.negu.xxx elvems.pt.LA_EI99.negu.xxx emiss.pt.LA_hourly_egu.9909xxx.PO elvems.pt.LA_hourly_egu.9909xxx.PO emiss.pt.LA_hourly_egu.yyyyyy.noPO elvems.pt.LA_hourly_egu.yyyyyy.noPO	Point source emissions for the Regional Grid (hourly & daily).[8]
Texas Offshore	pts.TX_offshore	afs.offshore.lcp.93_2.srt	Processing of Texas offshore PO point sources (ENVIRON, 2002).
Texas counties (without Houston/ Galveston, Beaumont/ Port Arthur, or Victoria regions)	pts.TX_minor.99po.a	afs.0813-2299minorpts_nna.lcp.srt	Processing of minor PO point sources, no elevated sources (ENVIRON, 2002).
	pts.TX_negu.99po.b	TX_noHGBPA_negu.afs.txt	TCEQ processing of non-egu point sources.[9]
	pts.TX_hrly_egu.0913_2099	TX_noHGBPA_hrly_egu_S_afs.txt	Processing of Texas hourly EGU point sources.[10]
	Pt.TX_hrly_egu.9013_2099. PO	TX_noHGBPA_hrly_egu_PO_afs.txt	Processing of Texas daily EGU point sources.[11]
Houston/Galveston 8-county Region & Beaumont/Port Arthur 3-county Region	pts.houston_hrly_egu.0913_ 2099.job	hourly_Txegu_0913_2099.afs_Rev6b.lcp.srt_v2.noPO	TCEQ processing of hourly egu point sources, no PO.[12]
		ctl.zero_non.houston.bpa	Removes counties other than Houston/Galveston & Beaumont/Port Arthur counties (in diff. script).
	pts.houston_hrly_egu.PO.09 13_2099.job	hourly_Txegu_0913_2099.afs_Rev6b.lcp.srt_v2.PO	TCEQ processing of PO egu point sources.[13]

[7] UT; email from Gary McGaughey received 11/4/03, "EGU and NEGU NEI99 AFS Data files." [based on EPA's NEI ver. 2]
[8] UT; email from Alba Webb received 03/11/04, "1999 EI Comparison."
[9] UT; email from Gary McGaughey received 03/05/03, "RE: 1999 EI." [TCEQ based data (Dallas SIP)]
[10] UT; email from Gary McGaughey received 03/05/03, "RE: 1999 EI." [TCEQ based data (Dallas SIP)]
[11] Texas Commission on Environmental Quality (TCEQ), email from Ron Thomas received 5/22/03, "RE: DWF 1999 AFS files." [TCEQ based data (Dallas SIP)]
[12] TCEQ; email from Ron Thomas received 05/22/03, "RE: DFW 1999 AFS files."
[13] TCEQ; email from Ron Thomas received 05/22/03, "RE: DFW 1999 AFS files." [for Houston Sip]

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(cont.) Houston/Galveston 8-county Region & Beaumont/Port Arthur 3-county Region		ctl.zero_non.houston.bpa	Removes counties other than Houston/Galveston & Beaumont/Port Arthur counties (in diff. Script).
	pts.houston_negu.99po.job	afs.tx_negu.agg_re.000818_000906.vlsp.3pols.lcp	TCEQ processing of non-egu point sources.[14]
		ctl.zero_non.houston.bpa	Removes counties other than Houston/Galveston & Beaumont/Port Arthur counties (in diff. Script).
Victoria 7-county region		emiss.pt.vic_egu.99nopo.yyyyyy elvems.pt.vic_egu.99nopo.yyyyyy emiss.pt.vic_egu.99po.xxx elvems.pt.vic_egu.99po.xxx	UT processing of hourly & daily egu point sources.[15]
		emiss.pt.vic_negu.99po.xxx elvems.pt.vic_negu.99po.xxx	Processing of daily non-egu point sources. [16]
		emiss.pt.TX_negu.yyyyyy.BP_daily.vic_updates.ph50 elvems.pt.TX_negu.yyyyyy.BP_daily.vic_updates.ph50 emiss.pt.TX_negu.yyyyyy.Dow-UC_upsets.vic_updates.ph50 elvems.pt.TX_negu.yyyyyy.Dow-UC_upsets.vic_updates.ph50 emiss.pt.TX_negu.yyyyyy.Dupont_hourly.vic_updates.ph50 elvems.pt.TX_negu.yyyyyy.Dupont_hourly.vic_updates.ph50 emiss.pt.TX_negu.yyyyyy.Dupont_upsets.vic_updates.ph50 elvems.pt.TX_negu.yyyyyy.Dupont_upsets.vic_updates.ph50 emiss.pt.TX_negu.yyyyyy.Koch_daily.vic_updates.ph50 elvems.pt.TX_negu.yyyyyy.Koch_daily.vic_updates.ph50	Processing of hourly non-egu point sources.[17]

[14] TCEQ; email from Ron Thomas received 05/22/03, “RE: DFW 1999 AFS files.” [for Houston Sip]
[15] UT; email from Gary McGaughey received 03/10/04, “1999 VCT Point data.”
[16] UT; email from Gary McGaughey received 03/10/04, “1999 VCT Point data.”
[17] UT; email from Gary McGaughey received 03/10/04, “1999 VCT Point data.”

AREA SOURCE EMISSIONS FOR 1999 BASE CASE

Area source emissions were developed using a variety of sources from national EIs to the use of local data. Local data were used to calculate emissions where available, chiefly in urban areas. Minor refinements to these inventories are explained further under the county/regional sections that follow.

Regional

For states other than Texas in the 36-km grid, emissions were based on the NEI99 version 2, emissions inventory database maintained by the EPA. The database contains point, area, and mobile 1999 emission rates of VOCs, NOx, and CO for all 50 states.

Texas Rural Counties

Updated area source emissions files were downloaded for rural counties in Texas from TCEQ's ftp web site. In addition, updated area emissions were obtained from EPA's "Clearinghouse for Inventories & Emission Factors" web site.[18]

Alamo Area Council of Governments (AACOG) staff used the Texas Air Quality Study (TexAQS) Emissions Inventory for attainment counties.[19] This EI was later updated with a refined temporal allocation methodology, discussed further in the Temporal Adjustments section. The EI matches the emissions in the Houston SIP; Houston also used the TexAQS EI. The EI contains new emissions data for Houston that were not available previously; the data are more accurate, especially in upwind sites of Houston. The TexAQS EI contains improved emissions source data, as well as calculations.

For the urban regions of Texas, emissions data were gathered from several organizations and government agencies or developed with the use of models, local surveys, and/or local data.

San Antonio Region

Surveys and local inputs were used to determine emission rates when available. In the absence of local data, surrogate data were used to calculate emission rates. Surrogate data may include gross state product, employment, national/state sales estimates, sales tax rates, or population estimates.

The data collected for and contained within the 1999 AACOG EI were used for most of the area sources in AACOG's 12-county region. Temporal adjustments were incorporated into the photochemical model to account for the 1999 Sept. 13-20th dates.

<u>Wastewater</u>

The San Antonio Water System (SAWS) provided AACOG with updated emission estimates and methodologies in January 2004. The information sent contained several documents:

- "Permit by Rule Submittal for San Antonio Water System's Dos Rios Water Recycling Center" (Ewen, 2003)
- monitoring samples for Dos Rios dating back to September 1997, Salado Creek dating back to November 1997, Medio Creek dating back to September 1997, and Leon Creek dating back to June 1998

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[18] Available: ftp://ftp.epa.gov/EmisInventory/finalnei99ver2/criteria/datafiles/

[19] TCEQ; email received 03/26/03, "Modeling EI for the Houston." Available online at: ftp://ftp.tnrcc.state.tx.us/pub/OEPAA/TAD/Modeling/HGAQSE/Modeling/EI

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- "VOC Emissions from Wastewater Treatment Plants." (Prakasam, 2003)
- "Predicting VOC Emissions from Wastewater Processes using General Fate Models (GEMs)," (Curto, 1996).
- Salado Creek, Dos Rios, and Medio Creek flow data

SAWS estimated their VOC Emissions to be:

Dos Rios WRC	8.51 tons/yr.
Salado Creek WRC	1.36 tons/yr.
Leon Creek WRC	1.70 tons/yr.
Medio Creek WRC	0.07 tons/yr.
WW Total	11.6 tons/yr.

Austin Region
Surveys and local inputs were used to determine emission rates when available. In the absence of local data, surrogate data were used to calculate emission rates. Surrogate data may include gross state product, employment, national/state sales estimates, sales tax rates, or population estimates.

This data, collected for and contained within the 1999 CAPCO EI, were used for most of the area sources in CAPCO's 10-county region. Temporal adjustments were incorporated into the photochemical model to account for the 1999 Sept. 13-20th dates.

Houston/Galveston Region
Area source emissions developed for counties in the Houston/Galveston region were downloaded from TCEQ's web site[20] on March 17, 2003. These emission files were used to perform the photochemical modeling included in the most recent SIP revision for the Houston area. The emissions were calculated for August 2000. To estimate 1999 emissions from the 2000 data, version 4.0 of the Economic Growth Analysis System (EGAS) was used to backcast the emissions to September 1999 (PECHAN, 2001). EGAS is an EPA-recommended model used to project emissions (backward or forward) based on economic forecasts.

Other Urban Regions
The Corpus Christi and Victoria regions were processed for 1999 by UT and contain local data.

[20] Available: ftp://ftp.tceq.state.tx.us/pub/OEPAA

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Table D-4. Photochemical Input Files Used for 1999 EI Development of Area Sources

Counties/Regions	Job Scripts	Input Files	Description
Regional Outside Texas	ar.regional.net99	nei99ver2_area.ams	Process regional ams area based on EPA's NEI99 ver2.[21]
Regional	mrguam.ar.all_reg99po	emiss.ar.reg_tx.net99.xxx emiss.ar.houston.net99.xxx emiss.nr.reg_tx.net99.xxx emiss.ar.reg.net99.xxx emiss.nr.reg.net99.xxx	Merge Area and Non-road emissions for the Regional Grid.
Texas Counties (excludes San Antonio, Austin, Houston/Galveston, Corpus Christi, and Victoria regions.)	ar.texas.net99	ams.TX_00.area_base2	Process ams emissions.[22]
		ctl.area.00.to.99	Backcast area source emissions from 2000 to 1999 using EGAS (Pechan, 2001) factors.
AACOG 12-county region	ar.sa.99.a0	ams.aacog.area.b	Process the ams area sources with local data (AACOG, Aug. 2001).
	afsar.sa.99.a	afs.capco.aacog.area	Process the afs (geo-coded) area sources for AACOG counties with local data (AACOG, Aug. 2001).
CAPCO 10-county region		emiss.artnr.Aus99.ams.xxx	Process the ams area sources with local data.[23]
		emiss.artnr.Aus99.afs.xxx	Process the afs (geo-coded) area sources with local data.[24]
Houston/Galveston 8-county region	ar.houston.net99*	ams.TX_00.area_base2	Process ams emissions.[25]
		ctl.houston.00.to.99	Backcast Houston area source emissions from 2000 to 1999 using EGAS (Pechan, 2001) factors.

[21] TCEQ; "TCEQ Modeling EI August 27, 2003 based on EPA's NIF version 2." (ftp://ftp.tnrcc.state.tx.us/pub/OEPAA/TAD/Modeling/)
[22] TCEQ; 3/26/03. "TCEQ Modeling EI for Houston SIP" (ftp://ftp.tceq.state.tx.us/pub/OEPAA/TAD/Modeling/DFWAQSE/Modeling/EI)
[23] UT; email: from Gary McGaughey received 03/08/04, "RE: San Antonio ar+nr emiss files?"
[24] UT; email: from Gary McGaughey received 03/08/04, "RE: San Antonio ar+nr emiss files?"
[25] TCEQ; 3/26/03. "TCEQ Modeling EI for Houston SIP" (ftp://ftp.tceq.state.tx.us/pub/OEPAA/TAD/Modeling/DFWAQSE/Modeling/EI)

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Corpus Christi 2-county region	ar.cc.99	ams-area-nsp.prn	Process the ams area sources with local data (ENVIRON, 2002).
Victoria 7-county region		emiss.artnr.vic.99ams_nomil.a0.xxx emiss.vic.Fire.yyyyyy	Process the area emissions with local data.[26]

[26] UT; email: from Gary McGaughey received 03/08/04, "RE: San Antonio ar+nr emiss files?"

NON-ROAD SOURCE EMISSIONS FOR 1999 BASE CASE
Non-road source emissions were developed using a variety of sources, from national EIs to the use of local data. Local data were used to calculate emissions where available, chiefly in urban areas. Minor refinements to these inventories are explained further under the county/regional sections.

Regional
Non-road data from the EPA SCRAM site (NEI99 version 2 data), downloaded in March 2003, were used to update the off-road emissions for the states other than Texas, within the 36-km grid.

Texas Rural Counties
The off-road equipment files contained on TCEQ's web site were used to update the 1999 base case for the rural counties of Texas.

San Antonio Region
The data collected for and contained within the EPA-approved 1999 AACOG EI (AACOG, 2001) were used for most of the non-road sources in the 12-county AACOG region. The information included in the AACOG EI has been gathered through the use of a local survey, available employment data, and application of EPA's NONROAD model. In addition, adjustments were made to the temporal allocation of non-road data in the photochemical model for the 1999 EI Sept. 13-20th dates.

Diesel Construction Equipment
The EI for diesel construction equipment in the AACOG region was updated using surrogate factors obtained by the same means as in a Houston-Galveston area study conducted by Eastern Research Group (ERG), (Eastern, 2000). This methodology was also used in two other studies conducted by ERG for the CAPCO and DFW regions. Where data were not obtainable, the NONROAD Model was used instead.

The surrogate factors for various categories of diesel construction equipment were calculated as folloows:

- *Highway:* AACOG obtained highway construction lettings in the 1999 District and County Statistics (DISCOS) from the Texas Department of Transportation.

Surrogate Factor = SA Hwy Construction Lettings / Houston Hwy Construction Lettings
= $171,059,013.76 / $629,586,701.01
= 0.2717

- *Municipal & Utility:* MSA populations were used to calculate the surrogate factors. MSA populations for 1999 were obtained from the AACOG 1999 Emissions Inventory (AACOG, Aug. 2001).

Surrogate Factor = 1,637,460 (San Antonio MSA Pop.) / 4,490,310 (Houston MSA Pop.)
= 0.3647

- *Commercial:* Construction employee populations (NAICS 23), were used for the calculation of commercial construction equipment. Employee populations for the San Antonio and Houston MSAs were collected from the US Census Bureau 1999 County Business Patterns (US Census, 2001).

Surrogate Factor = 40,909 SA MSA commercial construction employees /
153,981 Houston MSA commercial construction employees
= 0.2657

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- *Residential:* The number of single family dwelling permits for metropolitan areas were used as a comparison to calculate the factor for this category. The data were collected from the Texas A&M Real Estate Center (Texas A&M, 2003)

Surrogate Factor = 8,678 (San Antonio MSA single-family housing building permits) / 22,248 (Houston MSA single-family housing building permits)
= 0.3901

- *Rental:* In the creation of a surrogate factor for rental equipment, the employee populations, NAICS 42181 and 53249 were obtained for the San Antonio and Houston metro areas from the US Census Bureau's 1999 County Business Patterns (US Census, 2001)

Surrogate Factor = 1335 (San Antonio Employees) / 5013 (Houston Employees)
= 0.2663

- *>25 horsepower*: To maintain consistency in a comparison between construction equipment inventories, it was necessary for AACOG to add back in the 12,615 engines under 25 horsepower in Texas thus allocating 1,015 to the San Antonio MSA or 8.05% of the Texas equipment population
- *Landfill Equipment*: To adjust for local landfill equipment data, AACOG applied the same equipment configuration used in the CAPCO study (Eastern, 2001).
- *Quarry Equipment:* This category was calculated separately. Data for horsepower, hours of use, and equipment population were obtained from local survey results and applied to the study. In the absence of local survey data, default values from the NONROAD Model were used. Although the survey data were obtained from a 2002 survey, it was assumed that operations have not changed drastically in the 3 years in between the studies. There were investigations on quarries to see if they were still in operation in 1999. Three quarries were shown not to be in operation and were discarded from the study. The emissions were calculated by using the following formula:

EP*HRS*HP*LF*EF = Tons per year
Where,
EP = Equipment population
HRS = Annual hours of use
HP = Average rated horsepower
LF = Typical load factor
EF = Average emission of pollutant per unit of use

Quarry equipment was geocoded according to each site location so emissions could be calculated with site specific accuracy in the photochemical model. The resulting emissions from quarry equipment for the region was 0.3483 tons per day of VOC and 2.8909 tons per day of NOx. The resulting emissions are the combination of all points discussed in this section.

<u>Quarry Equipment</u>
This category consists of emissions produced from equipment used in quarry and mining activities. The methodology used in estimating quarry equipment emissions for the AACOG region is based on the local data extracted from aerial photographs and surveys, and EPA's NONROAD model. The NONROAD model was used in the absence of reliable local data. The methodology involved:

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1. Conducted a survey of local quarry equipment activity and determined local equipment population, usage rates, and equipment characteristics.
2. Analysis of aerial photography was conducted as a result of a low response to surveys. Quarry equipment was identified and quantified using available imagery of quarry sites.
3. County equipment populations for quarry sites without local data were calculated by applying an average employee to equipment ratio of those quarry sites with available equipment population data to those quarry sites without data.
4. Estimated VOC, NOx, and CO annual emissions by multiplying the county equipment populations by the average annual hours of use, average rated horsepower, typical load factor, and the EF for each type of equipment. The EPA's NONROAD Emission Model (EPA, 2000) was used to provide the average hours of use and load factor for the seven quarry equipment categories.
5. Converted the tons/year estimate into an estimate for a typical weekday (tons/day), and a typical weekend day (tons/day).

Austin Region
CAPCO developed the non-road emissions for the Austin 10-county region which were based on data collected for and contained within the EPA-approved 1999 CAPCO EI (AACOG, 2001). The information included in the CAPCO EI was gathered through the use of local survey, available employment data, and application of the NONROAD model. In addition, temporal adjustments were incorporated within the photochemical model to account for the 1999 EI Sept. 13-20th episode.

Houston/Galveston Region
Non-road emissions for the counties in the Houston-Galveston region were downloaded from TCEQ's web site[27] on March 17, 2003. The Houston-Galveston non-road emissions were for the year 2000; therefore, the EPA's NONROAD model was used to estimate the emissions for September 1999. This model can be used to estimate past, current, and future inventories for most off-road equipment categories. The model produces emission estimates for all criteria pollutants, as well as carbon dioxide, down to the county level.

The NONROAD runs were conducted for a typical summer day (weekday and weekend day) in 1999 and in 2000 (EPA, 2000). The percent differences between 1999 and 2000 statewide emissions on a typical summer day, by SCC code, were used to develop weekday and weekend adjustment factors for each equipment type. These factors were applied to the 2000 Houston data to estimate 1999 non-road emissions.

Other Urban Regions
The non-road emissions for the Corpus Christi 2-county region were developed by ENVIRON and processed in three files: geocoded military, geocoded commercial airport, and the remaining sources, non-geocoded. The Victoria region's emissions were developed and supplied by UT and were made available in one file containing all non-road emissions.

[27] Available at: ftp://ftp.tceq.state.tx.us/pub/OEPAA/TAD/Modeling/HGAQSE/Modeling/EI/

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Table D-5. Photochemical Model Jobs & Files for 1999 EI Development of Non-road Sources.

Counties/Regions	Job Scripts	Input Files	Description
Regional	nr.regional.net99	nei99ver2_nonroad.ams	Process of emissions based on EPA's NEI99 version 2.[28]
Texas (Rural Counties)	nr.texas.net99	ams.TX_00.NR_base2	Process of 2000 non-road source file for Texas.
		ctl.nr.tx.00.to.99	Backcast them to 1999[29] using NONROAD Model.
San Antonio (AACOG) 12-county region	afs.quarry.99	afs.quarry.aacog	Process of geo coded quarry emissions including local data (AACOG, 2001) and NONROAD Model.
	afs_nr.sa.a.99	afs.nonroad.capco.aacog.a	Process of afs file for non-road emissions including local data for all the AACOG counties.
		ctl.construction	Adjusts construction diesel engines emissions to demonstrate the re-calculation of equipment population for 4-county SAER.
	afs_tractors.combine.sa.99	afs.tractors_combines.sa	Geo-coded tractor /combine emissions including local data for Bexar, Wilson, Comal, Atascosa, Medina, Guadeloupe, and Fayette counties
	tractors_combines.sa.au	ams.tractors_combines.sa.au	Process of ams tractor & combine emissions (non-geocoded), includes local data.
	airport.sa.99	ams.airport.sa	Process of civilian airport emissions with local data for all the AACOG counties (geo coded to its location using the grdsrg file in grdem).
	military.sa.99	ams.military.sa	Process of military airport emissions including local data (geo coded to location using the grdsrg file in grdem).
	nr.sa.99.a0	ams.aacog.nonroad.b	Process of ams file for non-road sources including local data.
Austin (CAPCO) 10-county region		emiss.nr.Aus99.ams.xxx emiss.nr.Aus99.afs.xxx (geo-coded)	Process of afs file non-road emissions including local data (includes temporal adjustment for day of the week).[30]
	ma.austin.99	airport-military.austin	Process of ams file for civilian & military airport emissions geo coded to its location using the grdsrg file in grdem (AACOG, Jun. 2001)
Corpus Christi 2-county region	ma.cc.99	afs-ma-nsp.txt.a0	Process of military emissions including local data (ENVIRON, 2002).
	ca.cc.99	afs-ca-nsp.txt.a0	Process of commercial airport emissions including local data (ENVIRON, 2002).

[28] TCEQ, "Modeling EI," Aug. 27, 2003. Available online at: ftp://ftp.tnrcc.state.tx.us/pub/OEPAA/TAD/Modeling/HGAQSE/Modeling/EI
[29] TCEQ, March 26, 2003 "Modeling EI for the Houston SIP," ftp://ftp.tnrcc.state.tx.us/pub/OEPAA/TAD/Modeling/HGAQSE/Modeling/EI
[30] UT; email: from Gary McGaughey received 03/08/04, "RE: San Antonio ar+nr emiss files?"

Corpus Christi 2-county region	nr.cc.99	ams-nonroad-nsp.prn	Process of ams file non-road sources including local data (ENVIRON, 2002).
Victoria 7-county region		emiss.vic.nonroad.yyyyyy	Process emissions.[31]

[31] UT; email: from Gary McGaughey received 02/26/04, "1999 vct emiss files"

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ON-ROAD SOURCE EMISSIONS FOR 1999 BASE CASE
Emissions from on-road sources are calculated using the EPA's MOBILE model. AACOG staff integrated MOBILE6 on-road files into the photochemical model for all major urban areas of Texas, when available.

Regional
Outside of Texas, emissions data were developed by TCEQ based on the EPA's NIF version 2.0, and is available on the ftp web site.[32]

Texas Counties
MOBILE6 input files have only been completed for certain counties within nonattainment and near-nonattainment areas. Therefore, on-road inputs were updated using the gridded MOBILE6 files when available; otherwise MOBILE5 emission inventories were used. The methodology is the same as in the Houston SIP which used MOBILE5 for counties outside of the Houston area[33].

The TCEQ directory, MOBILE6 On-Road Emission Data for Texas Near Nonattainment Area Ozone Episodes Emissions for 1999 Base Case & 2007 Future Case (Updated on December 5, 10, and 13, 2002. Originally posted on October 2, 2002.), contains MOBILE6-based on-road mobile source emissions data that are being used to support photochemical modeling efforts for the Texas near nonattainment areas of:
- Austin 3-county Region
- Corpus Christi
- San Antonio (Bexar County only)
- Tyler-Longview
- Victoria

The ozone episode for the Austin, Corpus Christi, San Antonio, and Victoria areas extends from Monday September 13, 1999 through Monday September 20, 1999. The ozone episode for the Tyler-Longview area extends from Friday August 13, 1999 through Sunday August 22, 1999. Inventory data exist for both the 1999 "base cases" and 2007 "future cases" of these episodes. Four "day type" inventories are provided for each area and calendar year:
- Weekday (Monday-Thursday)
- Friday
- Saturday
- Sunday

The inventories were developed under contract to the TCEQ by the Texas Transportation Institute (TTI) and converted into a photochemical model-ready format by TCEQ staff using the 2X version of the Emissions Preprocessor System (EPS2X).

MOBILE6 was not used for rural counties because the 1999 MOBILE6 estimates, as well as, 2007 MOBILE6 emissions estimates were not available in time. In addition, emissions from

[32] Available at: ftp://ftp.tceq.state.tx.us/pub/OEPAA/TAD/Modeling/DFWAQSE/Modeling/EI
[33] Houston SIP used adjusted MOBILE5a-h data in Houston's Mid-Course Review Phase I: Attachment 3 - Emissions Inventory Development and Modeling for the August 25 - September 1, 2000, p. A3 – 79. Episode. Available http://www.tnrcc.state.tx.us/air/aqp/airquality_photomod.html#tsd2

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on-road sources in these counties are not significant and would have minimal impact on the San Antonio ozone level.

San Antonio Region
In August 2003, TTI completed the MOBILE6 version 2 gridded on-road input files for Bexar County. The files were made available by the TCEQ and provided in model-ready format on that agency's file transfer protocol (ftp) web site.[34]

Before entering the on-road network data file in the photochemical model, TTI's Bexar County MOBILE6 file was updated in one primary way. The TTI files provided on-road emissions for an average September weekday, Friday, Saturday, and Sunday. These files were adjusted by the University of Texas at Austin (UT) to calculate emissions for the individual episode days of September 13-16, 1999 and September 20, 1999. Temperature and humidity differences between weekdays, as well as, differences in VMT were used for these.

The SAER MOBILE5 emissions estimates were converted to MOBILE6 v. 2 values with day-specific, pollutant-specific factors.

Austin Region
On-road data for the Austin region was also developed by TTI and made available by TCEQ in model-ready format on that agency's file transfer protocol (ftp) web site.[35] This data includes the MoPac/IH-35 adjustment. An estimated 45% of the MoPac NOx emissions were moved to IH-35 to account for the lesser emissions on MoPac freeway as compared to the greater emissions on the IH-35 expressway. This adjustment was made because the two roads were both categorized as freeways, exaggerating the NOx emissions on MoPac.

Houston/Galveston Region
MOBILE6 on-road files were also obtained for the Houston area.[36] However, the Houston on-
road emission rates were estimated for an August 2000 timeframe. Therefore, several adjustments were necessary to make the files suitable for use in the September 1999 episode.

The 2000 Houston episode spanned 8 days, from Wednesday, August 23, 2000 through Wednesday, August 30, 2000, so an initial step in the adjustment process involved selecting appropriate 2000 episode days to backcast to 1999. Since the number of vehicle-miles-traveled (VMT) and vehicle mix vary by day of the week, the Friday (August 25th), Saturday (August 26th) and Sunday (August 27th) 2000 Houston on-road files were used to determine the Friday (September 17th), Saturday (September 18th) and Sunday (September 19th) 1999 on-road inputs, respectively. Ron Thomas of TCEQ recommended using Wednesday, August 30, 2000 as a typical weekday (September 13th through 16th and 20th) for purposes of the 1999 episode.

The August 2000 vehicle emission rates were adjusted to reflect the correct month and year. This was accomplished using the MOBILE6 model. Two runs were conducted for Houston

[34] Available: ftp://ftp.tceq.state.tx.us (April 4, 2003)
[35] Available: ftp://ftp.tceq.state.tx.us (April 4, 2003)
[36] TCEQ, email: from Chris Kite received 12/10/02 (NNA areas) and 02/28/03 (Houston area).

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using MOBILE6: one with appropriate settings (such as hourly temperature) for the August 2000 episode and one with appropriate settings for a September 1999 timeframe. The percent difference between the two was applied, in concert with a Vehicle Miles Traveled (VMT) adjustment to account for the difference between total VMT for the two runs, to the 2000 Houston link-based on-road emission file.

The 1999 MOBILE6 LBASE input files aggregate the 28 vehicle-types (EPA, 2001) into 9 (LDG, HDGV, LDD V and T1-4, HDDV2-7, HDDV8a-b, MC, HDGB, HDDBT, and HDDBS) categories; the 13 roadway-types are aggregated into 3 (freeway, arterial, & local) categories.[37]

Other Urban Regions

The MOBILE5 on-road files for Corpus Christi, Tyler-Longview, and Victoria areas that were used in the development of the original September 1999 base case were replaced with the MOBILE6 files developed by the Texas Transportation Institute (TTI) and provided in model-ready format on TCEQ's ftp web site.[38] MOBILE6 ver.1 was used for Gregg, Smith, San Patricio, Nueces, and Victoria counties.

The on-road emissions files, photochemical model job scripts, counties they affect, and a brief description of what the job scripts/files accomplish are listed in Table D-6.

[37] TCEQ, email: from Chris Kite received 02/28/03, "MOBILE6 LBASE Input Files for Houston."
[38] Available ftp://ftp.tceq.state.tx.us (April 4, 2003)

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Table D-6. Photochemical Model Jobs & Files for 1999 EI Development of On-Road Sources.

Counties/Regions	Job Scripts	Input Files	Description
Regional (outside of Texas)	mv.regional.net99	nei99ver2_mobile.ams	Process the regional on-road source file.[39]
Other Texas Counties (where MOBILE6 was not available)	pream.txnna.12km.HPMS chmspl.txnna.12km.HPMS grdem.txnna.12km.HPMS cntlem.daily.txnna.12km.mobile5.HPMS.job	AMS.mv.HPMS.hourly.xxx.yyyyyy.a0	Process MOBILE5 emissions, NIF (ENVIRON, 2002).
Bexar County	lbase.mobile6.4km.v2 chmspl.mobile6.4km.v2.job grdem.mobile6.4km.v2.job Cntlem.mobile6.4km.v2.job	m6.1999.bexar,.xxx.0920.lbase_in (Weekdays: Sep. 13-16 and 20th) m6.1999.$county,xxx.yyyyyy.lbase_in (Weekend days: Fri. Sep. 17, Sat. Sep. 18, & Sun. Sep. 19) cntlem.mobile6.4km.v2	Process on-road EI w/ MOBILE6 ver 2 for Bexar county.[40] Applied to MOBILE6 on-road emissions to adjust for each weekday based on day-specific temperature & humidity.[41]
CAPCO 3-county region		emiss.m6.limks.4km.Austin_3county.roadnox.yyyyyy	MOBILE6 ver. 2 w/MOPAC/ IH35NOx decrease of 45% for HDDV[42]and day specific emissions.
CAPCO Counties: Bastrop Caldwell *AACOG Counties:* Comal Guadalupe Wilson	cntlem.daily.txnna.4km.mobile5.HPMS	mvfactors.aus.sa.yyyyyy	Converts MOBILE5 emissions estimates to MOBILE6 ver. 2 values with day-specific, pollutant-specific factors.[43]
Houston 8-county Region	lbase.mobile6.12km.houston chmspl.mobile6.12km.houston grdem.mobile6.12km.houston	mobile6.2000.HGA_8county.0830.lbase_in mobile6.2000.HGA_8county.0825.lbase_in mobile6.2000.HGA_8county.0826.lbase_in mobile6.2000.HGA_8county.0827.lbase_in	Process MOBILE6 EI for Houston counties.

[39] TCEQ, Modeling EI based on EPA's NIF version 2.0.
[40] UT; email: from Gary McGaughey received 08/27/03, "1999 M6 files for SA/AUS."
[41] UT; email from Alba Webb received 03/11/04, "RE: Gifs attached." [TTI, June 2003: Appendix C].
[42] UT; email: from Alba Webb received 01/16/04, "Revised Mobile Files," [TTI, June 2003: Appendix C].
[43] UT; email: from Alba Webb received 09/05/03; "RE: Victoria area/nonroad/point 1999 EI data"

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	cntlem.mobile6.12km.houston	ctl.onroad.LINKS.daily.yyyyyy	Backcast Houston emissions from Aug. 2000 to Sep. 1999.[44]
Gregg & Smith counties*	lbase.mobile6.12km.LINKS chmspl.mobile6.12km.LINKS grdem.mobile6.12km.LINKS	m6.1999.Tyler_2county.weekday.0816.lbase_in m6.1999.Tyler_2county.weekday.0813.lbase_in m6.1999.Tyler_2county.weekday.0814.lbase_in m6.1999.Tyler_2county.weekday.0815.lbase_in	Process MOBILE6 EI for Gregg & Smith counties.[45]
	cntlem.mobile6.12km.LINKS	ctl.onroad.Links.daily.yyyyyy	Project emissions from Aug. 1999 to Sept. 1999.[46]
Houston 8-county Region	mrguam.mobile6.12km.mv	emiss.mv.mobile6.12km.houston.xxx.yyyyyy.a0	Running of MRGUAM module for the Mobile EI 12km level in 1999.
Gregg County		emiss.mv.mobile6.12km.gregg.xxx.yyyyyy.a0	
Other counties		emiss.mv.mobile5.HPMS.$hpms_.xxx.yyyyyy.a0	
Nueces San Patricio	lbase.mobile6.4km.corpus chmspl.mobile6.4km.v2.job grdem.mobile6.4km.v2.job	m6.1999.corpus.xxx.yyyyyy.lbase_in	Process MOBILE6 Emissions.[47]
Victoria 7-county region		emiss.m6.links.4km.vic.yyyyyy	Day specific 7-county emissions[48] with MOBILE6 for Victoria County and MOBILE5 for other 6 counties.
Bexar Austin 3-county region** Nueces San Patricio Victoria Fort Bend Harris Waller Other	mrguam.txnna.4km.mobile6.v2	emiss.mv.mobile6.v2.4km.bexar.xxx.yyyyyy.a0 emiss.m6.links.4km.Austin_3county.roadnox.yyyyyy emiss.mv.mobile6.4km.nueces.weekday.yyyyyy.a0 emiss.mv.mobile6.4km.sanpatricio.weekday.yyyyyy.a0 emiss.mv.mobile6.4km.victoria.weekday.yyyyyy.a0 emiss.mv.mobile6.4km.fortbend.weekday.yyyyyy.a0 emiss.mv.mobile6.4km.harris.weekday.yyyyyy.a0 emiss.mv.mobile6.4km.waller.weekday.yyyyyy.a0 emiss.mobile5.HPMS.$hpms_day.yyyyyy.ao	MRGUAM module for the Mobile EI (4km) weekdays Mon. Sep 13 –Thurs. Sep. 16 and Mon. Sep 20.

[44] TCEQ, email: from Chris Kite received 02/28/03, "MOBILE6 LBASE Input Files for Houston."
[45] TCEQ; email: from Chris Kite received 08/29/03, "1999 Gridded Onroad Mobile CAMx Files for NNA Subdomain."
[46] TCEQ; email: from Chris Kite received 08/29/03, "1999 Gridded Onroad Mobile CAMx Files for NNA Subdomain."
[47] TCEQ; email: from Chris Kite received 08/29/03, "1999 Gridded Onroad Mobile CAMx Files for NNA Subdomain."
[48] UT; email from Alba Webb received 03/11/04, "RE: Gifs attached." [TTI, June 2003: Appendix C].

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Bexar Austin 3-county region** Nueces San Patricio Victoria Fort Bend Harris Waller Other	mrguam.txnna.4km.mobile6.v2	emiss.mv.mobile6.v2.4km.bexar.xxx.yyyyyy.a0 emiss.m6.links.4km.Austin_3county.roadnox.yyyyyy emiss.mv.mobile6.4km.nueces.xxx.yyyyyy.a0 emiss.mv.mobile6.4km.sanpatricio.xxx.yyyyyy.a0 emiss.mv.mobile6.4km.victoria.xxx.yyyyyy.a0 emiss.mv.mobile6.4km.fortbend.xxx.yyyyyy.a0 emiss.mv.mobile6.4km.harris.xxx.yyyyyy.a0 emiss.mv.mobile6.4km.waller.xxx.yyyyyy.a0 e3miss.mobile5.HPMS.$hpms_day.yyyyyy.ao	MRGUAM module for the Mobile EI (4km) to allocate for weekdays and weekend days.
Regional	mrguam.mv.all_reg.mobile6.0999	emiss.mv.all_counties.12km.yyyyyy.a0 emiss.mv.reg.net99.xxx	Merges Mobile emissions for the Regional Grid, 1999.

*Input days used are Aug. 13th for Friday, Aug. 14th for Saturday, Aug. 15th for Sunday, and Aug. 16 for a "representative" weekday. Each day was backcast to Sept. 1999 using day-specific temperatures in MOBILE6 to produce a Gregg and Smith county on-road EI for modeling episode Sept. 13-20, 1999. This is similar to the methodology used for Houston on-road emissions and approved by TCEQ. It was also found to be more accurate than "default" non-gridded on-road emissions.

**Austin emission files were provided by UT and were based on TTI emissions data. These files contain the I35/MOPAC adjustment in Travis County.

SUMMARY OF THE 1999 BASE CASE DEVELOPMENT

Development and refinement of the September 1999 photochemical modeling episode was an extensive project that required the assistance of consultants and the cooperation of several agencies. In addition, it required review and analysis of data from a variety of sources. Meteorological refinements were developed by consultants from ENVIRON International Corporation and the University of Texas at Austin. Their efforts produced three meteorological schemes (labeled 5d, 5g, and 6f) that replicated climatic and atmospheric conditions during the September 1999 episode. The new meteorological schemes were run through the photochemical model to determine their affect on the formation, transport, and deposition of ozone.

Another major step in the development and refinement process entailed developing/obtaining improved emission data for model input and, when necessary, adjusting the rates to the correct time period and converting the data to model-readable files. Sources of refined emissions data included EPA's National Emissions Trend database and State Implementation Plan data developed for other urban areas of Texas. Emissions databases were also reviewed for accuracy as recommended by the EPA in their draft modeling guidance (EPA, 1999a). During this quality assurance/quality control process, several problems were identified that required corrections, such as adjustments to the temporal and spatial allocation of emission rates

The most significant refinement to the emission inputs for the San Antonio region was development of gridded MOBILE6 and MOBILE6 version 2 based on-road emission estimations. The Texas Transportation Institute created average weekday on-road emissions for Bexar County and spatially allocated the emissions to the 4-km grid system. AACOG staff modified the average weekday on-road data to account for variances in temperatures during the modeling episode weekdays

The revised 1999 emissions rates used for input to the photochemical model for Bexar County are summarized in figures D-1 and D-2. These figures provide NOx and VOC emission totals by source category. Prior to incorporating these values in the model, all emission rates were spatially allocated to the 4-km grid using EPA-approved methodologies.

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Table D-7. 1999 Emissions by Source Category for Texas for Sept. 13 (Monday)

County FIPS Code	Non-Road Emissions		Area Emissions		Mobile Emissions		Point Emissions	
	NOx	VOC	NOx	VOC	NOx	VOC	NOx	VOC
48001	4.9	0.8	0.6	7.2	3.2	1.8	0.5	0.1
48005	2.7	8.3	0.3	6.2	7.9	3.4	4.6	4.2
48007	1.8	4.2	0.4	1.9	1.1	0.6	0.7	7.2
48009	0.8	0.6	0.2	20.1	0.9	0.5	0.0	0.0
48011	0.3	0.0	0.0	0.1	0.2	0.1	0.0	0.0
48015	7.2	0.6	1.3	3.7	4.6	1.7	0.0	0.0
48023	1.1	0.7	0.2	2.5	0.5	0.3	0.0	0.0
48025	1.3	0.3	1.6	8.0	1.9	1.1	0.5	0.0
48027	10.4	3.0	0.7	14.6	17.3	7.5	0.0	0.0
48033	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48035	4.4	1.0	0.1	1.9	1.2	0.6	1.7	0.0
48037	7.1	3.5	0.3	7.6	10.4	3.8	0.7	0.6
48039	14.1	4.5	4.7	15.6	12.6	7.9	65.9	5.9
48041	3.8	2.9	1.1	11.9	11.7	5.4	4.2	0.1
48045	0.2	0.0	0.0	0.6	0.1	0.0	0.0	0.0
48047	0.5	0.2	1.8	2.8	1.3	0.7	1.3	0.1
48049	1.7	0.8	3.4	11.3	2.4	1.3	0.2	0.2
48051	4.8	0.6	0.9	7.9	2.2	1.0	0.0	0.0
48059	4.9	0.4	0.7	6.8	4.6	1.6	0.0	0.0
48061	8.9	10.1	0.7	16.6	15.7	10.5	9.5	0.3
48063	2.8	0.4	0.0	1.3	0.9	0.4	0.0	0.0
48065	2.1	0.2	0.8	3.3	0.7	0.3	0.8	0.0
48067	7.0	1.9	0.4	4.2	3.2	1.4	4.8	0.8
48071	1.7	1.2	5.3	4.5	6.0	3.2	36.7	2.4
48073	4.8	1.7	0.7	5.7	3.5	1.9	5.8	0.3
48075	2.2	0.3	0.1	1.5	1.3	0.5	0.0	0.0
48077	1.0	0.6	0.4	8.0	2.0	1.0	0.1	0.0
48081	0.1	0.6	0.2	2.2	0.4	0.2	1.5	0.0
48083	1.5	0.4	2.1	7.4	0.9	0.6	0.0	0.0
48085	19.8	10.9	2.0	11.7	21.9	11.1	2.9	0.4
48087	1.2	0.2	1.9	3.2	0.3	0.2	0.0	0.0
48089	3.4	0.7	1.4	4.0	6.3	2.6	1.9	0.0
48093	1.5	0.5	0.9	3.2	1.3	0.7	0.0	0.0
48095	0.9	0.3	0.3	2.3	0.6	0.3	0.0	0.0
48097	3.4	1.0	0.3	12.9	4.0	1.7	0.0	0.0
48099	1.1	0.5	0.2	3.5	2.3	1.3	0.0	0.0
48101	0.5	0.1	0.3	1.1	0.3	0.1	0.0	0.0
48105	3.8	0.3	21.5	29.3	1.5	0.6	0.0	0.0
48107	0.4	0.1	0.0	1.1	0.2	0.1	0.0	0.0
48113	67.5	60.1	15.5	64.0	218.8	91.6	25.4	2.4
48119	0.4	0.1	0.0	0.8	0.5	0.2	0.0	0.0
48121	8.7	8.8	2.6	15.8	24.0	11.3	1.7	1.2
48125	0.5	0.1	0.0	1.4	0.3	0.1	0.0	0.0
48127	0.2	0.1	0.8	3.3	1.0	0.5	0.4	0.1
48129	2.0	0.4	0.0	0.9	1.7	0.8	0.0	0.0
48131	1.2	0.3	2.7	7.8	1.3	0.6	0.7	0.0

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48133	5.8	0.7	4.9	10.6	3.4	1.5	0.9	0.1
48137	0.4	0.0	1.9	2.2	0.2	0.1	0.0	0.0
48139	12.2	2.2	0.3	9.3	10.6	4.3	28.8	1.6
48143	1.5	0.5	1.4	4.8	2.4	1.3	0.0	0.0
48145	5.6	0.6	0.1	2.6	1.9	1.0	0.0	0.0
48147	1.7	0.5	0.3	3.9	1.9	0.9	12.7	0.4
48151	3.1	0.3	0.1	3.6	0.6	0.3	0.0	0.0
48153	0.6	0.1	0.0	0.5	0.2	0.1	0.0	0.0
48155	0.7	0.1	0.3	1.4	0.3	0.1	0.0	0.0
48157	13.1	6.9	1.8	12.2	14.7	8.9	117.0	1.0
48159	0.7	0.3	0.2	1.8	1.3	0.5	0.1	0.0
48161	3.8	0.4	4.8	9.3	4.6	1.7	39.0	0.3
48167	7.1	6.0	3.6	10.7	13.6	9.0	73.4	5.7
48169	0.6	0.1	0.0	2.4	0.3	0.1	0.0	0.0
48177	3.7	0.5	0.1	3.0	4.2	1.5	0.0	0.0
48179	3.7	0.7	5.5	19.0	3.0	1.2	11.4	4.4
48181	9.4	3.0	0.8	13.1	9.4	3.8	1.2	0.0
48183	6.5	2.8	3.1	17.3	10.0	6.0	3.9	1.4
48185	8.0	0.9	1.4	3.3	2.5	1.2	20.2	0.2
48191	1.6	0.2	0.0	1.3	0.7	0.4	0.0	0.0
48193	0.7	0.2	0.1	1.5	0.8	0.4	0.0	0.0
48195	0.8	0.1	1.3	2.2	0.1	0.1	8.7	0.4
48197	2.5	0.3	0.2	2.4	1.2	0.5	0.0	0.0
48199	3.6	1.9	0.6	5.6	4.6	2.4	0.7	0.3
48201	93.0	78.6	19.2	102.1	188.0	117.1	186.0	25.6
48203	5.8	1.0	3.3	11.2	10.5	3.9	37.0	1.2
48207	2.2	0.5	0.2	3.8	0.9	0.5	1.2	0.0
48211	2.6	0.2	6.5	7.3	0.4	0.2	1.0	0.1
48213	6.0	2.1	1.4	8.1	4.1	2.3	1.0	0.1
48215	15.3	7.2	7.2	30.0	27.7	19.4	6.1	0.7
48217	6.8	1.2	0.2	4.7	6.0	2.4	0.0	0.0
48221	1.0	0.6	1.3	3.3	1.9	1.0	28.3	0.4
48223	2.7	0.6	0.1	4.3	4.8	1.7	0.0	0.0
48225	2.9	0.8	0.3	3.2	2.1	0.9	0.0	0.0
48227	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48231	3.0	1.4	0.3	8.4	7.7	3.2	0.2	0.0
48233	0.2	0.1	1.0	4.7	0.2	0.1	0.0	0.0
48235	0.3	0.1	1.1	7.0	0.2	0.1	0.3	0.1
48237	1.2	0.3	5.9	14.6	0.8	0.4	0.2	0.0
48241	8.4	2.7	0.4	3.1	4.1	2.1	2.4	0.4
48245	21.8	6.3	7.8	17.2	25.1	12.6	69.4	6.6
48247	0.2	0.1	0.9	1.8	0.3	0.2	0.1	0.0
48249	2.2	0.6	1.7	5.4	3.6	2.0	3.6	0.7
48251	8.1	2.1	0.3	7.9	7.3	3.7	5.9	0.4
48253	2.0	0.5	0.1	5.9	2.2	1.1	5.6	0.2
48257	4.6	0.8	0.2	5.8	8.7	4.1	0.0	0.0
48261	2.6	7.8	0.5	1.5	1.1	0.5	0.5	0.0
48263	0.2	0.1	0.0	2.2	0.2	0.1	1.9	0.2
48267	0.1	0.2	0.1	1.1	1.8	0.8	0.1	0.0

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48269	0.1	0.0	0.2	2.4	0.2	0.2	0.0	0.0
48271	4.4	0.2	0.0	0.4	0.5	0.3	0.0	0.0
48273	2.3	3.9	1.4	4.4	2.4	1.5	7.5	0.0
48275	1.5	0.3	0.3	3.1	0.5	0.2	0.0	0.0
48277	6.2	1.4	0.2	6.4	3.4	1.8	0.6	0.2
48281	0.5	0.3	0.0	1.4	1.2	0.6	0.0	0.0
48283	0.8	0.3	1.2	2.9	2.2	0.9	0.0	0.0
48289	5.5	0.5	1.5	4.5	4.4	1.5	0.0	0.0
48291	6.4	2.1	0.6	6.0	4.9	3.2	6.3	0.4
48293	5.3	0.8	1.7	5.4	1.6	0.8	85.5	0.7
48295	2.2	0.2	4.7	6.8	0.3	0.2	3.2	0.0
48297	6.7	1.0	1.7	4.2	3.8	1.6	2.5	0.5
48307	1.7	0.3	0.2	2.4	0.9	0.5	0.0	0.0
48309	8.4	4.9	0.5	15.3	18.9	8.2	56.6	0.6
48311	2.2	0.6	3.1	6.0	0.3	0.2	0.1	0.2
48313	0.4	0.2	0.2	1.9	3.0	1.1	0.3	0.0
48315	1.9	1.1	0.3	1.9	1.1	0.5	6.0	0.5
48319	0.2	0.1	0.0	0.8	0.4	0.2	0.0	0.0
48321	13.2	7.6	1.5	6.6	3.0	1.4	3.7	0.2
48323	0.6	0.5	0.5	4.2	2.4	1.5	0.0	0.0
48327	0.1	0.1	0.1	0.9	0.4	0.2	0.0	0.0
48331	7.9	0.8	0.1	8.6	2.8	1.4	77.6	4.0
48333	0.6	0.1	0.0	1.0	0.7	0.3	0.0	0.0
48335	1.3	0.4	0.0	10.3	2.3	0.7	5.4	0.1
48337	4.6	0.7	0.3	11.8	1.8	0.8	0.0	0.0
48339	7.3	5.3	2.0	11.0	16.8	10.0	15.3	0.5
48343	1.9	0.5	0.0	1.6	1.8	0.7	0.5	0.0
48345	0.5	0.1	0.0	0.9	0.2	0.1	0.0	0.0
48347	1.9	3.8	1.1	7.4	6.0	2.6	0.4	3.3
48349	7.4	1.4	0.2	9.5	5.4	2.4	3.9	0.5
48351	1.0	2.7	0.3	2.1	1.5	0.9	0.2	0.3
48353	3.9	0.7	0.4	5.2	4.4	1.4	4.8	0.1
48355	43.3	28.8	0.9	43.3	20.8	15.1	54.4	5.8
48357	3.4	0.5	4.7	9.4	0.9	0.5	2.3	0.1
48361	7.3	1.5	0.5	4.0	11.2	4.9	34.3	3.3
48363	6.4	1.4	7.3	11.3	2.6	1.3	2.9	0.1
48365	4.2	1.0	10.1	16.4	3.2	1.3	6.4	0.7
48367	6.9	1.4	4.8	9.6	7.5	3.5	2.0	0.2
48373	1.3	2.9	0.6	4.0	5.0	2.1	1.1	2.5
48379	0.3	0.5	0.1	0.8	0.8	0.4	0.0	0.0
48383	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48385	0.1	0.1	0.0	0.3	0.2	0.1	0.0	0.0
48387	0.9	0.4	0.0	2.2	1.1	0.5	0.0	0.0
48393	1.6	0.1	3.0	4.0	0.2	0.1	0.0	0.0
48395	10.5	0.8	0.5	2.9	2.2	1.0	4.8	0.0
48397	1.3	1.0	0.1	2.1	3.5	1.4	0.0	0.0
48399	1.9	0.4	0.3	4.3	1.0	0.5	0.0	0.0
48401	6.3	2.9	6.0	9.6	3.5	2.0	78.9	1.2
48403	2.4	1.5	0.0	1.1	1.1	0.5	0.2	0.1

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48405	2.2	2.5	0.0	0.9	1.0	0.4	0.0	0.0
48407	0.4	0.9	0.2	1.6	2.6	1.3	0.0	0.0
48409	19.6	20.6	0.2	15.4	4.7	3.6	7.5	0.5
48411	0.5	0.2	0.0	1.1	0.4	0.3	0.0	0.0
48413	0.7	0.1	3.2	4.9	0.4	0.2	0.2	0.0
48415	4.8	0.6	0.1	13.0	2.3	0.7	1.0	0.0
48417	0.5	0.2	1.2	11.4	0.8	0.4	0.0	0.0
48419	4.2	5.2	1.1	3.9	2.5	1.0	0.0	0.0
48423	8.7	3.6	1.1	13.5	15.1	10.1	2.6	2.1
48425	0.2	0.3	0.0	0.5	0.5	0.3	0.0	0.0
48427	2.0	0.5	5.3	8.3	2.8	2.0	0.8	0.2
48429	1.6	0.7	3.7	10.1	0.7	0.4	0.0	0.0
48431	0.7	0.1	3.0	8.4	0.5	0.2	0.0	0.0
48433	0.5	0.1	0.0	3.6	0.5	0.2	0.0	0.0
48435	2.6	0.2	16.3	16.1	1.7	0.6	2.8	0.2
48439	50.2	32.6	7.9	47.9	141.2	57.6	13.1	1.4
48441	7.1	3.2	0.5	14.3	14.6	5.8	0.0	0.0
48447	0.8	0.2	0.4	5.7	0.2	0.1	0.0	0.0
48449	2.6	0.9	0.1	3.3	3.8	1.4	141.2	1.2
48451	3.2	2.6	0.6	11.9	6.0	3.0	2.3	0.1
48455	1.4	1.1	0.0	1.2	1.2	0.5	0.0	0.0
48457	0.5	1.6	0.1	2.3	1.9	0.9	0.0	0.0
48459	6.0	0.7	3.9	11.8	2.9	1.3	0.0	0.0
48463	7.5	1.0	0.1	1.4	2.4	1.6	0.0	0.0
48465	3.1	1.9	0.8	3.6	2.0	1.1	0.0	0.0
48467	4.2	0.6	0.3	4.6	5.8	2.7	0.1	0.0
48471	2.6	1.9	0.2	3.5	7.9	3.1	0.2	0.0
48473	5.0	0.6	0.4	1.9	4.5	3.0	4.9	0.2
48477	2.4	0.9	0.9	4.5	3.7	1.6	0.0	0.0
48479	5.8	2.7	15.9	24.4	10.5	5.8	3.8	0.2
48481	4.7	1.2	2.5	9.3	5.2	2.3	1.4	0.1
48483	1.6	0.2	4.2	7.0	2.4	0.7	0.3	0.0
48485	3.2	2.5	0.6	38.9	8.4	4.6	16.7	0.0
48487	3.0	0.6	0.4	7.2	1.9	1.0	23.4	0.0
48489	3.3	3.4	0.3	3.1	1.2	0.9	0.0	0.0
48497	8.6	1.2	16.5	22.2	4.8	2.4	2.9	0.2
48499	3.8	1.5	0.5	6.1	1.9	1.1	2.9	0.1
48503	1.3	0.7	1.6	17.1	1.1	0.6	20.2	0.3
48505	1.8	1.3	10.4	10.5	1.0	0.6	0.8	0.1
48507	0.7	0.2	0.7	2.3	1.0	0.6	0.0	0.0

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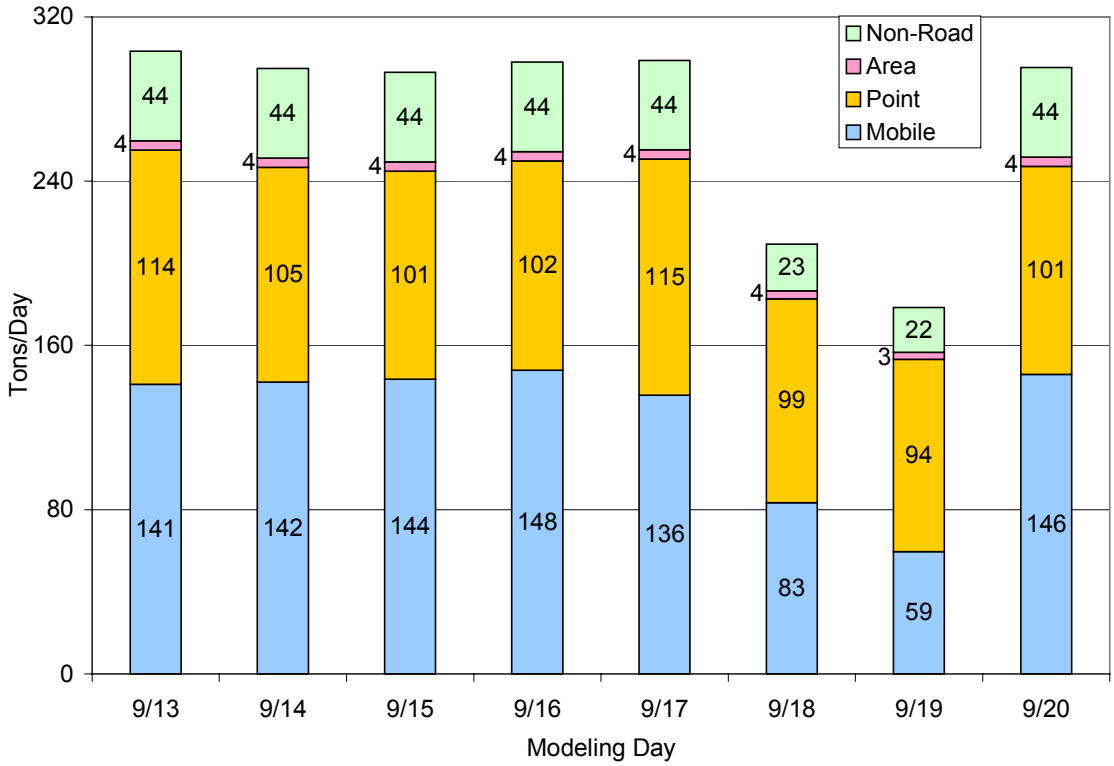
Figure D-1. 1999 Estimated NOx Emissions in Tons/Day for the San Antonio EAC Region during the September 1999 episode.



Modeling Day	Mobile	Point	Area	Non-Road	Total
Day 1	141.1	114.0	4.5	43.6	303.3
Day 2	142.2	104.6	4.5	43.6	298.2
Day 3	143.6	101.3	4.5	43.6	296.3
Day 4	147.9	101.9	4.5	43.6	301.2
Day 5	135.8	114.9	4.5	43.6	302.2
Day 6	83.4	99.2	3.9	22.7	209.2
Day 7	59.5	93.7	3.4	21.9	178.5
Day 8	145.8	101.4	4.5	43.6	298.7

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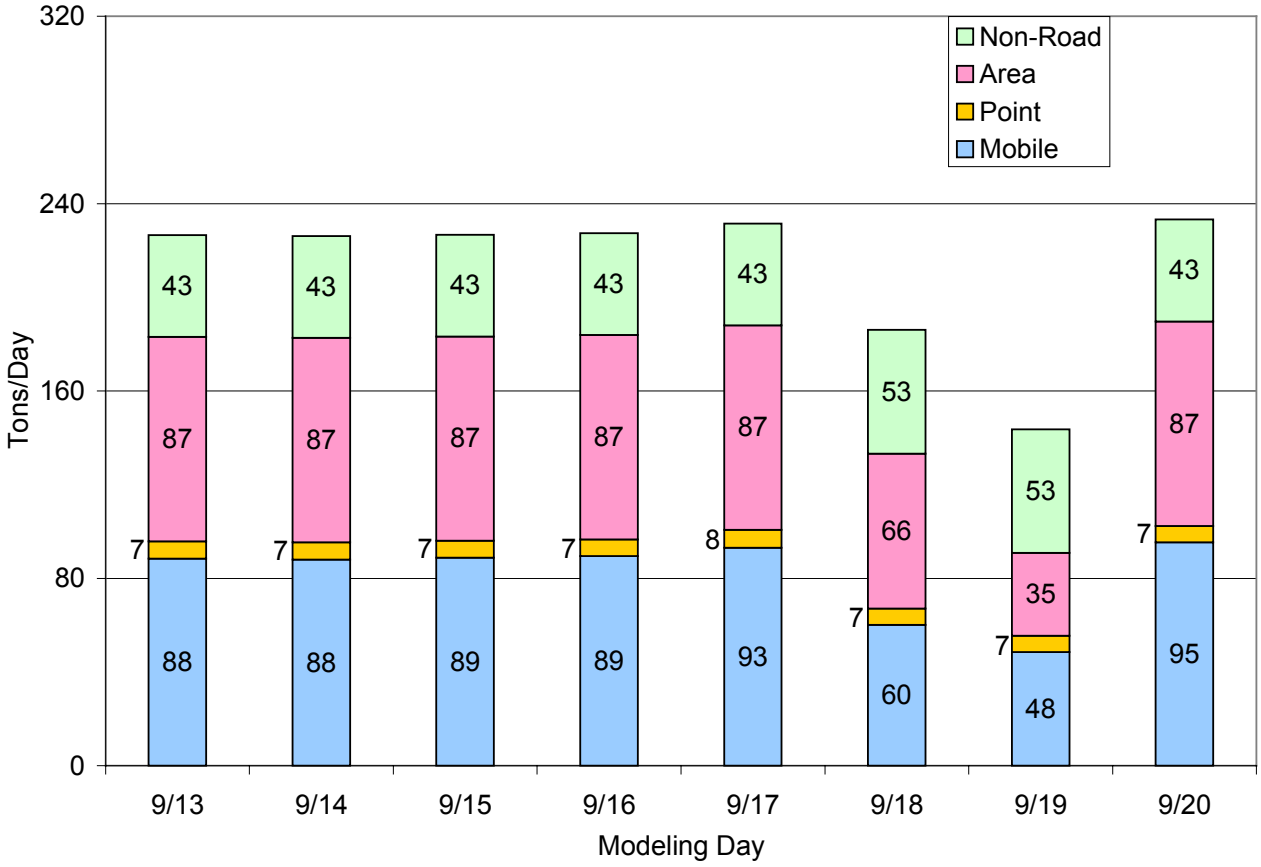
Figure D-2. 1999 Estimated VOC Emissions in Tons/Day for the San Antonio EAC Region during the September 1999 episode.



Modeling Day	Mobile	Point	Area	Non-Road	Total
Day 1	88.4	7.5	87.3	43.4	226.5
Day 2	88.1	7.3	87.3	43.4	226.1
Day 3	88.8	7.2	87.3	43.4	226.7
Day 4	89.4	7.2	87.3	43.4	227.4
Day 5	93.1	7.6	87.3	43.4	231.4
Day 6	60.2	6.9	66.1	52.9	186.1
Day 7	48.5	6.9	35.4	52.7	143.5
Day 8	95.3	7.1	87.3	43.4	233.2

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APPENDIX E

1999 BASE CASE DEVELOPMENT AND PERFORMANCE ANALYSES

SAN ANTONIO EAC REGION ATTAINMENT DEMONSTRATION

MARCH 2004

AACOG
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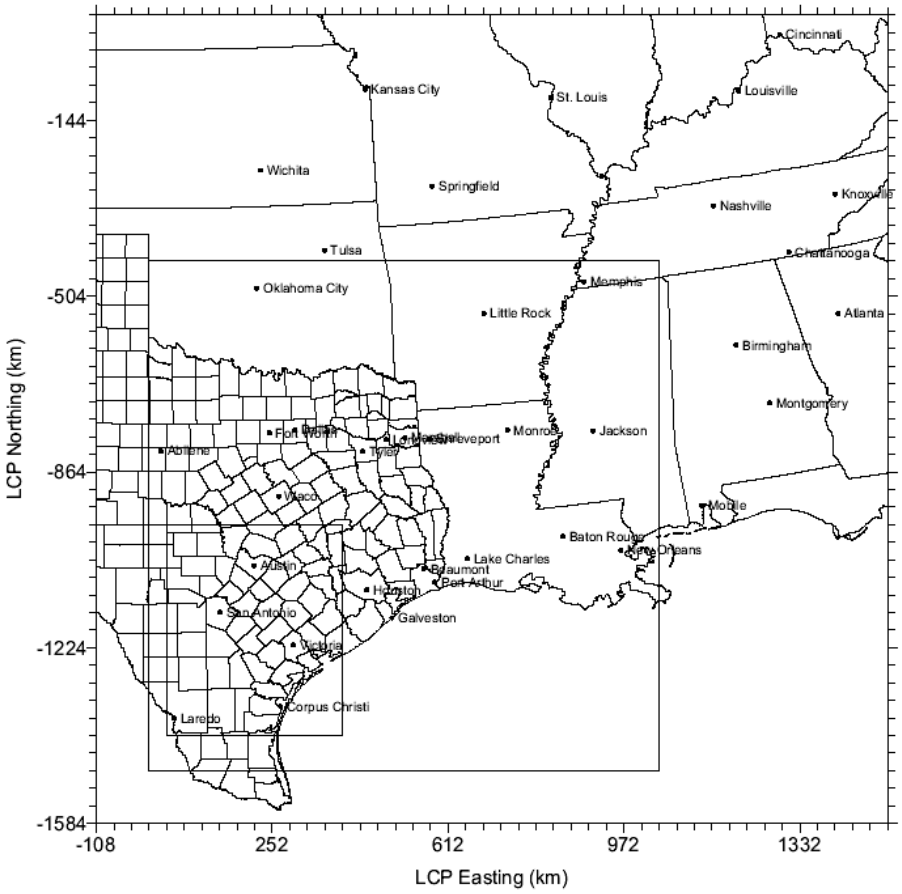
INTRODUCTION

The elevated ozone episode that occurred between September 15 – 20, 1999 in South-central Texas was modeled using the Comprehensive Air quality Model with extensions (CAMx). This is an alternative model for developing air quality simulations in accordance with EPA's (On-line, no date) report, Summary Descriptions of Alternative Air Quality Models. CAMx is a Eulerian photochemical grid model that makes use of a two-way nested grid structure, with the coarsest grid (36-km) covering a wide regional domain, a 12-km grid that incorporates Eastern Texas including the nonattainment areas of Dallas/Fort Worth, Houston/Galveston, and Beaumont/Port Arthur, and a fine grid (4-km) extending over four Texas near nonattainment areas as shown in figure E-1.

Figure: E-1. Nested Grid System for the 1999 South Texas Photochemical Model Simulation.



CAMx Grid Dimensions

LCP Grid with reference origin at (40 N, 100 W)

36 km Grid: 45 x 46 cells from (-108, -1584) to (1512, 72)
12 km Grid: 87 x 87 cells from (0, -1476) to (1044, -432)
4 km Grid: 90 x 108 cells from (36, -1404) to (396, -972)
(nested grid dimensions do not include buffer cells)

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The original September 1999 simulation was developed by ENVIRON International Corporation and documented in their report *Development of a Joint CAMx Photochemical Modeling Database for the Four Southern Texas Near Non-Attainment Areas* (Emery, Tai, Wilson, and Yarwood, 2002). Their final and best performing run (developed without arbitrary meteorological or emissions inputs), labeled CAMx Run 13, produced promising results. However, CAMx Run 13 exhibited some problems that were prevalent in earlier simulations, including consistent under-predictions of maximum and mean ozone concentrations. ENVIRON staff recommended performing comprehensive QA/QC procedures on model settings and inputs, particularly meteorological and emissions inputs, and incorporating refinements to the model where appropriate.

ENVIRON and the University of Texas at Austin conducted extensive analyses of the meteorological model used as CAMx input for the September 1999 episode. Development of the original meteorological model, labeled Met 3c, was described in ENVIRON's report (Emery et al., 2002). As a product of the QA/QC analyses conducted by the ENVIRON/UT team, numerous improvements were made to the meteorological model. Some revised runs, including Met 6f and Met 5d, attenuated, although not necessarily eliminated, certain problems associated with Met 3c, including over-prediction of wind speeds at night and under predictions during the daytime and over prediction of early morning temperatures. Most of the refinements the ENVIRON/UT team incorporated into the meteorological model are documented in the report *Revised Meteorological Modeling of the September 13-20, 1999 Texas Ozone Episode* (Emery, Tai, McGaughey, and Allen, 2003). Development of the meteorological model used as input to the final photochemical model run, labeled Met 5g, is described in appendix B of the SAER SIP revision.

Emissions inputs were also reviewed and refined for the September 1999 baseline simulation. One of the most significant refinements made to the 1999 modeling EI was use of MOBILE6 to estimate on-road emissions for some urban counties in Texas. MOBILE6 was not available when the original September 1999 model was created. Texas Transportation Institute, under contract with the TCEQ, recalculated on-road files for 18 NNA counties, including Bexar County, using the newly-released MOBILE6 model. The original MOBILE6 file, referred to as version 1, was later refined to incorporate an improved methodology to account for heavy-duty diesel vehicle VMT. The refined MOBILE6 on-road file for the 18 NNA counties is labeled version 2. (See Appendix C for a detailed description of TTI's on-road estimation methodology.) In addition to enhanced mobile on-road estimations, the State provided AACOG with refined EIs for specific geographic locations including other NNA areas (Austin, Corpus Christi and Victoria), Houston, and the remainder of the State of Texas.[1]

AACOG was also provided a refined point source file (TCEQ 2003), which contained additional VOC emissions for Houston, to account for the results of a study conducted as part of the TexAQS 2000 project. However, staff decided to omit the revised Houston point source file in the final 1999 baseline simulation for several reasons. First, a sensitivity run (CAMx Run 17c) in which the file was included as model input indicated

[1] The updated Texas EI was developed for the 2000 Houston attainment SIP and includes refined area and non-road emission estimations. Since the Houston EI was developed for a different time period, the emissions were backcast to September 1999 using projection ratios developed from EGAS and NONROAD models.

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the increased VOC emissions for Houston point sources had an insignificant impact on ozone concentrations in San Antonio during the September 1999 episode. Second, as of the timeframe when the final baseline run (CAMx Run 18) was developed and tested, the State had yet to receive approval from the EPA to use the modified point source file in the Houston attainment demonstration SIP. Third, the refined VOC database did not include a 2007 projection. Using the refined data for only the 1999 base case would create inconsistencies in the treatment of the base case and projection case EIs. And fourth, the modified EI was designed for a 2000 episode, not 1999.

Table E-1 provides a description of the meteorological and emissions inputs to the final set of sensitivity and baseline runs conducted for the September episode beginning with the first 1999 base case submitted by ENVIRON, CAMx Run 13, through development of the final baseline run, CAMx Run 18.

MODEL INPUTS

Methodologies used to develop the major inputs to the photochemical model are described in detail in appendix B *Development of the 1999 Meteorological Model*, Appendix C *On-Road Mobile Emissions Inventory Development*, and appendix *D 1999 Base Case Modeling Emissions Inventory Development* of the SAER attainment demonstration SIP. This appendix focuses on development of other inputs to the model simulation and selection of CAMx model options. The following sections on development/determination of land use data, dry deposition algorithms, chemistry data, boundary/initial conditions, and CAMx model options were provided by The University of Texas at Austin and ENVIRON (September 17, 2003) in their draft report *Development of the September 13-20, 1999 Base Case Photochemical Model for Austin's Early Action Compact.* Except where noted, these sections focus on model inputs and options for the final baseline run, CAMx Run 18.

Land Use Data

ENVIRON (Jimenez et al., 2002) developed land use grid data to characterize surface boundary conditions for the September 1999 episode. This information was developed from the same data used to generate spatial emission surrogates. ENVIRON created software to process the raw spatial surrogate data into the eleven land use categories used by CAMx, to grid the data to the 36, 12, and 4km CAMx grids, and to write the results in an appropriate format for input to CAMx.

Dry Deposition Algorithms

Dry deposition algorithms in CAMx are based on the regional-scale deposition model developed by Wesely et al. (1989). These algorithms have been widely used in both field applications and air quality models.

ENVIRON and UT reviewed the Palmer drought severity index, shown in figure E-2 for eastern Texas and found a moderate level of drought stress during the episode. Although the MM5 models accounted for reduced soil moisture, the original dry deposition algorithm in the September 13-20, 1999 CAMx model did not account for vegetation moisture stress. Because of the potential influence of drought stress on the uptake of pollutants through plant stomata and the importance of dry deposition as a

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Table E-1. Meteorological and Emissions Inputs to CAMx Photochemical Model Test Runs.

CAMx Run:	Run 13	Run 13b	Run 13c	Run 13d	Run 13e	Run 14	Run 15	Run 16	Run 17	Run 17b	Run 17c	Run 17d	Run 18
Met 3c	✔	✔	✔	✔	✔								
Met 3c + Increased Mixing layer				✔									
Mer 6f								✔					
Met 5d						✔	✔						
Met 5g									✔	✔	✔	✔	✔
Updated Texas EI										✔	✔	✔	✔
Updated Austin EI										✔	✔	✔	✔
Updated 2007 Regional EI*													✔
Updated Victoria's EI													✔
BC/IC 60		✔			✔		✔		✔	✔		✔	✔
Mobile5	✔	✔	✔	✔	✔	✔	✔	✔					
Mobile6 version 1									✔	✔	✔		
Mobile6 version 1x1.4**												✔	
Mobile6 version 2 (VMT Upgrade)													✔
Modified dry deposition			✔		✔		✔		✔	✔		✔	✔
Additional VOC from Houston's Point Sources											✔		

*The Austin, Corpus Christi, San Antonio, and Victoria portions of the August 2000 Texas EI were removed from the model and replaced with refined area-specific September 1999 emissions for those areas. For the remainder of the State, the August 2000 Texas EI was backcast to September 1999.

**Version 1x1.4 is a sensitivity run conducted prior to receiving the MOBILE6 version 2 EI file. It was employed to test the anticipated impact of increasing HDD VMT (Version 2) by multiplying HDD VMT by 1.4 (increasing HDD VMT by 40%).

physical removal process for ozone and other secondary pollutants, ENVIRON initiated changes to the CAMx deposition algorithms for the September 13-20, 1999 episode.

Wesely supplies minimum bulk stomatal resistances by season and land use type. High resistances (9999) represent no deposition through the stomata. Vegetation moisture stress codes (0=unstressed; 1=stressed, 2=extremely stressed) essentially define The current formulation of Wesely's dry deposition model in CAMx can be manipulated to account for drought stress through the use of vegetation moisture stress codes. Factors by which minimum bulk stomatal resistances are increased/decreased to reflect drought conditions: if istress =1 then the stomatal resistance is increased by a factor of two; if istress = 2, then the stomatal resistance is increased by a factor of 10. ENVIRON increased drought stress codes over land use categories by one to reflect summer drought conditions for those land use categories that did not already have very high minimum bulk stomatal resistances. With the approval of the TCEQ and the U.S. EPA, these modifications were adopted by San Antonio and Austin for the September 13-20, 1999 photochemical model.

Figure E-2. Long-term Palmer Drought Severity Index for September 18, 1999 (NOAA Climate Prediction Center, 2003).

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Chemistry Data
Chemistry data, developed by ENVIRON (Emery *et al.*, 2002) for the September 1999 episode, are summarized in Table E-2.

Table E-2. Summary of Chemistry Data for the September 13-20, 1999 CAMx Model.

Input Data/Specification	Description
Chemistry Parameters	CB4 with current radical termination reactions and isoprene mechanism
Photolysis rates	TUV version 4
Albedo/Haze/Ozone File	• Surface UV albedo from land use grid data • Total ozone column data from satellite data from the Total Ozone Mapping Spectrometer (TOMS) • Haze optical depth field assumed spatially and temporally constant at 0.1.

Boundary and Initial Conditions
A number of sensitivity studies focusing on boundary and initial conditions were conducted following the initial CAMx model performance evaluation of the September 13-20, 1999 episode. The results of the model performance evaluation and CAMx simulations conducted by ENVIRON suggested that the September 1999 episode was promising, but required additional refinement to improve performance. Daily peak and daily mean ozone concentrations were under predicted by 10-20% and 10-30%, respectively, at each ambient monitoring site. Although the unpaired peak accuracy and normalized gross error met EPA criteria on most days, the relative bias failed to meet EPA criteria in all near non-attainment areas on at least one episode day.

EPA default boundary and initial conditions, which were used in the original modeling, are shown in the last column of Table E-3. AACOG initiated sensitivity studies that focused on increasing ozone concentrations from 40 ppb to 60 ppb along all boundaries of the 36-km domain and in the initial conditions supplied to CAMx. Model performance improved significantly and indeed, EPA performance criteria for unpaired peak accuracy, normalized bias, and gross error, were met on most days in Central Texas. The AACOG and the University of Texas, on behalf of CAPCO, then undertook a number of sensitivity studies to further elucidate the influence of boundary and initial conditions on model performance:

- Increase all boundary conditions to 60 ppb
- Increase ozone concentrations along the northern and eastern boundaries from 40 ppb to 60 ppb.
- Increase ozone concentrations along the northern boundary from 40 ppb to 60 ppb.
- Increase ozone concentrations along the eastern boundary from 40 ppb to 60 ppb.
- Increase initial ozone concentrations from 40 ppb to 60 ppb.

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In conjunction with the sensitivity studies, UT also examined whether the increase in ozone concentrations upwind and along the boundaries could be supported by ambient monitoring data during the episode. UT developed time series from relevant U.S. EPA AIRS monitors as well as from the IMPROVE network. In total, data from sixteen states (Oklahoma, Kansas, Nebraska, Missouri, Iowa, Indiana, Illinois, Arkansas, West Virginia, Ohio, Kentucky, Tennessee, North Carolina, Georgia, South Carolina, Alabama) were examined. Although the sensitivity studies led to variable degrees of improvement in model performance, the ambient data did not support increasing ozone concentrations above 40 ppb along most boundaries throughout the episode. The exception was the area of domain that encompassed Tennessee and North Carolina, which experienced ozone concentrations in excess of 60 ppb on most episode days.

The TCEQ suggested that UT examine the effects of boundary and initial conditions used for the September 1993 photochemical model for Houston's State Implementation Plan on model performance. These boundary and initial conditions are currently being used for the August 13-22, 1999 episode for the Dallas/Fort Worth area, for the Longview/Tyler/Marshall area, and for Oklahoma (Yarwood, 2003).

All of the model applications described above suffered from a tendency to underpredict regional ozone levels, which prompted a review of the boundary conditions. In particular, total VOC levels of only 4.4 ppb may be too low in areas of the regional modeling domain that are over land. Boundary condition values shown in Columns 1-3 of Table E-3 were originally developed for the TCEQ's regional modeling of the September 1993 episode (Yocke *et al.*, 1996). These values varied by boundary segment, as shown in Figure E-3 and were based on several data sources. Concentrations along the East/Northeastern Boundary were based on EPA's guidance for UAM modeling (EPA, 1991) with CO reduced from 350 ppb to 200 ppb and higher biogenic VOCs (ISOP, MEOH and ETOH) based on measurements at Kinterbish, AL for the Rural Oxidants in the Southern Environment study (Goldan *et al.*, 1995). Western boundary concentrations were based on EPA's UAM modeling guidance (EPA, 1991) with CO reduced from 350 ppb to 200 ppb and were consistent with data from Niwot Ridge, CO (Watkins *et al.*, 1995). Southern Boundary concentrations were based on the GMAQS (Gulf of Mexico Air Quality Study) sponsored by the Minerals Management Service (MMS, 1995). Initial conditions were identical to those in Column 3.

UT conducted a sensitivity study using the September 1993 Houston/Galveston boundary and initial conditions and found improved model performance for the September 13-20, 1999 episode in Central Texas. The negative bias predicted by the original model was considerably reduced, and this metric, now fell within the range of EPA performance criteria. Model performance statistics will be described in detail below, but improved ozone predictions were observed throughout the regional domain, including in the Houston/Galveston area. Because of the significantly improved model performance and the robust technical basis of these data, Austin and San Antonio, in collaboration with the TCEQ, decided to use these boundary and initial conditions for the photochemical modeling for their Early Action Compacts.

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Table E-3. Boundary and Initial Conditions used by in the Original Model and the Final Model used by San Antonio and Austin for their Early Action Compacts. (Initial conditions were identical to concentrations along the western boundary. The EAC boundary and initial conditions are identical to those used in the September 1993 Houston/Galveston model for the State Implementation Plan.)

Species	NE Boundary below 1700m (ppb) *(EAC)*	West Boundary below 1700 m (ppb) *(EAC)*	SE Boundary and Above 1700m (ppb) *(EAC)*	Default Initial and Boundary Conditions used in original modeling*.
O_3	40	40	40	40
CO	200	200	100	100
NO	0.1	0.1	0.1	0.000049
NO_2	1	1	1	0.08555
HNO_3	3	3	1	1.525
HNO_2	0.001	0.001	0.001	0.000728
ALD2	0.555	0.555	0.05	0.1051
ETH	0.51	0.51	0.15	0.005315
HCHO	2.1	2.1	0.05	1.068
OLE	0.3	0.3	0.05	
PAR	14.9	14.9	7.6	3.078
TOL	0.18	0.18	0.0786	0.006043
XYL	0.0975	0.0975	0.0688	
ISOP	3.6	0.1	0.001	
PAN	0.1	0.1	0.1	0.03834
H_2O_2	3	3	1	2.263
MEOH	8.5	0.001	0.001	
ETOH	1.1	0.001	0.001	

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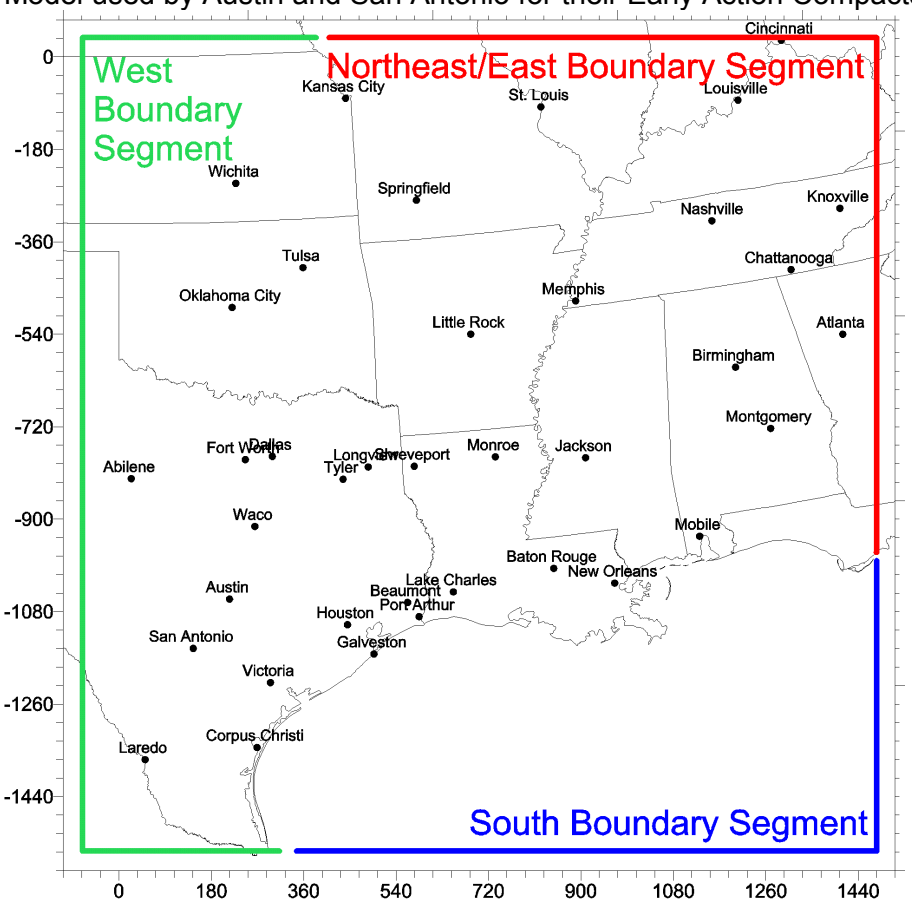
Figure E-3. Map Showing the Delineation of Boundary Segments for the Photochemical Model used by Austin and San Antonio for their Early Action Compacts.*



*below 1700 m

CAMx Model Options

CAMx model options, established by ENVIRON (Emery et al., 2002), are summarized in Table E-4.

Table E-4. Summary of Options for the September 13-20, 1999 CAMx Model.

Input Data/Specification	Description
Advection Scheme	Piece Parabolic Method (PPM)
Plume-in-Grid Model	Selected for major NOx sources ≥10 tons/day in 4 km grid > 25 tons/day in 12- and 36-km grids
Chemical Mechanism	CMC fast solver

SEPTEMBER 13-20, 1999 PHOTOCHEMICAL MODEL PERFORMANCE

Performance analyses were conducted on several versions of the baseline runs as a means of comparing the results of refinements made to the model. EPA recommends various types of performance tests in their 8-hour guidance: graphics, ozone metrics, precursor concentrations, observational models, weekend/weekday comparisons, ratios

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of indicator species, and retrospective analyses. Analyses using observational models, ratios of indicator species, and retrospective studies were not conducted on the 1999 model, due to a lack of necessary data & tools.

For example, the use of observational models is suggested in cases where an extensive monitoring network exists and precursor and indicator species are measured using instruments with appropriate sensitivity (EPA, 1999). During the September 1999 time period, just three regulatory ozone monitors were operational in the entire San Antonio EAC region. Also, there were no (e.g., SO2) species being measured in the region. The sole ozone precursor monitored by San Antonio area CAMS stations was NOx: CAMS 27 located in downtown San Antonio, CAMS 59 located at Calaveras Lake in southeastern Bexar County, and CAMS 62 located northeast of San Antonio in Caldwell County. However, the NOx levels were employed for precursor concentration analyses, provided in section 3.6.3 of the Executive Summary; all other performance evaluations are provided in the sections that follow.

Model performance was evaluated using statistical and graphical metrics in accordance with EPA guidance (1999) for both 1-hour and 8-hour attainment demonstrations. The following sections provide the results of the 1-hour and 8-hour performance tests conducted on the final September 1999 base case, CAMx Run 18.

During the September 1999 episode, peak ozone concentrations in the SAER were measured at CAMS 23 and 58. Therefore, metrics results for these monitors are of particular interest. Because of their importance, all statistics (1-hour and 8-hour) for CAMS 23 and CAMS 58 are included in this appendix. Some test results (1-hour time series plots and 8-hour scatter and Q-Q plots) for other monitors within the 4-km subdomain were omitted from this appendix for the sake of brevity. These tests/results will be provided to the EPA and the TCEQ on compact disc with submission of this SIP revision.

Model Performance: 1-Hour Averaged Ozone Concentrations
EPA recommends conducting a series of 1-hour graphical performance procedures and statistical performance tests as part of the performance evaluation process (EPA 1991). When evaluating statistical test results, monitoring network density should be considered. Since, individually, the San Antonio and Austin area networks are sparse, statistical measurements were conducted on groups as well as individual monitors.

Ozone Metrics
The 1-hour statistics were determined using a program developed by ENVIRON: "camxpost." This program calculates unpaired peak accuracy (UPA), average paired peak accuracy (APPA), peak timing bias (PTB), normalized bias (NB), fractional bias, normalized error (NE), and fractional error (FE). Statistical metrics and associated EPA performance criteria for 1-hour averaged ozone concentrations include

Statistical Performance Measure	Performance Criteria
Unpaired highest prediction accuracy	±20%
Normalized bias	±15%
Gross error of all pairs > 60 ppb	+35%
Average paired peak accuracy	--
Bias in peak timing	--

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The results of the camxpost program are presented for each monitor and for groups of monitors (averages for Austin monitors, San Antonio monitors, and the eight Central Texas monitors) within the 4-km subdomain in tables E-5 through E-17. Yellow-highlighted values in these tables represent statistics that fall outside EPA's performance criteria on primary episode days (September 15 – 20, 1999). While it is not necessary to conduct these tests on model initialization days (September 13-14, 1999), statistics for the initialization period are included for comparison purposes. Model initialization statistics that fall outside performance thresholds are listed in bold type. Columns where data are missing represent days in which predicted measurements were less than 60 ppb.

The 1-hour statistical results are also provided in graphic form for some monitors. Figures E-4 through E-21 present bar graphs of 1-hour statistics for CAMS 23, CAMS 58, and the averaged data for eight Central Texas monitors. Monitor numbers, monitor locations, and descriptions of monitor groups are as follows:

CAMS #	Monitor Name/ Group Name	Location	AIRS #
3	Murchison	Travis County	48-453-0014
4	Corpus Christi West	Nueces County	48-355-0025
21	Corpus Christi Tuloso	Nueces County	48-355-0026
23	San Antonio Northwest	Bexar County	48-029-0032
38	Audubon	Travis County	48-453-0020
58	Camp Bullis	Bexar County	48-029-0052
59	Calaveras Lake	Bexar County	48-029-0059
62	San Marcos	Caldwell County	48-055-0062
87	Victoria	Victoria County	48-469-0003
601	Fayette	Fayette County	48-149-0001
678	CPS Pecan Valley	Bexar County	48-029-0055
3, 38	Austin Monitors	Travis County	
23, 58, 59, 678	San Antonio Monitors	Bexar County	
3, 23, 38, 58, 59, 62, 601, 678	Central Texas Monitors	Bexar, Caldwell, Fayette, Travis	

Performance statistics for the San Antonio area monitors were quite good overall, although the statistical results for CAMS 59 tended to exhibit a negative bias. Unpaired peak accuracy was also somewhat problematic, particularly at CAMS 678. When results of all four San Antonio monitors were averaged (table E-12), all daily 1-hour statistical measurements fell within acceptable bounds with the exception of unpaired peak accuracy on September 19th.

Normalized bias was also a performance issue for the Austin area. Furthermore, when 1-hour results for the two Austin monitoring locations were averaged, the problem only improved slightly. One-hour statistics for the coastal areas, Corpus Christi and Victoria, exhibited a similar negative bias.

Table E-15 provides statistical metrics for 1-hour averaged ozone concentrations in Central Texas, which includes results for the Austin, San Antonio, San Marcos, and Fayette County monitors. As demonstrated, model performance met EPA acceptance criteria for each day of the primary episode.

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Table E-5. 1-hour Statistics for CAMS 3, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	N/A	N/A	21.1%	13.1%	5.2%	5.1%	4.8%	3.2%
APPA	N/A	N/A	1.5%	-5.0%	-9.3%	-3.9%	-1.7%	-28.5%
PTB	N/A	N/A	-1	0	0	1	2	1
NB	N/A	N/A	1.2%	-7.5%	15.0%	-10.9%	-5.2%	-23.7%
FB	N/A	N/A	1.1%	-7.9%	-16.5%	-12.2%	-5.8%	-28.5%
NE	N/A	N/A	4.2%	7.5%	15.0%	11.4%	10.2%	23.7%
FE	N/A	N/A	4.1%	7.9%	16.5%	12.7%	10.6%	28.5%

Table E-6. 1-hour Statistics for CAMS 38, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	N/A	12.4%	13.8%	-16.9%	-5.4%	15.0%	-3.8%	26.8%
APPA	N/A	-9.1%	-7.2%	-20.5%	-12.0%	-25.6%	8.9%	22.0%
PTB	N/A	-1	-1	-2	1	1	1	-10
NB	N/A	-7.1%	-7.1%	-12.8%	-15.8%	-19.4%	-15.8%	-19.4%
FB	N/A	-7.4%	-7.6%	-13.8%	-18.0%	-22.1%	-17.7%	-22.1%
NE	N/A	7.1%	8.1%	12.8%	16.3%	19.4%	15.8%	19.4%
FE	N/A	7.4%	8.5%	13.8%	18.4%	22.1%	17.7%	22.1%

Table E-7. 1-hour Statistics for Austin Monitors (CAMS 3 & 38), September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	N/A	12.4%	13.8%	-16.9%	-5.4%	-15.0%	-3.8%	3.2%
APPA	N/A	-9.1%	-2.8%	-12.7%	-10.6%	-14.7%	-5.3%	-25.2%
PTB	N/A	-1	-1	-1	1	1	2	-6
NB	N/A	-7.1%	-4.2%	-10.5%	-15.5%	-15.7%	-11.0%	-21.3%
FB	N/A	-7.4%	-4.5%	-11.3%	-17.4%	-17.8%	-12.4%	-24.8%
NE	N/A	7.1%	6.7%	10.5%	15.8%	15.9%	13.3%	21.3%
FE	N/A	7.4%	7.0%	11.3%	17.7%	18.0%	14.6%	24.8%

Table E-8. 1-hour Statistics for CAMS 23, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	1.3%	7.9%	9.0%	2.6%	15.0%	8.7%	26.3%	6.7%
APPA	-16.7%	-12.5%	-9.9%	-16.7%	-5.3%	3.9%	-3.2%	-0.3%
PTB	-1	0	-1	-3	2	1	-2	-3
NB	**-20.7%**	-14.3%	-12.6%	-21.2%	-11.0%	-3.2%	-5.7%	6.8%
FB	-23.6%	-15.5%	-13.7%	-24.5%	-11.8%	-3.7%	-6.0%	4.6%
NE	20.7%	14.3%	12.6%	21.2%	11.0%	6.7%	6.7%	19.8%
FE	23.6%	15.5%	13.7%	24.5%	11.8%	7.1%	7.0%	19.2%

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Table E-9. 1-hour Statistics for CAMS 58, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	5.7%	**20.8%**	14.0%	15.0%	15.0%	2.6%	23.6%	13.1%
APPA	-12.9%	-4.2%	-16.1%	-2.7%	0.6%	-12.3%	20.1%	-9.6%
PTB	-3	-3	-4	-2	1	0	0	-4
NB	**-24.5%**	-6.2%	-9.9%	-7.9%	0.9%	-10.4%	4.8%	2.1%
FB	-28.0%	-6.7%	-10.5%	-8.7%	0.8%	-11.0%	4.2%	0.8%
NE	24.5%	6.8%	9.9%	10.2%	4.7%	10.4%	9.0%	14.4%
FE	28.0%	7.3%	10.5%	11.0%	4.7%	11.0%	8.6%	14.5%

Table E-10. 1-hour Statistics for CAMS 59, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	-8.8%	14.2%	9.9%	1.4%	5.4%	32.0%	23.6%	16.6%
APPA	-20.7%	-20.5%	-27.3%	-13.8%	-17.8%	-21.1%	-17.6%	2.6%
PTB	1	-3	2	5	7	2	1	-2
NB	**-23.3%**	**-19.3%**	-16.8%	-10.2%	-10.6%	-18.5%	-14.4%	-16.6%
FB	-26.5%	-21.4%	-18.8%	-11.3%	-11.6%	-20.6%	-15.7%	-20.1%
NE	23.3%	19.3%	16.8%	12.5%	11.3%	18.5%	15.4%	18.0%
FE	26.5%	21.4%	18.8%	13.6%	12.3%	20.6%	16.8%	21.4%

Table E-11. 1-hour Statistics for CAMS 678, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	-1.0%	**25.3%**	27.0%	14.1%	33.5%	32.0%	30.4%	5.7%
APPA	-7.9%	-10.2%	-11.3%	-13.0%	-1.0%	-7.9%	-4.6%	-10.1%
PTB	1	-1	1	-2	1	3	-1	-1
NB	-8.2%	-12.2%	-9.6%	-7.0%	1.6%	-6.2%	-5.7%	-4.5%
FB	-8.7%	-13.0%	-10.2%	-7.6%	1.6%	-6.7%	-5.9%	-4.8%
NE	8.2%	12.2%	9.6%	8.2%	2.7%	6.5%	5.7%	6.1%
FE	8.7%	13.0%	10.2%	8.7%	2.6%	7.0%	5.9%	6.4%

Table E-12. 1-hour Statistics for San Antonio Monitors (CAMS 23, 58, 59 & 678), September 13 – 20, 1999.San Antonio Monitors

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	-8.8%	7.9%	9.0%	2.6%	5.4%	2.6%	23.6%	5.7%
APPA	-14.6%	-11.9%	-16.1%	-11.5%	-5.9%	-9.4%	-1.3%	-4.3%
PTB	-1	-2	-1	-1	3	2	-1	-3
NB	**-19.8%**	-12.9%	-12.9%	-11.5%	-5.6%	-10.2%	-5.7%	-4.0%
FB	-22.4%	-14.1%	-14.1%	-12.9%	-6.1%	-11.1%	-6.4%	-6.0%
NE	19.8%	13.1%	12.9%	13.0%	8.0%	11.0%	9.6%	14.9%
FE	22.4%	14.3%	14.1%	14.4%	8.5%	11.9%	10.0%	15.9%

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Table E-13. 1-hour Statistics for CAMS 62, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	N/A	N/A	21.1%	15.4%	7.7%	19.2%	22.9%	30.1%
APPA	N/A	N/A	-9.2%	5.3%	-14.6%	-11.6%	-3.5%	1.2%
PTB	N/A	N/A	0	1	5	-11	-1	0
NB	N/A	N/A	-4.5%	4.9%	-10.0%	-11.6%	-6.5%	2.6%
FB	N/A	N/A	-4.7%	4.5%	-11.4%	-12.5%	-6.9%	2.6%
NE	N/A	N/A	6.3%	6.5%	14.2%	11.6%	7.6%	3.3%
FE	N/A	N/A	6.5%	6.3%	15.3%	12.5%	8.0%	3.2%

Table E-14. 1-hour Statistics for CAMS 601, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	-4.5%	N/A	9.3%	29.5%	-6.1%	3.6%	13.8%	24.4%
APPA	-18.7%	N/A	-5.5%	2.0%	-14.4%	-10.5%	-5.7%	4.0%
PTB	-1	N/A	-1	-3	2	-1	-2	3
NB	**-18.5%**	N/A	-3.8%	-0.9%	-17.6%	-11.8%	-12.5%	-5.8%
FB	-20.3%	N/A	-4.1%	-1.2%	-19.7%	-12.9%	-14.5%	-6.8%
NE	18.5%	N/A	5.2%	6.7%	17.6%	11.9%	16.4%	10.5%
FE	20.3%	N/A	5.4%	6.7%	19.7%	13.0%	18.1%	11.3%

Table E-15. 1-hour Statistics for Central Texas Monitors (CAMS 3, 23, 38, 58, 59, 62, 601, 678), September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	-8.8%	7.9%	-9.0%	-16.9%	-5.4%	-15.0%	-3.8%	5.7%
APPA	-15.4%	-11.3%	-10.6%	-8.0%	-9.2%	-11.1%	-3.1%	-7.8%
PTB	-1	-2	-1	-1	2	-1	0	-2
NB	**-19.5%**	-11.7%	-8.5%	-8.2%	-11.0%	-12.1%	-8.5%	-9.1%
FB	-22.0%	-12.7%	-9.2%	-9.2%	-12.3%	-13.4%	-9.6%	-11.2%
NE	19.5%	11.9%	9.5%	11.0%	12.7%	12.5%	11.7%	14.9%
FE	22.0%	12.9%	10.2%	11.8%	13.9%	13.8%	12.5%	16.6%

Table E-16. 1-hour Statistics for Corpus Christi (CAMS 4 & 21), September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	13.0%	-11.9%	-0.9%	2.7%	-1.5%	6.9%	9.6%	-0.7%
APPA	-31.8%	-24.7%	24.9%	-18.6%	-15.2%	-3.1%	4.9%	-15.0%
PTB	-1	-2	0	-6	-4	-2	3	2
NB	**-29.4%**	**-23.6%**	-21.5%	-23.0%	-21.7%	-14.3%	-8.3%	-25.4%
FB	-35.5%	-27.2%	-24.2%	-26.1%	-24.7%	-16.7%	-10.5%	-31.4%
NE	29.4%	23.6%	21.5%	23.0%	21.7%	15.6%	16.2%	25.4%
FE	35.5%	27.2%	24.2%	26.1%	24.7%	18.0%	17.9%	31.4%

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Table E-17. 1-hour Statistics for CAMS 87, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	-13.8%	1.9%	8.4%	6.2%	3.0%	0.7%	-0.5%	-16.8%
APPA	-44.8%	18.5%	-17.3%	-3.5%	-6.6%	15.1%	-3.9%	-20.4%
PTB	0	-6	-1	-2	-1	1	-3	1
NB	**-31.5%**	-13.3%	-7.6%	-3.7%	-9.7%	-21.5%	-18.7%	-20.0%
FB	-37.8%	-14.4%	-8.2%	-4.0%	-10.8%	-24.6%	-24.4%	-23.3%
NE	31.5%	13.3%	11.2%	5.3%	10.4%	21.5%	20.0%	20.0%
FE	**37.8%**	14.4%	11.9%	5.5%	11.5%	24.6%	25.6%	23.3%

Figure E-4. 1-hour Unpaired Peak Accuracy, CAMS 23, September 13 – 20, 1999.

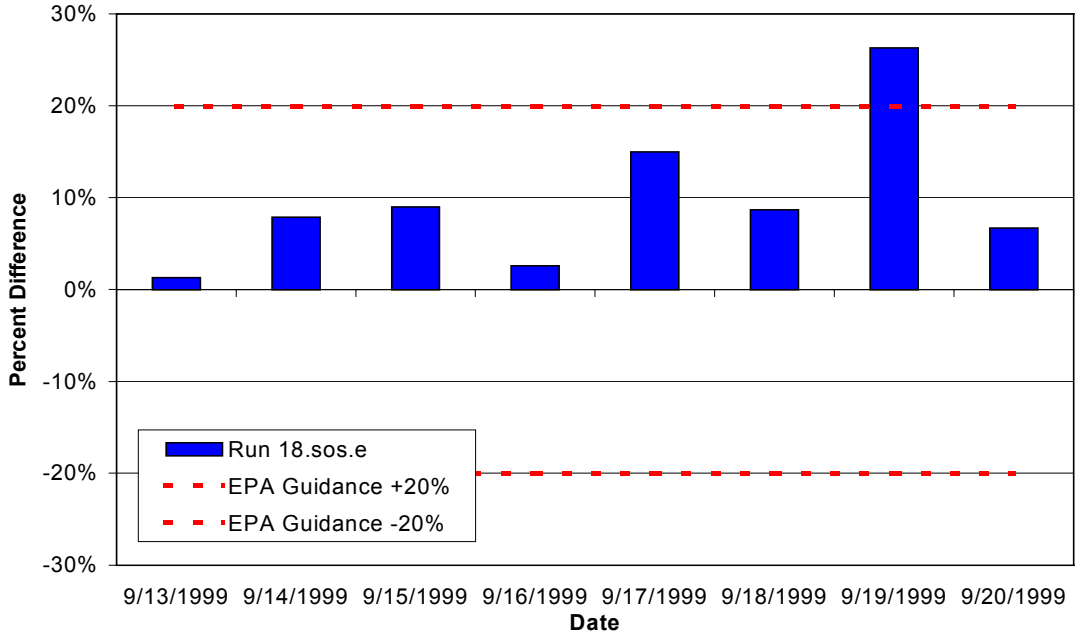

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Figure E-5. 1-hour Unpaired Peak Accuracy, CAMS 58, September 13 – 20, 1999.

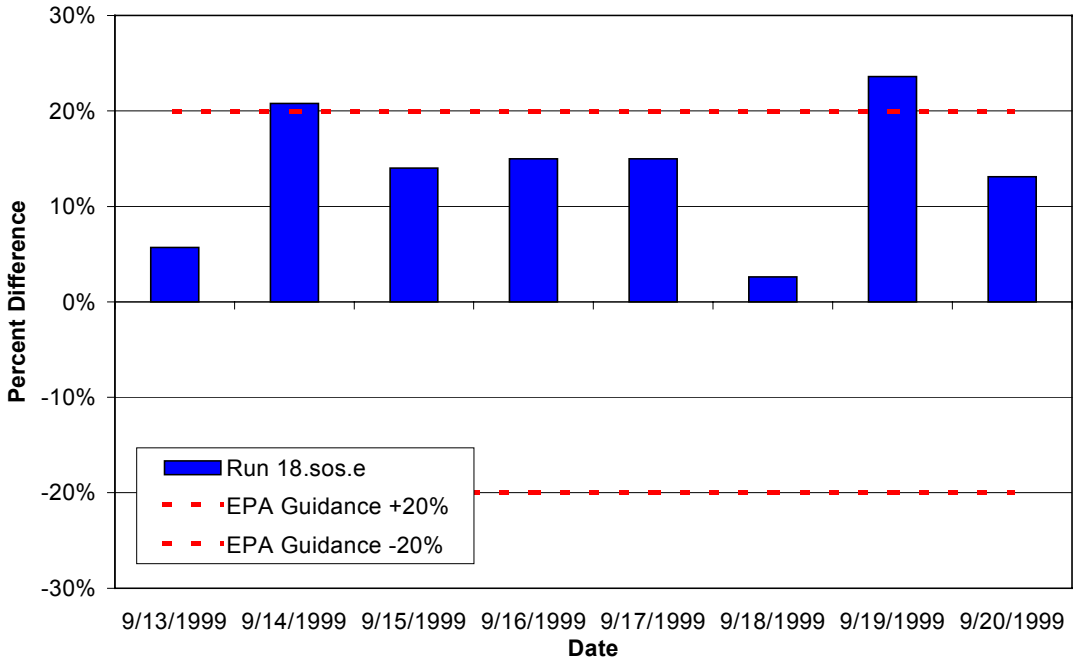

Figure E-6. 1-hour Unpaired Peak Accuracy, Central Texas Monitors (CAMS 3, 23, 38, 58, 59, 62, 601, 678), September 13 – 20, 1999.

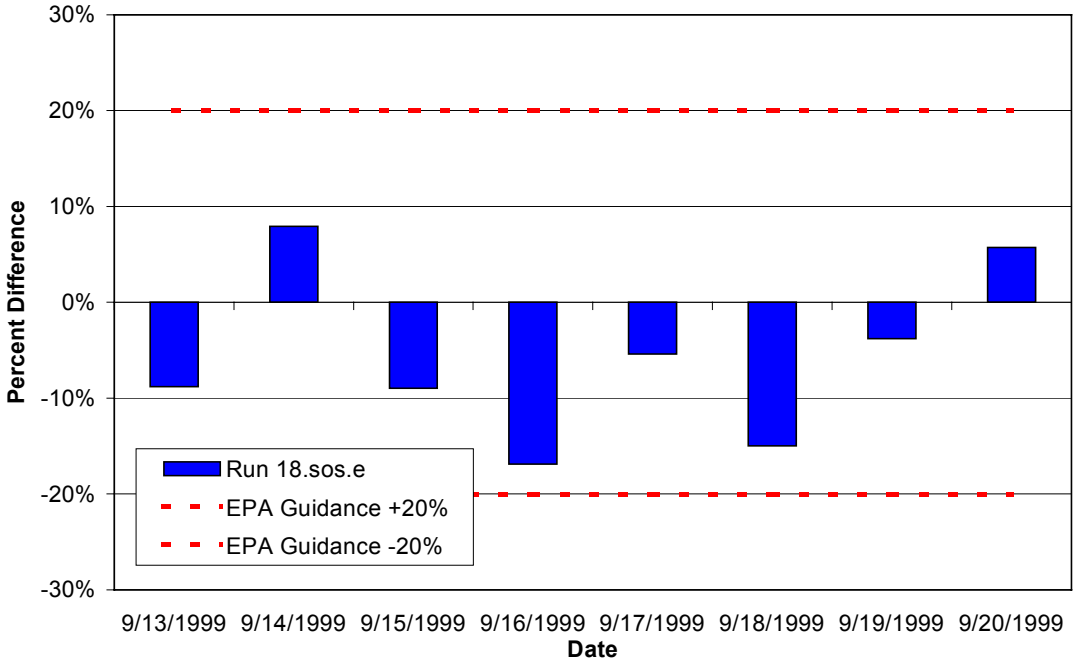

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Figure E-7. 1-hour Average Paired Peak Accuracy at CAMS 23, September 13-20, 1999.

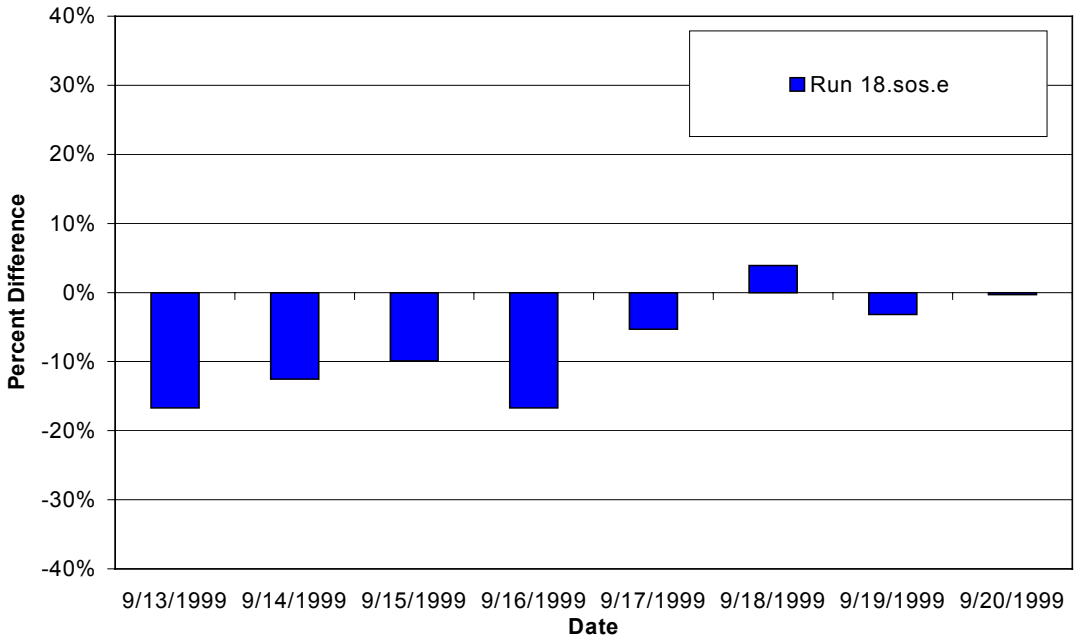

Figure E-8. 1-hour Average Paired Peak Accuracy at CAMS 58, September 13-20, 1999.

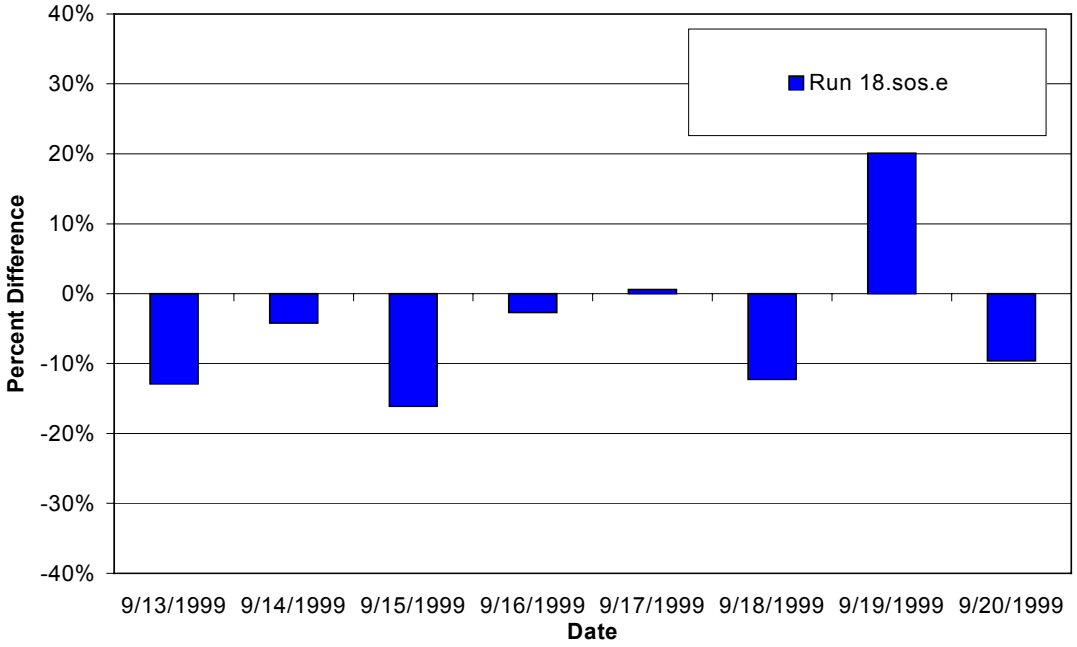

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Figure E-9. 1-hour Average Paired Peak Accuracy at Central Texas Monitors (CAMS 3, 23, 38, 58, 59, 62, 601, 678), September 13-20, 1999.

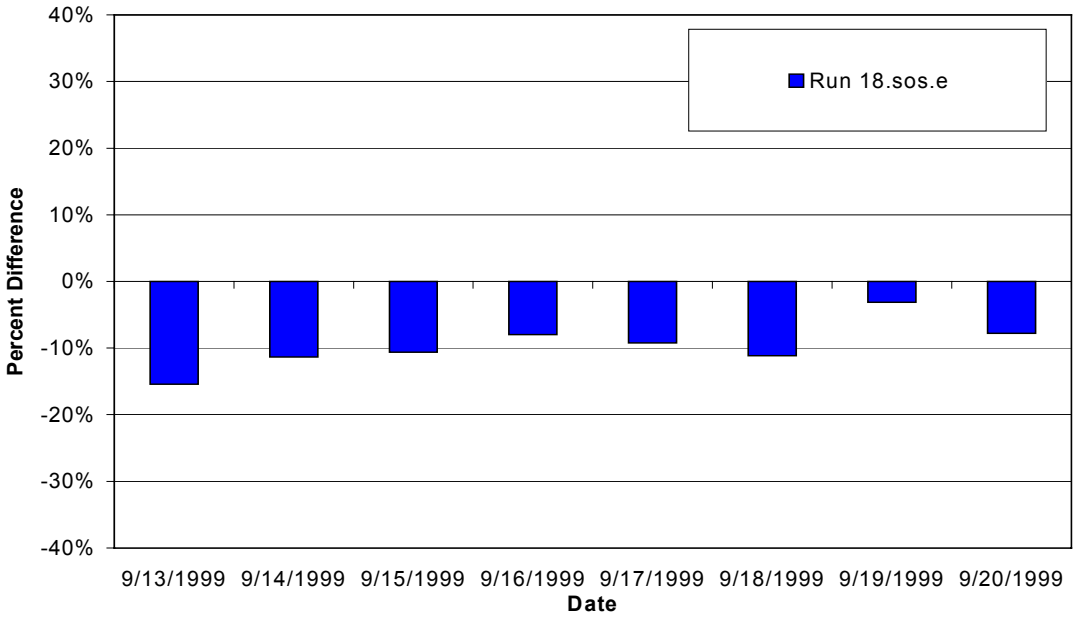

Figure E-10. 1-hour Normalized Bias at CAMS 23, September 13 – 20, 1999.

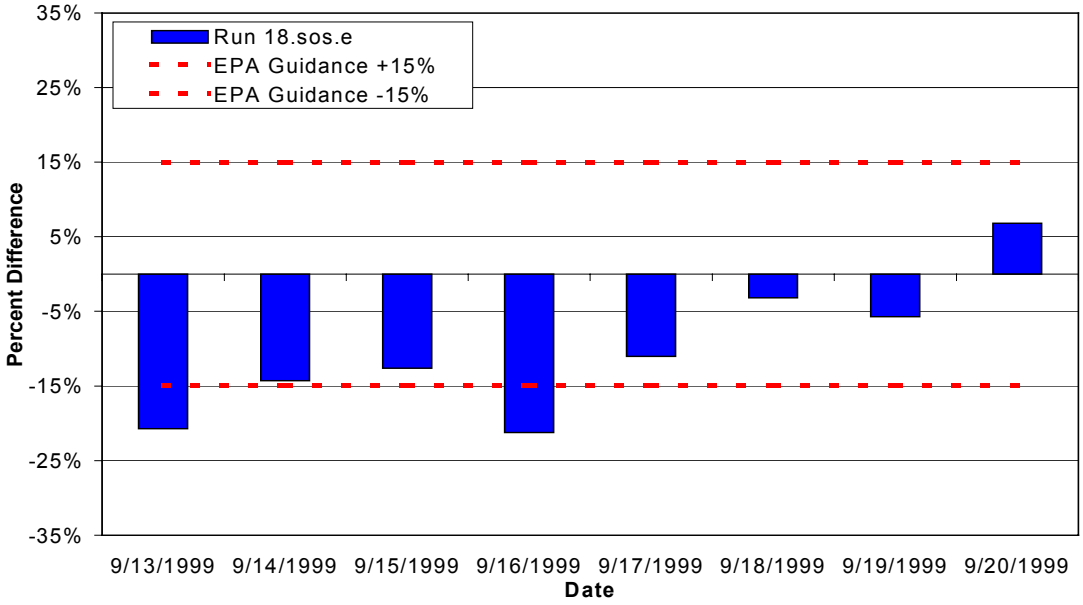

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Figure E-11. 1-hour Normalized Bias at CAMS 58, September 13 – 20, 1999.

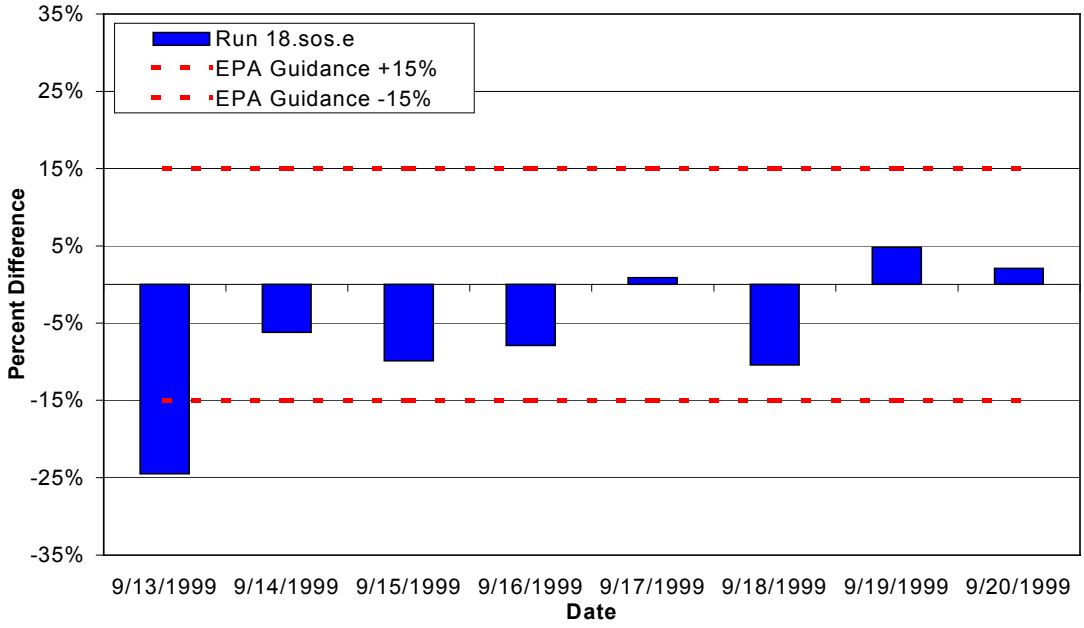

Figure E-12. 1-hour Normalized Bias at Central Texas Monitors (CAMS 3, 23, 38, 58, 59, 62, 601, 678), September 13 – 20, 1999.

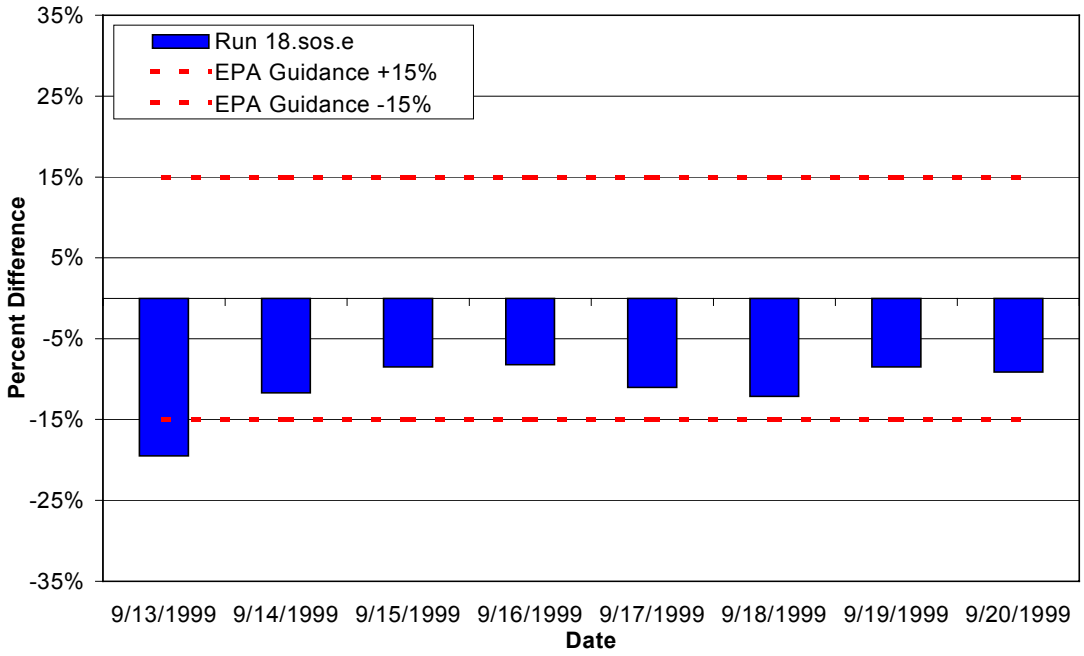

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Figure E-13. 1-hour Normalized Error at CAMS 23, September 13 – 20, 1999.

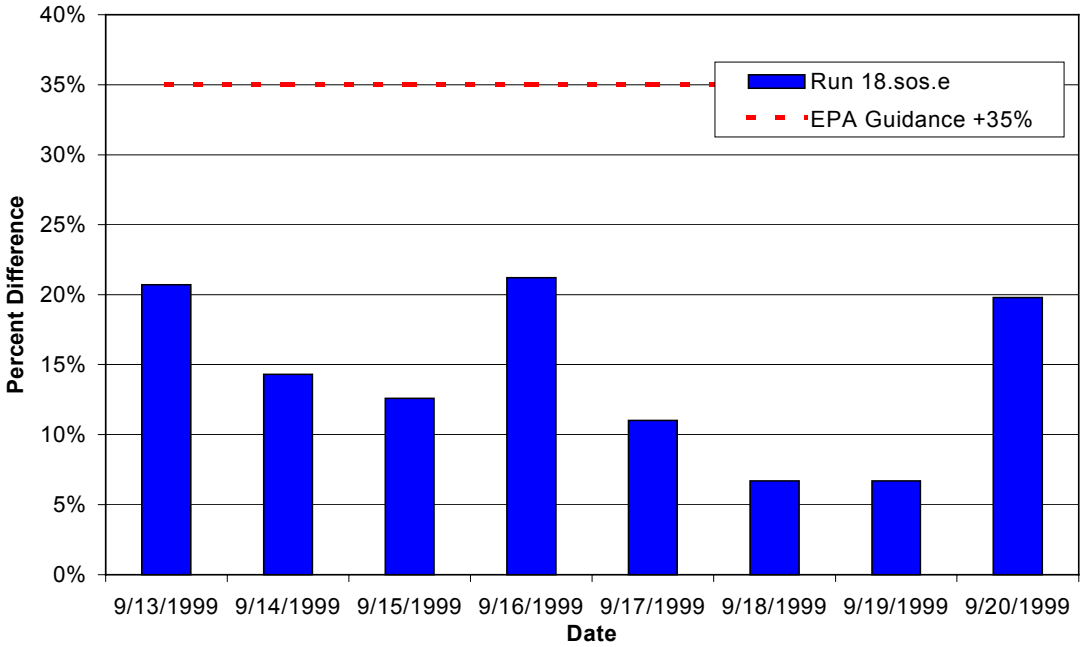

Figure E-14. 1-hour Normalized Error at CAMS 58, September 13 – 20, 1999.

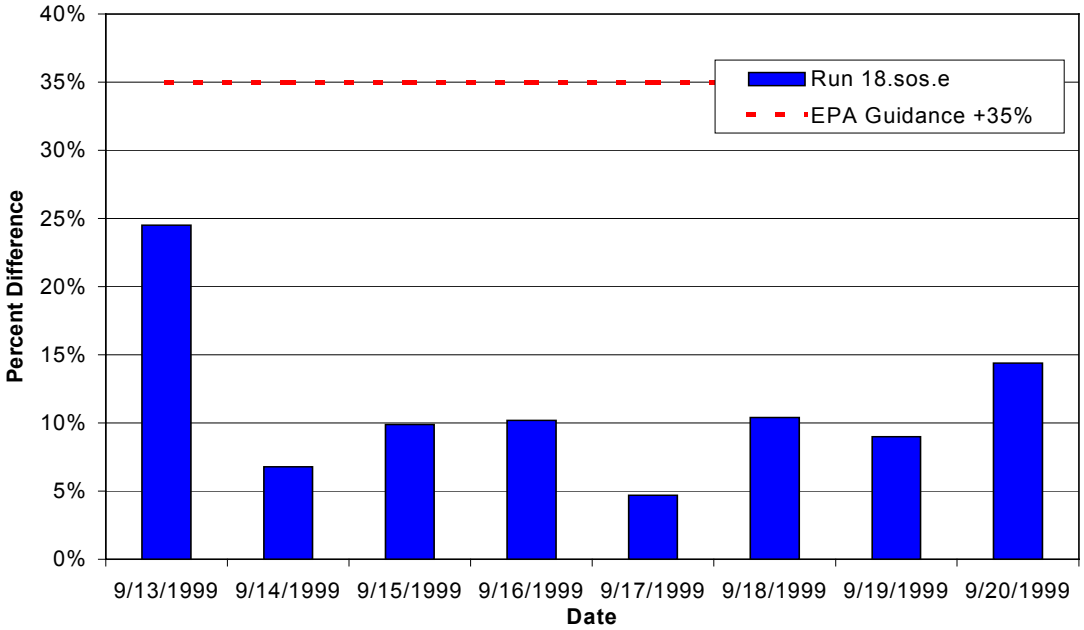

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Figure E-15. 1-hour Normalized Error at Central Texas Monitors (CAMS 3, 23, 38, 58, 59, 62, 601, 678), September 13 – 20, 1999.

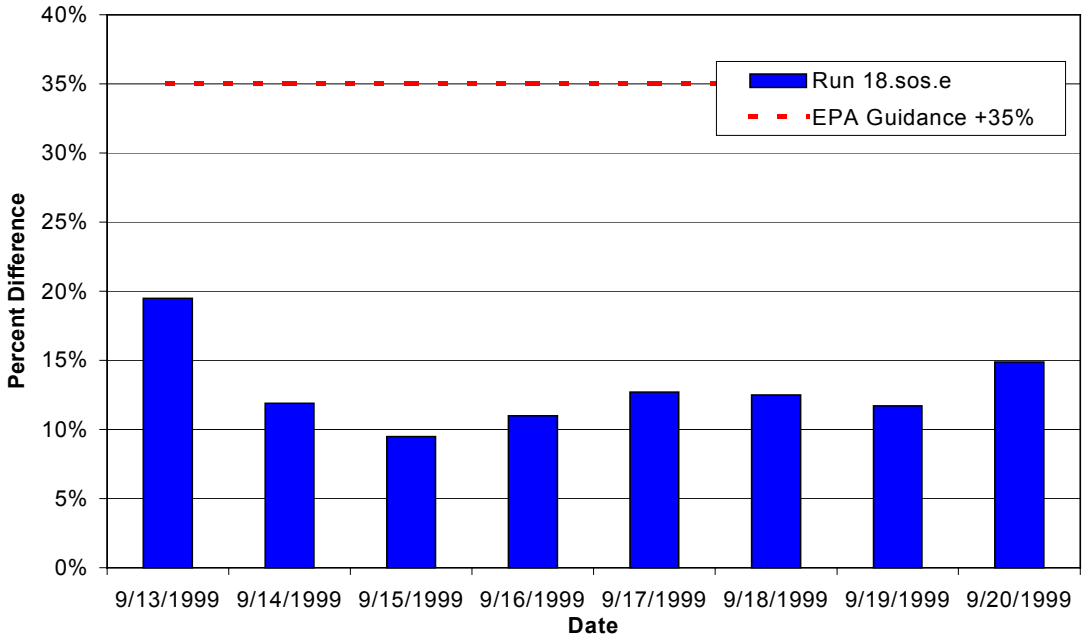

Figure E-16. 1-hour Timing Bias at CAMS 23, September 13 – 20, 1999.

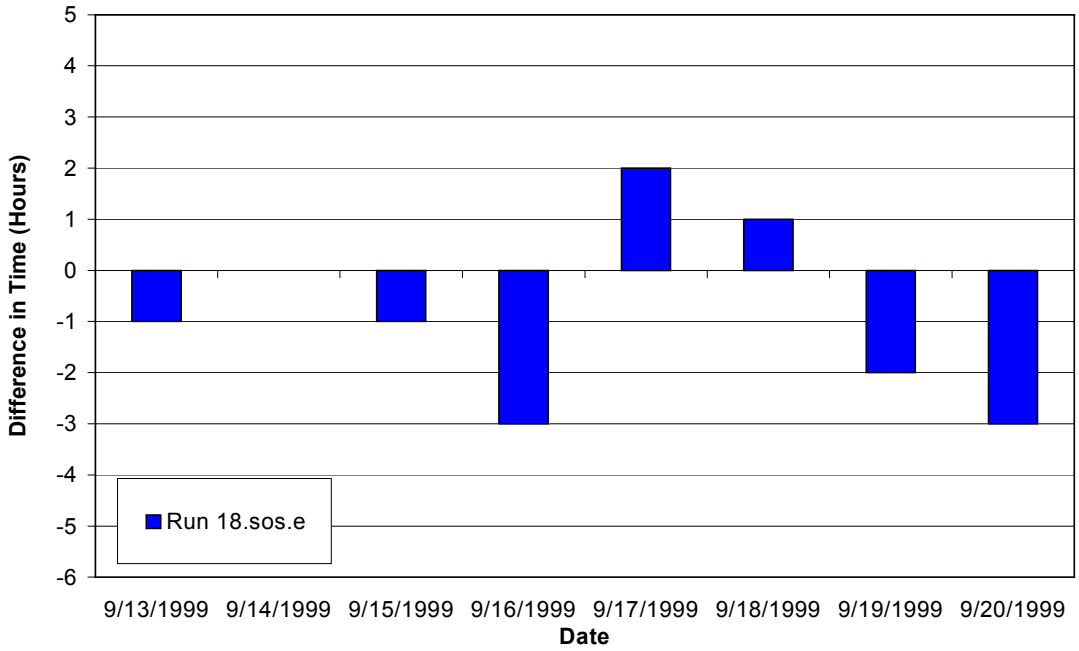

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Figure E-17. 1-hour Timing Bias at CAMS 58, September 13 – 20, 1999.

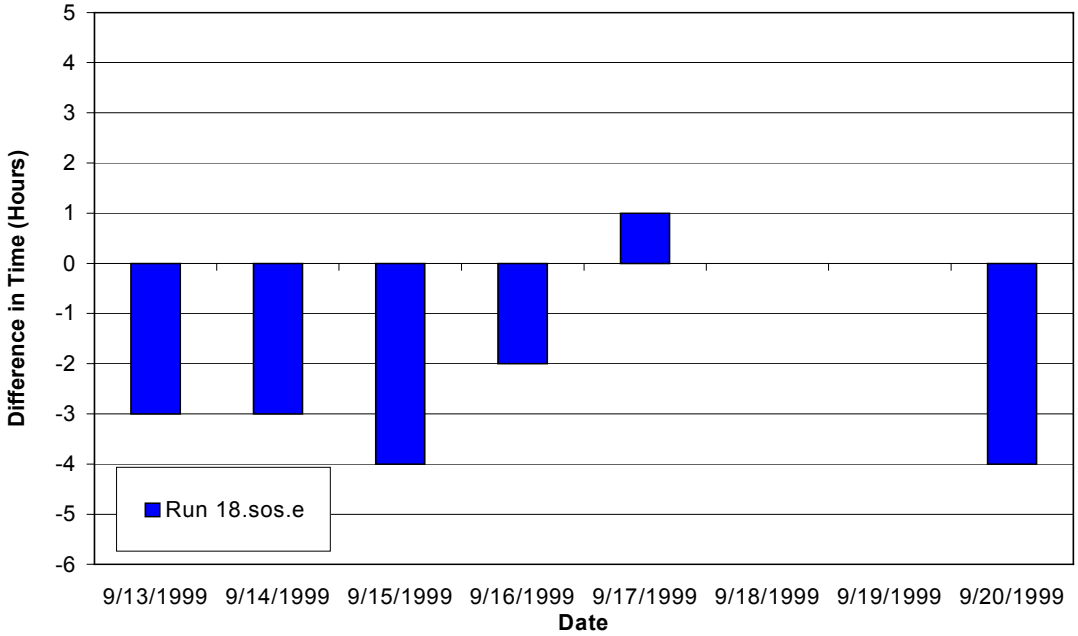

Figure E-18. 1-hour Timing Bias at Central Texas Monitors 23 (CAMS 3, 23, 38, 58, 59, 62, 601, 678), September 13 – 20, 1999.

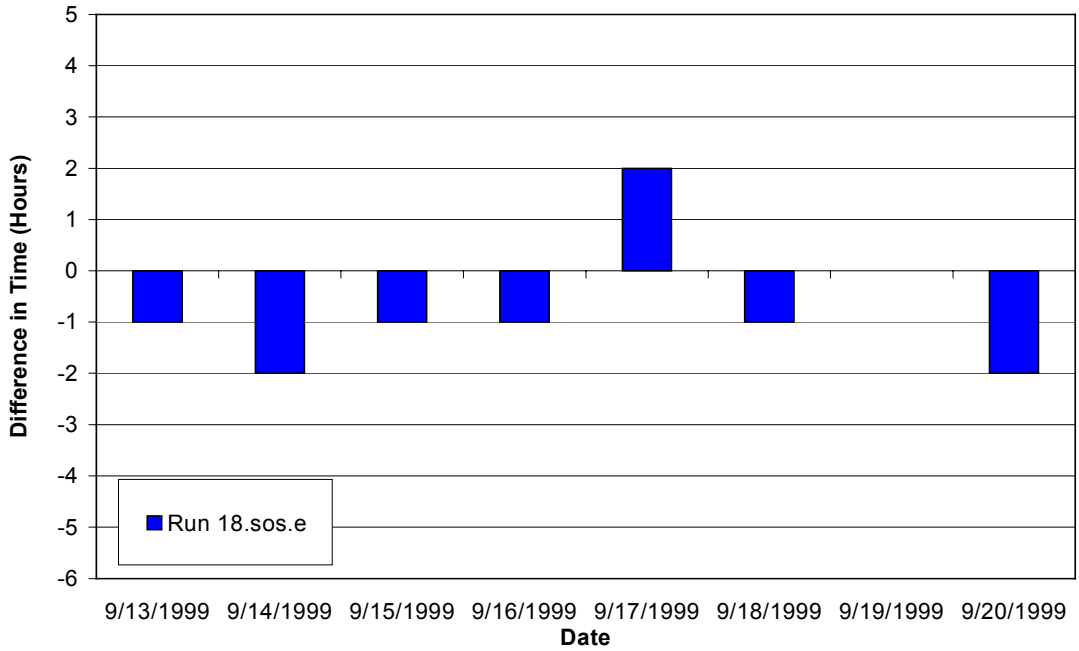

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Figure E-19. 1-hour Fractional Bias at CAMS 23, September 13 – 20, 1999.

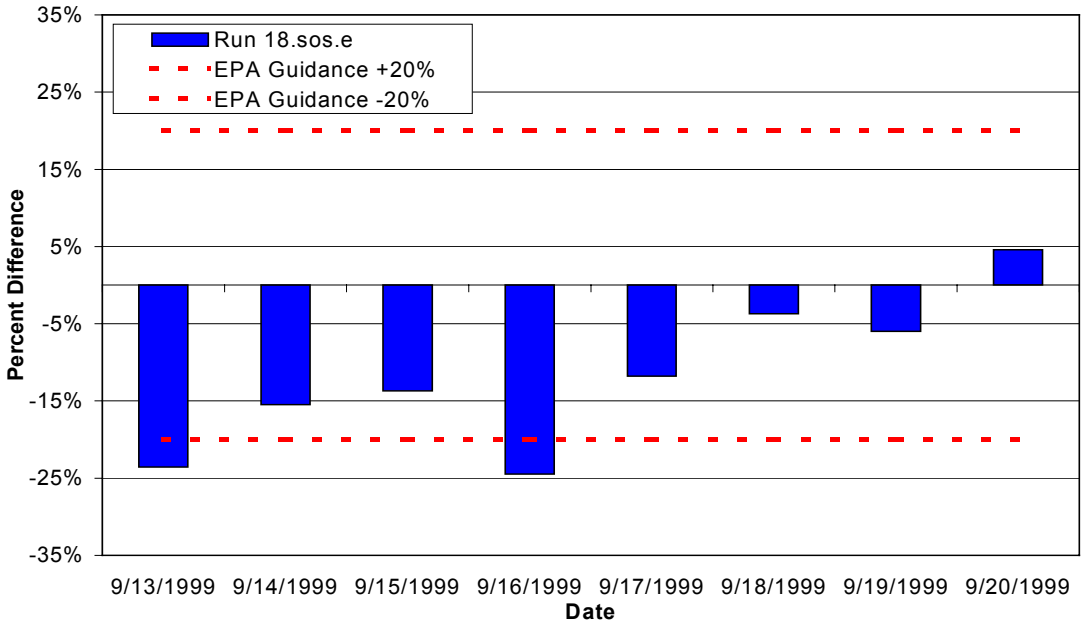

Figure E-20. 1-hour Fractional Bias at CAMS 58, September 13 – 20, 1999.

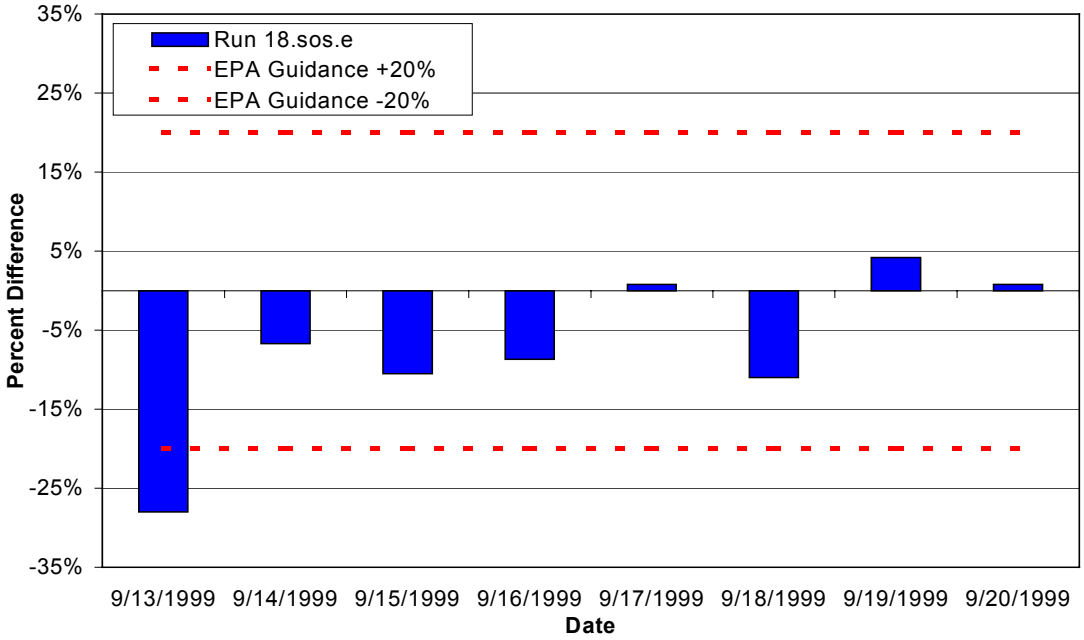

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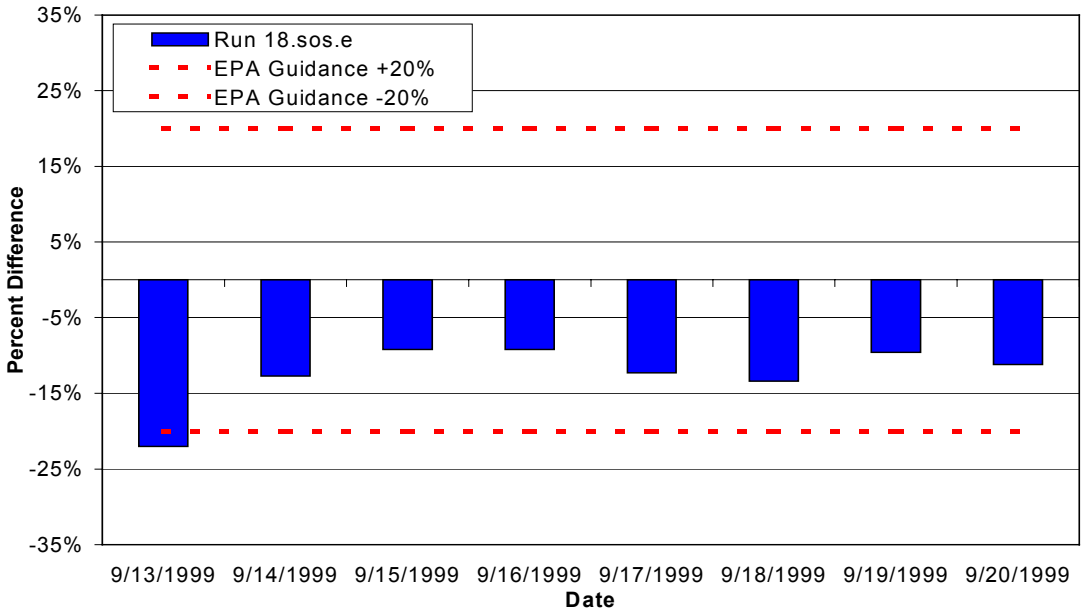
Figure E-21. 1-hour Fractional Bias at Central Texas Monitors 23 (CAMS 3, 23, 38, 58, 59, 62, 601, 678), September 13 – 20, 1999.



Time Series Plots

In addition to conducting 1-hour statistical measurements, staff produced time series plots of observed versus predicted 1-hour ozone concentrations. These plots provide an indication of the model's ability to replicate peak predictions, the presence of bias within the diurnal cycles, as well as biases in timing of the predicted daily maxima. Time series plots for the four San Antonio area monitors are provided in figures E-22 through E-25. These graphs indicate that diurnal trends were replicated quite well, although peak concentrations were slightly under-predicted at CAMS 23, 58, and 678 during several episode days. Peak concentrations at CAMS 59 were consistently under predicted, except for the final day of the episode, September 20th.

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Figure E-22. Observed versus Predicted 1-hour Average Ozone Concentrations at CAMS 23, September 13 – 20, 1999.

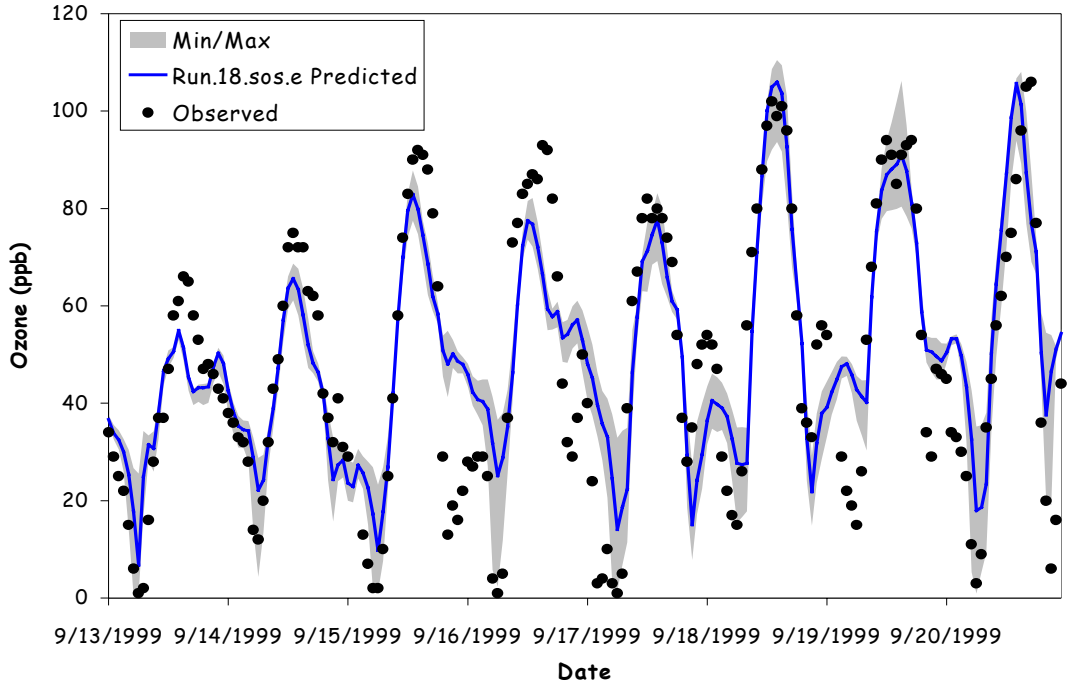

Figure E-23. Observed versus Predicted 1-hour Average Ozone Concentrations at CAMS 58, September 13 – 20, 1999.

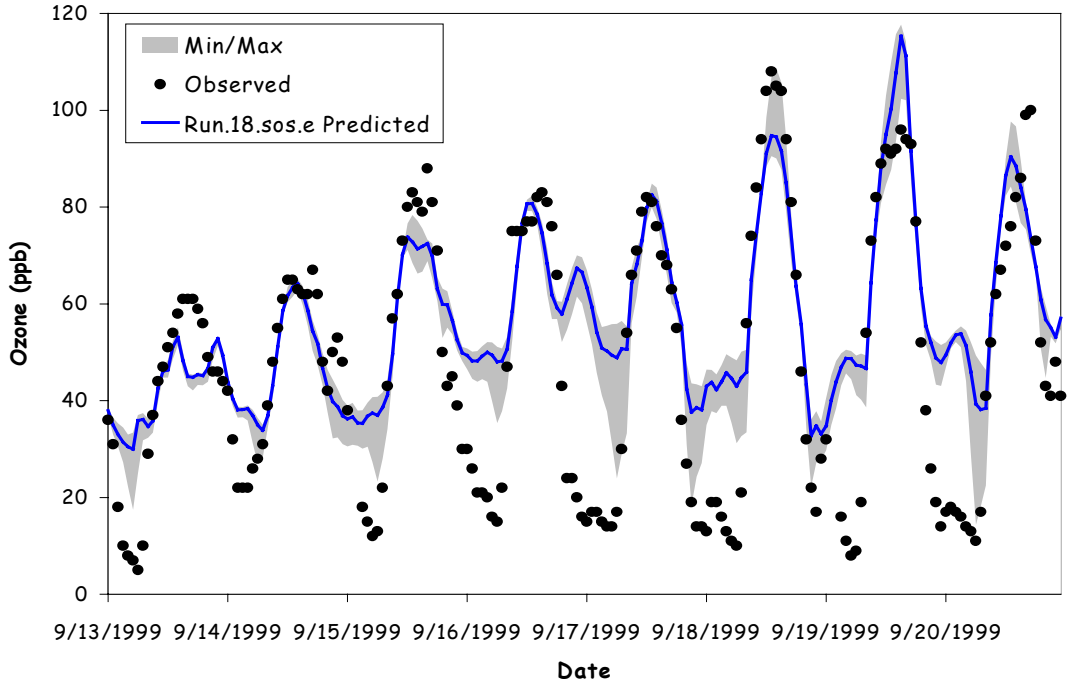

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Figure E-24. Observed versus Predicted 1-hour Average Ozone Concentrations at CAMS 59, September 13 – 20, 1999.

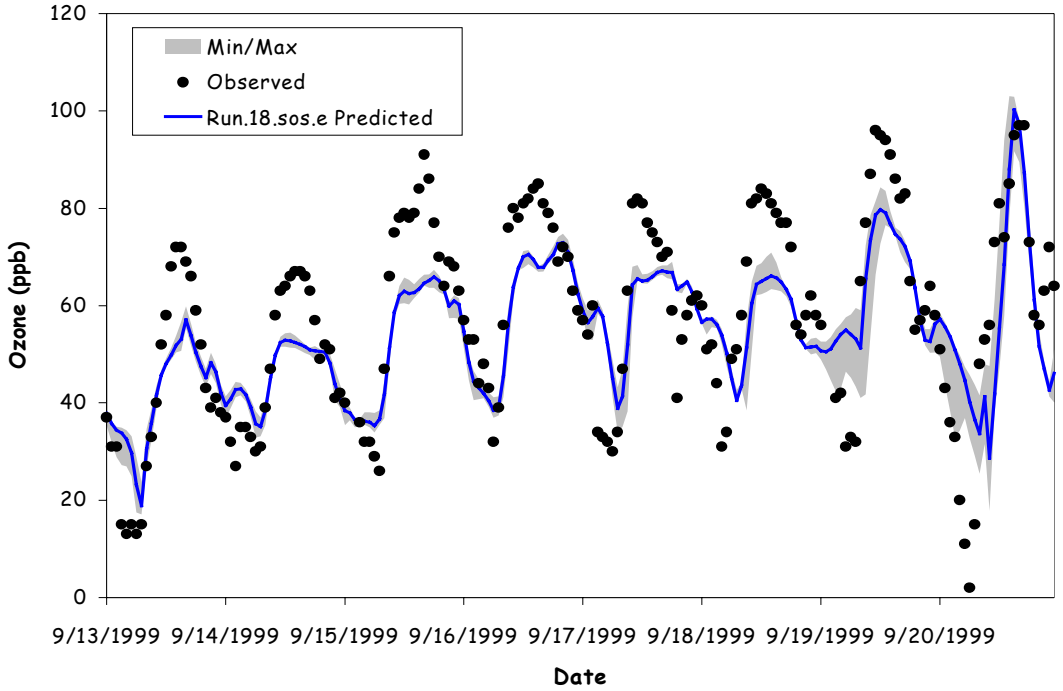
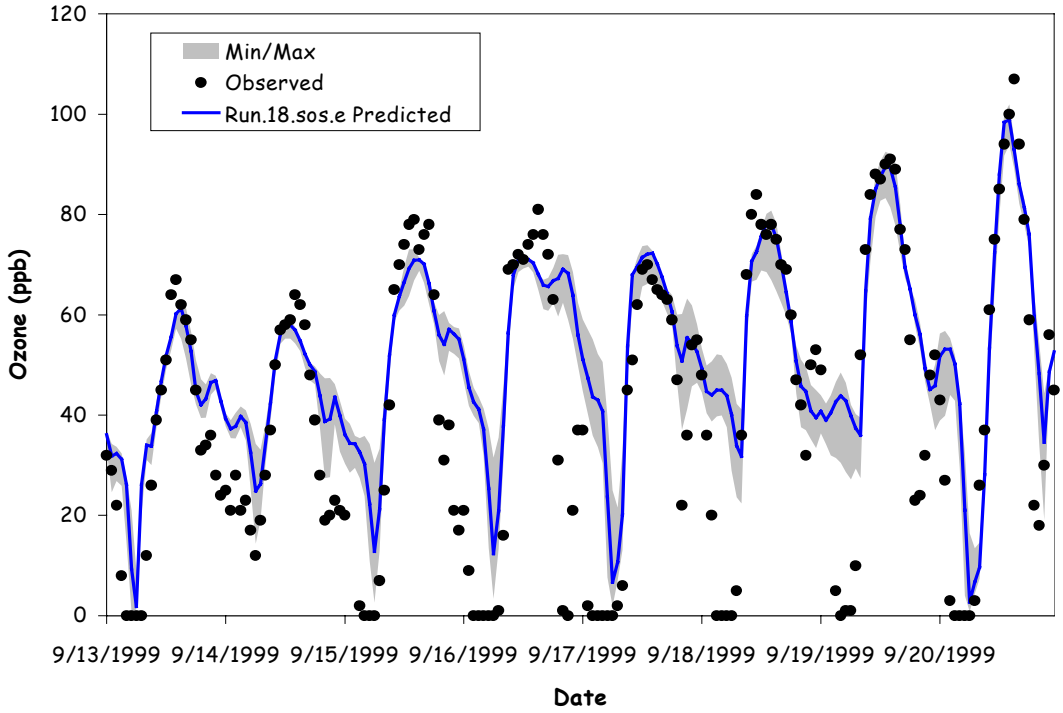


Figure E-25. Observed versus Predicted 1-hour Average Ozone Concentrations at CAMS 678, September 13 – 20, 1999.



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Scatter Plots

Scatter plots of 1-hour observed (x) and predicted (y) data for the four SAER monitors are provided in figures E-26 through E-29. The observed/predicted data points for each monitor follows the 1:1 reference line fairly well and each plot exhibits moderate, positive correlation coefficients. Some outlier data pairs are evident in each chart, however.

Figure E-26. Scatter Plot of 1-hour Observed/Predicted Data Pairs at CAMS 23.

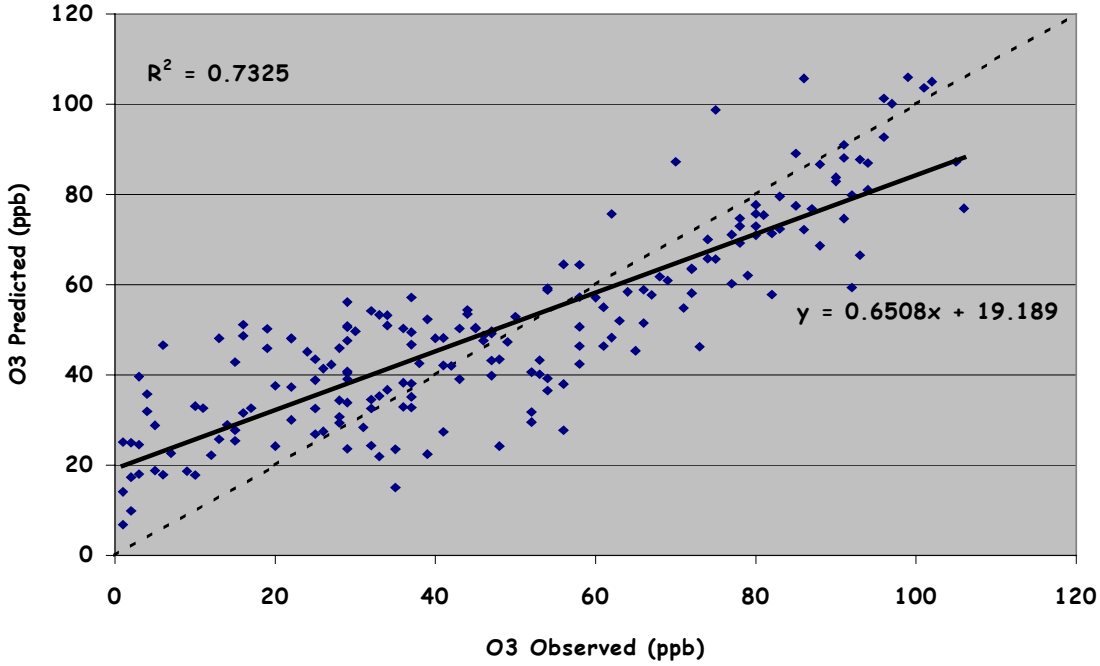

Figure E-27. Scatter Plot of 1-hour Observed/Predicted Data Pairs at CAMS 58.

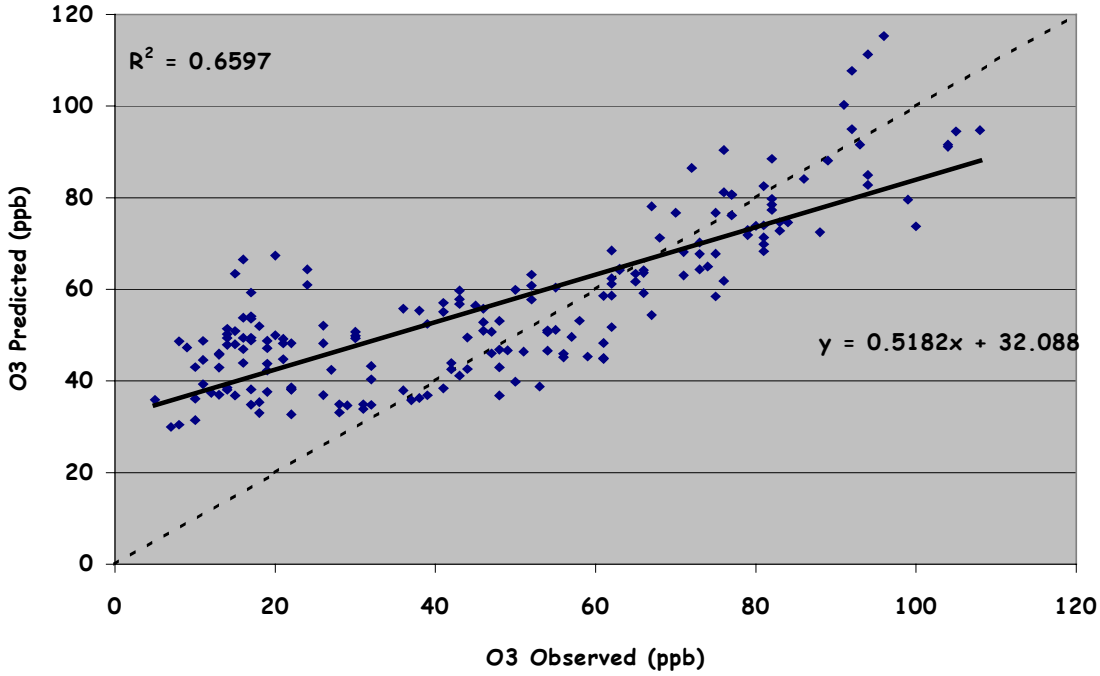

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Figure E-28. Scatter Plot of 1-hour Observed/Predicted Data Pairs at CAMS 59.

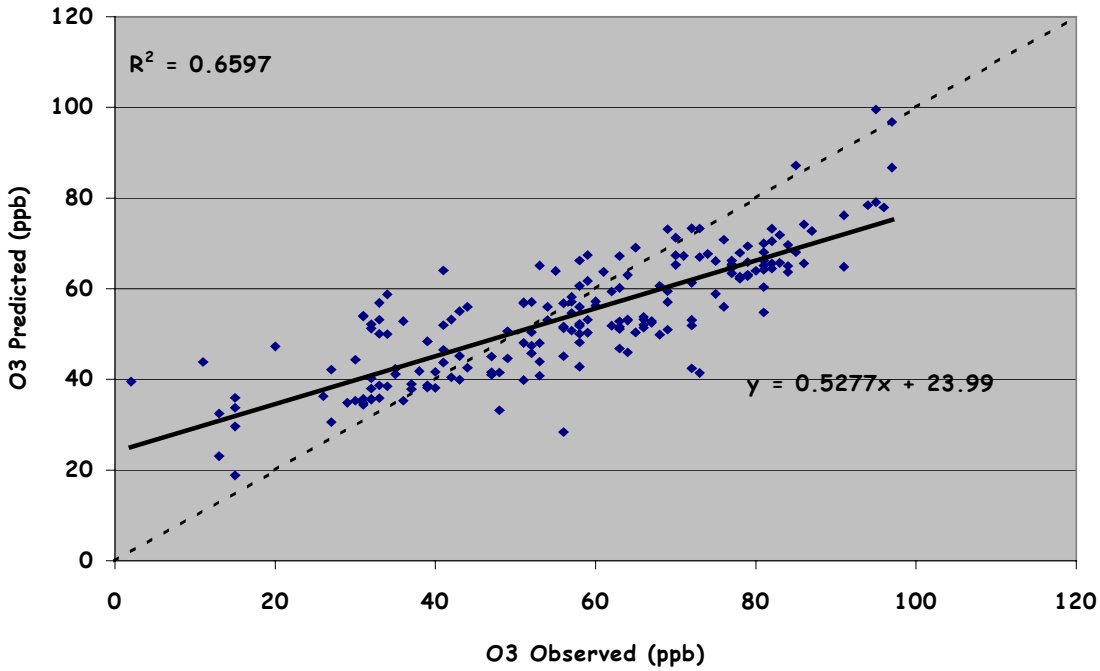
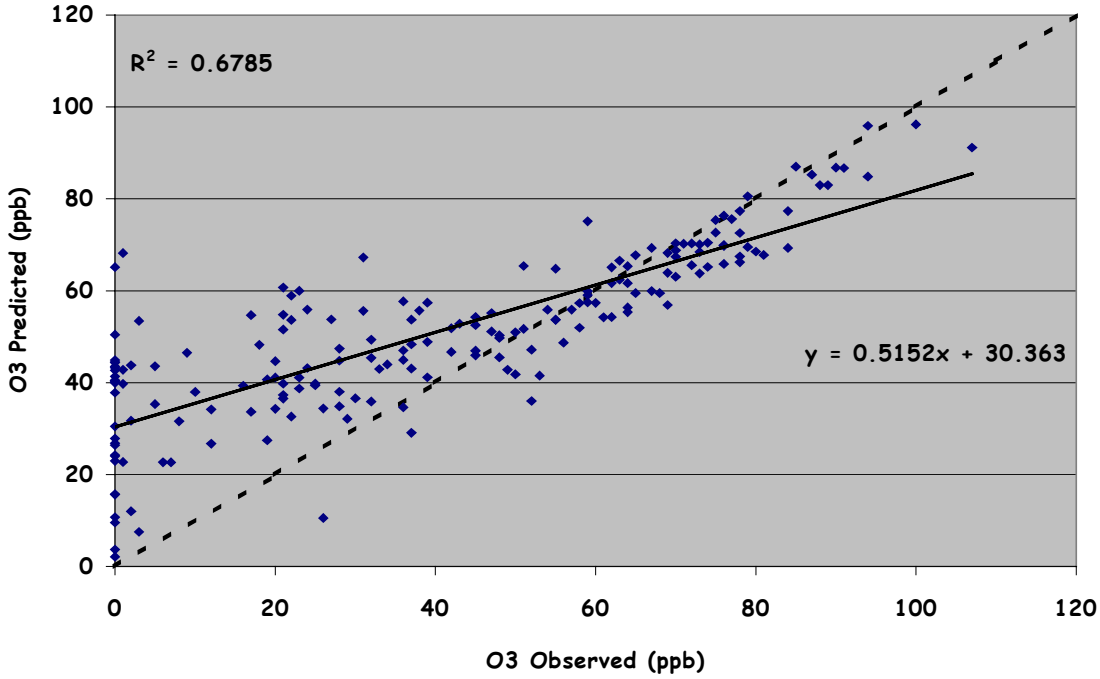


Figure E-29. Scatter Plot of 1-hour Observed/Predicted Data Pairs at CAMS 678.



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Weekend/Weekday Comparisons

Weekend/weekday analyses may be useful for determining whether the model responds appropriately to changes in precursor emission rates. Typically, EIs for weekdays are very different than weekends. For example, vehicle miles traveled (VMT) are generally lower on weekends than weekdays. In areas such as San Antonio where mobile sources are the primary source of NOx emissions, this means the NOx EIs for Saturday and Sunday are the lowest of the week.

Figure E-30 provides a comparison between predicted/observed 1-hour average ozone concentrations at CAMS 23 and the daily NOx EI for Bexar County. As shown, observed and predicted concentrations track fairly closely throughout the episode. Both curves show a rise in ozone concentrations on Saturday as the result of lower NOx emissions (NOx reduction disbenefit). Higher ozone concentrations were predicted at CAMS 58 (figure E-31) on Saturday and Sunday, although actual 1-hour measurements fell on Sunday.

Figure E-32 aggregates the predicted peak concentrations (September 13 – 20, 1999) of the four San Antonio area monitors into a single chart and compares the data to the daily NOx EI for Bexar County. Unlike the predictions at CAMS 23 and 58, the peak predictions at CAMS 59 and 678 do not rise as sharply between Friday, September 17th and Saturday, September 18th. These results are consistent with expectations since CAMS 59 and 678 are upwind monitors.

Figure E-30. Comparison of Observed/predicted 1-hour Concentrations at CAMS 23 and Daily NOx EI for Bexar County, September 13 – 20, 1999.

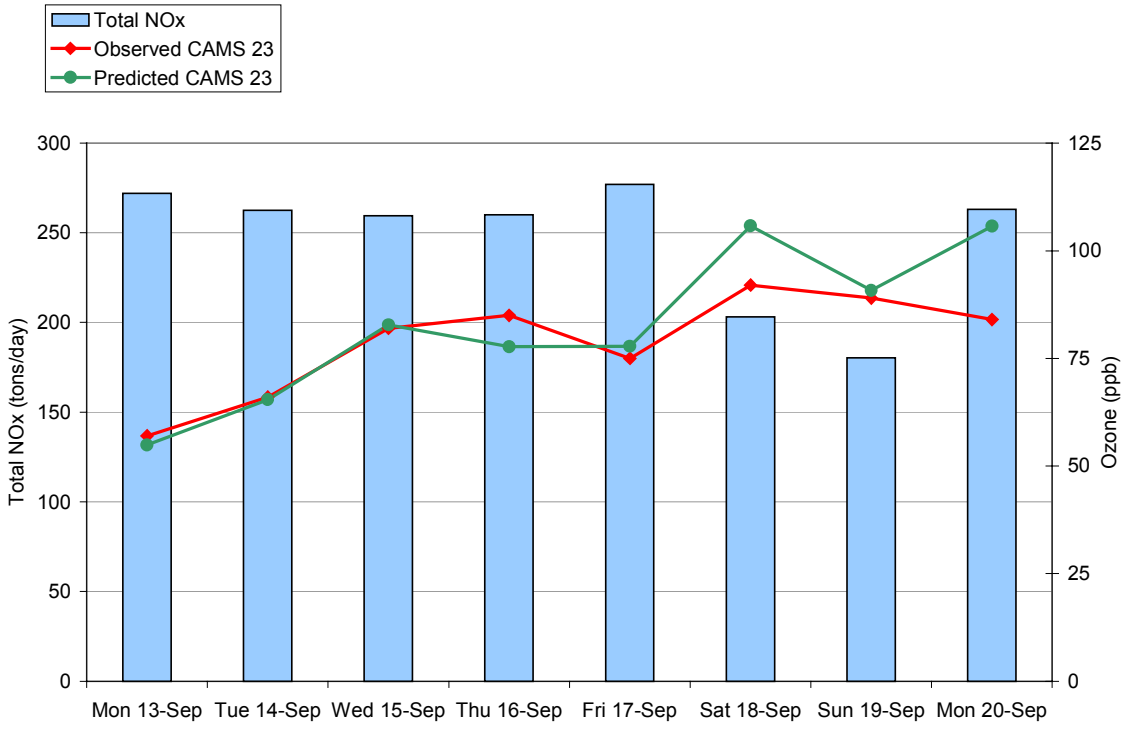

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Figure E-31. Comparison of Observed/predicted 1-hour Concentrations at CAMS 58 and Daily NOx EI for Bexar County, September 13 – 20, 1999.

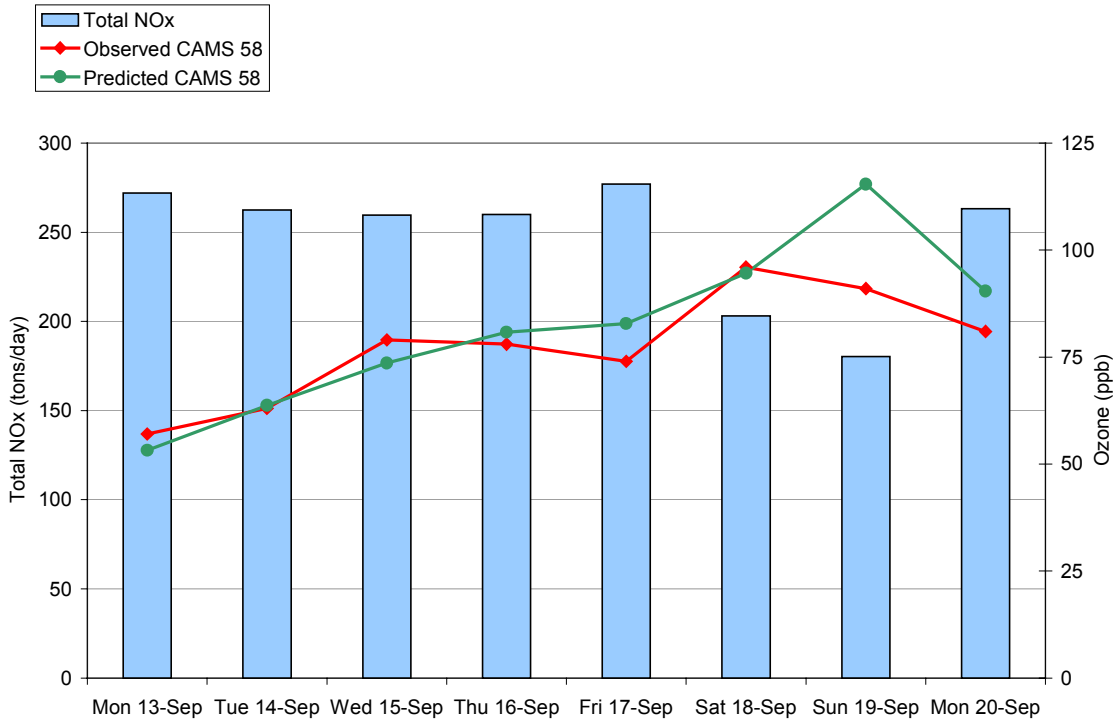
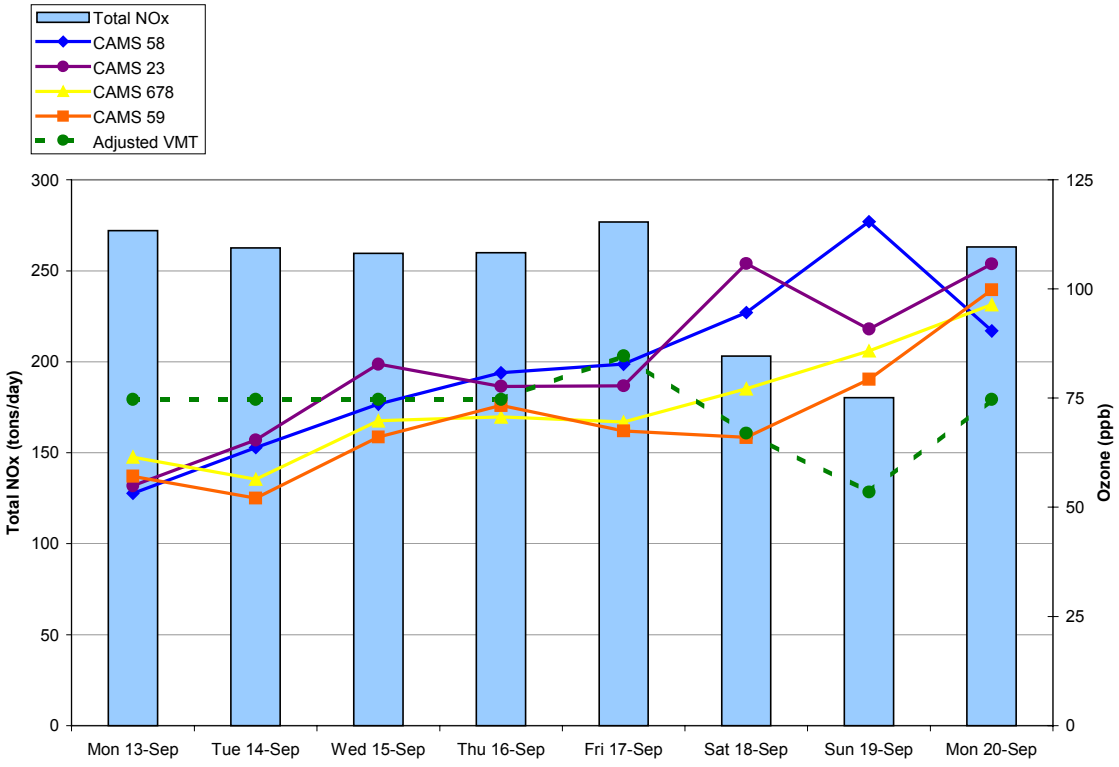


Figure E-32. Comparison of Observed/predicted 1-hour Concentrations at Four San Antonio CAMS and Daily NOx EI for Bexar County, September 13 – 20, 1999.



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Model Performance: 8-Hour Average Ozone Concentrations
In their draft 8-hour guidance, the U.S. EPA recommends conducting a variety of tests to evaluate a photochemical model. In broad terms, these evaluations include performance tests and diagnostic analyses. Both types of evaluations were conducted on the September 1999 simulation with excellent results. The performance tests, used to determine how well the model predicted 8-hour concentrations are described in the following sections on ozone metrics, graphic analyses, and tile plots

Ozone Metrics
Metrics are used to evaluate how closely predicted ozone concentrations match observations, both in terms of spatial and temporal distributions. To evaluate the performance of the 1999 base case, staff conducted statistical tests from EPA's 1-hour and 8-hour guidance documents. To apply the 1-hour metrics to 8-hour data, staff utilized ENVIRON's "camxpost" program, described in the 1-hour statistics section. The program provided unpaired peak accuracy (UPA), average paired peak accuracy (APPA), peak timing bias (PTB), normalized bias (NB), fractional bias, normalized error (NE), and fractional error (FE) for peak 8-hour data. Results of these 8-hour tests are provided in tables E-18 through E-34. Whenever daily modeled predictions were less than 60 ppb, statistical tests were not performed. These days are indicated by "N/A" in the appropriate columns.

Yellow-highlighted values in these tables represent statistics that fall outside EPA's performance criteria on primary episode days (September 15 – 20, 1999. Although it is not necessary to conduct these tests on model initialization days (September 13-14, 1999), statistics for the initialization period are included for comparison purposes. Model initialization statistics that fall outside performance thresholds are listed in bold type. Columns where data are missing represent days in which predicted measurements were less than 60 ppb.

EPA recommends grouping monitored data in terms of location, i.e., downwind, upwind, and city center, as a means of developing useful comparisons. Averaged metrics tests were conducted for groups of monitors when possible.[2] The Central Texas monitoring network is relatively sparse; consequently, the Austin and San Antonio areas, in conjunction with the TCEQ and the U.S. EPA Region 6, recommended evaluating performance based on averaged data from all Central Texas stations. As a result, metrics tests were applied to averaged results at all eight Central Texas monitors, as well as groups of monitors. Monitor numbers, locations, and monitor groups are as follows:

[2] Austin has two monitors, both of which are downwind. San Antonio has two downwind, two upwind, and no city center monitors. As a consequence, there are no average statistics for city center for Austin, San Antonio or Central Texas.

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CAMS #	Monitor Name/ Group Name	Location	AIRS #
3	Murchison	Travis County	48-453-0014
4	Corpus Christi West	Nueces County	48-355-0025
21	Corpus Christi Tuloso	Nueces County	48-355-0026
23	San Antonio Northwest	Bexar County	48-029-0032
38	Audubon	Travis County	48-453-0020
58	Camp Bullis	Bexar County	48-029-0052
59	Calaveras Lake	Bexar County	48-029-0059
62	San Marcos	Caldwell County	48-055-0062
87	Victoria	Victoria County	48-469-0003
601	Fayette	Fayette County	48-149-0001
678	CPS Pecan Valley	Bexar County	48-029-0055
3, 38	Austin Downwind Monitors	Travis County	
23, 58	San Antonio Downwind Monitors	Bexar County	
59, 678	San Antonio Upwind Monitors	Bexar County	
23, 58, 59, 678	San Antonio Monitors	Bexar County	
3, 23, 38,58	Central Texas Downwind Mntrs	Bexar, Travis	
59, 62, 601, 678	Central Texas Upwind Mntrs	Bexar, Caldwell, Fayette	
3, 23, 38, 58, 59, 62, 601, 678	Central Texas Monitors	Bexar, Caldwell, Fayette, Travis	

Applying the same performance criteria recommended for 1-hour statistics to peak 8-hour observed/predicted data comparisons, the results are excellent. Although a few individual monitors exhibit results that fall outside EPA thresholds (such as the negative bias exhibited by the coastal monitors), outcomes for monitor groups generally fell within acceptable ranges. The sole exception was unpaired peak accuracy on September 18th when testing paired data for San Antonio upwind monitors and Central Texas upwind monitors.

Table E-18. 8-hour Statistics for CAMS 3, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	N/A	N/A	18.9%	13.0%	-0.9%	-1.3%	-0.9%	8.8%
APPA	N/A	N/A	1.2%	-6.7%	-14.3%	-8.7%	-4.4%	-19.0%
PTB	N/A	N/A	0	1	0	1	0	0
NB	N/A	N/A	3.1%	-4.8%	-12.9%	-10.9%	-3.3%	-18.2%
FB	N/A	N/A	3.0%	-5.0%	-13.8%	-12.1%	-3.5%	-20.2%
NE	N/A	N/A	3.1%	5.6%	12.9%	11.4%	5.6%	18.2%
FE	N/A	N/A	3.0%	5.8%	13.8%	12.6%	5.7%	20.2%

Table E-19. 8-hour Statistics for CAMS 38, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	N/A	9.9%	3.3%	-8.4%	-11.5%	-13.0%	-11.1%	26.7%
APPA	N/A	-7.1%	-9.5%	-12.7%	-13.7%	-19.0%	-18.3%	-16.3%
PTB	N/A	0	1	0	0	1	1	-1
NB	N/A	-6.8%	-6.0%	-10.4%	-15.4%	-17.0%	-10.7%	-17.3%
FB	N/A	-7.1%	-6.2%	-11.0%	-16.9%	-19.0%	-11.7%	-19.1%
NE	N/A	6.8%	6.0%	10.4%	15.4%	17.0%	10.9%	17.3%
FE	N/A	7.1%	6.3%	11.0%	16.9%	19.0%	11.9%	19.1%

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Table E-20. 8-hour Statistics for Austin Downwind Monitors (CAMS 3 & 38), September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	N/A	9.9%	3.3%	-8.4%	-11.5%	-13.0%	-11.1%	8.8%
APPA	N/A	-7.1%	-4.1%	-9.7%	-14.0%	-13.8%	-11.4%	-17.6%
PTB	N/A	0	1	1	0	1	1	-1
NB	N/A	-6.8%	-3.7%	-8.7%	-14.4%	-14.8%	-7.8%	-17.7%
FB	N/A	-7.1%	-3.9%	-9.2%	-15.7%	-16.5%	-8.5%	-19.6%
NE	N/A	6.8%	5.3%	9.0%	14.4%	15.0%	8.9%	17.7%
FE	N/A	7.1%	5.5%	9.4%	15.7%	16.7%	9.5%	19.6%

Table E-21. 8-hour Statistics for CAMS 23, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	N/A	3.5%	1.1%	-1.2%	13.6%	6.3%	13.4%	10.5%
APPA	N/A	-14.7%	-12.9%	-20.8%	0.0%	-0.3%	-5.0%	4.0%
PTB	N/A	-1	0	0	1	0	0	0
NB	N/A	-14.0%	-9.3%	-16.6%	-7.9%	-1.4%	-2.0%	8.0%
FB	N/A	-15.1%	-9.9%	-18.3%	-8.3%	-1.5%	-2.0%	7.6%
NE	N/A	14.0%	9.3%	16.6%	7.9%	3.6%	3.6%	8.0%
FE	N/A	15.1%	9.9%	18.3%	8.3%	3.6%	3.7%	7.6%

Table E-22. 8-hour Statistics for CAMS 58, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	N/A	9.0%	5.0%	8.1%	16.0%	2.0%	11.8%	14.2%
APPA	N/A	-6.3%	-11.1%	-5.9%	0.7%	-11.1%	7.9%	-0.8%
PTB	N/A	0	0	0	1	0	0	-1
NB	N/A	-5.3%	-6.7%	-3.1%	3.1%	-7.8%	11.2%	1.2%
FB	N/A	-5.5%	-7.0%	-3.2%	3.0%	-8.2%	10.4%	1.2%
NE	N/A	5.3%	7.1%	4.3%	3.2%	7.8%	11.2%	2.9%
FE	N/A	5.5%	7.4%	4.4%	3.2%	8.2%	10.4%	2.8%

Table E-23. 8-hour Statistics for CAMS 59, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	-9.6%	1.9%	2.0%	-6.1%	1.1%	21.6%	14.2%	10.8%
APPA	-20.2%	-18.6%	-21.2%	-13.3%	-12.9%	-19.7%	-15.5%	-7.2%
PTB	0	1	2	4	1	1	0	1
NB	**-19.6%**	**-17.2%**	-16.8%	-9.6%	-6.8%	-17.0%	-9.6%	-11.2%
FB	-21.8%	-18.9%	-18.5%	-10.3%	-7.5%	-18.7%	-10.2%	-12.1%
NE	19.6%	17.2%	16.8%	10.2%	10.1%	17.0%	9.6%	11.2%
FE	21.8%	18.9%	18.5%	11.0%	10.7%	18.7%	10.2%	12.1%

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Table E-24. 8-hour Statistics for CAMS 678, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	N/A	N/A	12.6%	9.8%	31.1%	29.5%	20.1%	7.6%
APPA	N/A	N/A	-10.1%	-7.5%	2.6%	-5.9%	-4.8%	-1.7%
PTB	N/A	N/A	1	0	-1	0	0	1
NB	N/A	N/A	-6.3%	-5.2%	3.7%	-4.0%	-0.4%	0.1%
FB	N/A	N/A	-6.5%	-5.3%	3.6%	-4.1%	-0.6%	-0.2%
NE	N/A	N/A	6.3%	5.2%	3.7%	4.1%	5.6%	6.7%
FE	N/A	N/A	6.5%	5.3%	3.6%	4.2%	5.6%	6.6%

Table E-25. 8-hour Statistics for San Antonio Downwind Monitors (CAMS 23 & 58), September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	N/A	3.5%	1.1%	-1.2%	13.6%	2.0%	11.8%	10.5%
APPA	N/A	10.5%	-12.0%	-13.3%	-4.1%	-5.7%	1.5%	1.6%
PTB	N/A	-1	0	0	1	0	0	-1
NB	N/A	-10.1%	-7.7%	-10.3%	-2.4%	-4.4%	4.6%	4.2%
FB	N/A	-10.8%	-8.1%	-11.2%	-2.6%	-4.7%	4.2%	4.2%
NE	N/A	10.1%	8.0%	10.9%	5.6%	5.6%	7.4%	5.1%
FE	N/A	10.8%	8.4%	11.8%	5.7%	5.8%	7.1%	4.9%

Table E-26. 8-hour Statistics for San Antonio Upwind Monitors (CAMS 59 & 678), September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	-9.6%	1.9%	2.0%	-6.1%	1.1%	21.6%	14.2%	7.6%
APPA	-20.2%	-18.6%	-15.6%	-10.4%	-5.2%	-12.8%	-10.2%	-4.4%
PTB	0	1	2	2	0	1	0	1
NB	**-19.6%**	**-17.2%**	-13.5%	-8.5%	-3.8%	-12.4%	-6.1%	-6.2%
FB	-21.8%	-18.9%	-14.7%	-9.1%	-4.3%	-13.6%	-6.5%	-6.8%
NE	19.6%	17.2%	13.5%	9.0%	8.3%	12.5%	8.1%	9.2%
FE	21.8%	18.9%	14.7%	9.6%	8.7%	13.6%	8.4%	9.7%

Table E-27. 8-hour Statistics for all San Antonio Monitors (CAMS 23, 58, 59 & 678) September 13 – 20, 1999.San Antonio Monitors

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	-9.6%	3.5%	1.1%	-1.2%	1.1%	2.0%	11.8%	7.6%
APPA	-20.2%	-13.2%	-13.8%	-11.9%	-4.7%	-9.3%	-4.3%	-1.4%
PTB	0	0	1	1	1	0	0	0
NB	**-19.6%**	-12.7%	-10.9%	-9.3%	-3.1%	-8.5%	-0.9%	-1.3%
FB	-21.8%	-13.7%	-11.8%	-10.0%	-3.5%	-9.2%	-1.3%	-1.8%
NE	19.6%	12.7%	11.0%	9.8%	6.9%	9.1%	7.7%	7.3%
FE	21.8%	13.7%	11.9%	10.5%	7.2%	9.8%	7.8%	7.4%

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Table E-28. 8-hour Statistics for CAMS 601, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	N/A	N/A	6.3%	28.9%	-0.6%	3.2%	11.5%	17.0%
APPA	N/A	N/A	-2.2%	1.2%	-14.4%	-5.8%	-3.0%	1.7%
PTB	N/A	N/A	-1	1	-1	1	-3	0
NB	N/A	N/A	-3.5%	1.2%	-15.4%	-12.2%	-11.1%	-3.2%
FB	N/A	N/A	-3.6%	1.2%	-16.9%	-13.2%	-12.2%	-3.3%
NE	N/A	N/A	3.5%	1.4%	15.4%	12.2%	11.5%	3.6%
FE	N/A	N/A	3.6%	1.4%	16.9%	13.2%	12.7%	3.7%

Table E-29. 8-hour Statistics for CAMS 62, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	N/A	N/A	15.1%	13.1%	2.9%	13.0%	10.1%	24.5%
APPA	N/A	N/A	-6.1%	6.8%	-13.3%	-11.0%	-6.7%	3.3%
PTB	N/A	N/A	-1	1	6	1	0	0
NB	N/A	N/A	-2.1%	6.9%	-7.7%	-8.3%	-2.8%	4.2%
FB	N/A	N/A	-2.1%	6.6%	-8.6%	-8.7%	-3.0%	4.1%
NE	N/A	N/A	3.3%	6.9%	11.8%	8.3%	5.8%	4.2%
FE	N/A	N/A	3.3%	6.6%	12.5%	8.7%	5.9%	4.1%

Table E-30. 8-hour Statistics for Central Texas Downwind Monitors (CAMS 3, 23, 38, 58) September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	N/A	3.5%	1.1%	-8.4%	-11.5%	-13.0%	-11.1%	8.8%
APPA	N/A	-9.4%	-8.1%	-11.5%	-9.1%	-9.8%	-5.0%	-8.0%
PTB	N/A	0	0	0	1	1	0	-1
NB	N/A	-9.3%	-5.4%	-9.5%	-10.1%	-10.9%	-3.0%	-8.5%
FB	N/A	-10.8%	-8.1%	-11.2%	-2.6%	-4.7%	4.2%	4.0%
NE	N/A	9.3%	6.4%	9.9%	11.2%	11.4%	8.3%	12.4%
FE	N/A	9.9%	6.7%	10.5%	12.1%	12.6%	8.6%	13.4%

Table E-31. 8-hour Statistics for Central Texas Upwind Monitors (CAMS 59, 62, 601, 678) September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	-9.6%	1.9%	2.0%	-6.1%	-0.6%	21.6%	14.2%	7.6%
APPA	-20.2%	-18.6%	-9.6%	-3.0%	-8.4%	-10.1%	-7.1%	3.2%
PTB	0	1	0	2	1	1	-1	1
NB	**-19.6%**	**-17.2%**	-8.5%	-3.9%	-8.5%	-11.0%	-6.9%	-3.1%
FB	-21.8%	-18.9%	-9.2%	-4.3%	-9.4%	-11.9%	-7.6%	-3.4%
NE	19.6%	17.2%	8.8%	6.9%	12.2%	11.0%	8.9%	6.5%
FE	21.8%	18.9%	9.5%	7.3%	13.0%	11.9%	9.3%	6.7%

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Table E-32. 8-hour Statistics for Central Texas (CAMS 3, 23, 38, 58, 59, 62, 601, 678), September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	-9.6%	3.5%	1.1%	-8.4%	-11.5%	-13.0%	-11.1%	8.8%
APPA	-20.2%	-11.7%	-9.0%	-7.3%	-9.3%	-10.2%	-6.2%	-4.5%
PTB	0	0	0	1	1	1	0	0
NB	**-19.6%**	-11.6%	-7.1%	-6.7%	-9.5%	-11.0%	-4.9%	5.9%
FB	21.8%	-12.5%	-7.6%	-7.3%	-10.4%	-12.1%	-5.5%	-6.7%
NE	19.6%	11.6%	7.7%	8.4%	11.5%	11.3%	8.5%	9.5%
FE	21.8%	12.5%	8.2%	8.9%	12.3%	12.4%	9.0%	10.1%

Table E-33. 8-hour Statistics for Corpus Christi Monitors (CAMS 4 & 21), September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	4.1%	-5.5%	0.8%	-5.3%	-3.6%	-1.4%	1.6%	-1.2%
APPA	-25.7%	-21.7%	-22.2%	-22.6%	-19.6%	-10.1%	-6.1%	-22.6%
PTB	0	1	1	0	-2	-1	2	2
NB	**-27.2%**	**-22.4%**	-19.9%	-23.4%	-18.8%	-14.1%	-7.6%	-24.2%
FB	-31.7%	-25.5%	-22.1%	-26.5%	-20.9%	-15.7%	-8.4%	-27.8%
NE	27.2%	22.4%	19.9%	23.4%	18.8%	14.3%	9.2%	24.2%
FE	31.7%	25.5%	22.1%	26.5%	20.9%	15.9%	9.9%	27.8%

Table E-34. 8-hour Statistics for CAMS 87, September 13 – 20, 1999.

Statistic	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
UPA	-4.5%	9.8%	13.2%	10.0%	8.2%	0.6%	0.4%	-15.9%
APPA	-31.2%	-12.9%	-6.4%	-3.1%	-5.3%	-15.2%	-4.3%	-18.9%
PTB	0	-1	-1	0	1	-1	0	1
NB	**-28.8%**	-12.8%	-6.0%	-1.3%	-7.9%	-18.8%	-16.4%	-15.6%
	-33.6%	-13.7%	-6.3%	-1.4%	-8.3%	-20.8%	-19.4%	-17.6%
NE	28.8%	12.8%	6.3%	2.7%	7.9%	18.8%	16.4%	17.2%
FE	33.6%	13.7%	6.6%	2.8%	8.3%	20.8%	19.4%	19.1%

A variety of analyses are specifically recommended by the EPA in their draft guidance on 8-hour attainment demonstrations (EPA 1999). These include:

- Bias between spatially paired means of observations and predictions of 8-hour daily maximum ozone concentrations, with predicted values based on grid cells 'near' a monitor.
- Correlation coefficient and scatter plot for average observed and predicted 8-hour daily maximum ozone concentrations.
- Temporal correlation coefficient of observed and nearby predicted 8-hour daily maximum ozone concentrations, which are spatially averaged. If the monitoring network is sufficiently large, concentrations should be grouped into upwind, downwind, and center city locations.
- Quantile-quantile plots
- Fractional bias

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The EPA-recommended performance goal for each test is:

Test	Goal
Bias between predicted/observed mean 8-hour (and 1-hour) daily maxima near each monitor	20% most monitors (8-hr comparisons only)
Fractional bias between predicted/ Observed mean 8-hour (and 1-hour) daily maxima near each monitor	20% most monitors (8-hr comparisons only)
Correlation coefficients, all data, temporally paired means, spatially paired means	Moderate to large positive correlation
Bias (8-hour daily maxima and 1-hour observed/predicted), all monitors	5 – 15%
Gross error (8-hour daily maxima and 1-hour observed/predicted), all monitors	30 – 35%

Staff conducted metric, scatter plot, and quantile-quantile (Q-Q) plot analyses using a FORTRAN program developed by ENVIRON International, Inc. Due to some uncertainty as to the most appropriate means of calculating these evaluations, ENVIRON's statistical program performs the calculations using three different methodologies:

1) The predicted daily maximum ozone concentration within grid cells near a monitor;[3]
2) The predicted daily maximum ozone concentration within grid cells near a monitor that is closest in magnitude to the observed daily maximum at the monitor; and
3) A bilinear interpolation of predicted daily maximum ozone concentration around the monitor location.

Normalized bias, fractional bias, normalized error, and fractional error calculations for all monitors and monitoring groups in the 4-km subdomain are provided in tables E-35 through E-51. Each table presents the statistical results for all three methodologies.

To compare 8-hour normalized bias statistics more readily, line graphs were created of downwind, upwind, and coastal monitors for each methodology (figures E-33 through E-35). Episode day is designated by a number (1 = 9/13/99, 2 = 9/14/99, 3 = 9/15/99, 4 = 9/16/99, 5 = 9/17/99, 6 = 9/18/99, 7 = 9/19/99, and 8 = 9/20/99) in each graph. The model initialization period (days 1 and 2) are separated by a dashed black line and performance goals are designated by dashed red lines.

Method 1 for calculating normalized bias yields very good results. Discounting the model initialization period, the only days when EPA performance goals were not met using

[3] In accordance with EPA guidance, grid cells 'near' a monitor were defined as a 7x7 array of cells (U.S. EPA, 1999).

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method 1were September 15th (CAMS 59 – San Antonio upwind monitor), and September 19th (CAMS 23 and 58 – San Antonio downwind monitors).

Model performance based on the statistical metrics was best when calculated using method 2. The ±20% performance goal for normalized bias was only exceeded once using this method: September 15th at CAMS 59.

Method 3 yielded the most incidences where performance goals were not met. With the exception of CAMS 23, the normalized bias statistics for each downwind monitor failed performance goals during at least one primary episode day. These include CAMS 38 (Austin) on September 16th, 18th, and 20th, CAMS 3 (Austin) on September 20th, and CAMS 58 (San Antonio) on September 19th. Both Austin monitors (CAMS 3 & 38) are downwind monitors and both exhibited a negative bias during the modeling episode. Normalized bias calculated using method 3 yielded better results for the upwind monitors. The only days when performance goals were not met were September 15th and 18th, both at CAMS 59 (San Antonio). In addition, all three coastal monitors failed the normalized bias goal with method 3 on at least one episode day: CAMS 4 (Corpus Christi) on September 15th and 16th, CAMS 21 (Corpus Christi) on September 15th, and CAMS 87 (Victoria) on September 20th.

Line graphs of fractional bias statistics were also developed for each methodology. These graphs are presented in figures E-36 through E-38. Results of the fractional bias calculations are very similar to those for normalized bias, although the incidence of results that failed to meet performance goals increased somewhat with fractional bias. For the daily peak predicted/observed statistics (September 15 – 20, 1999) using Method 1, for example, the performance goal for normalized bias was met on 95% of the days and the performance goal for fractional bias was met on 94% of the days. Using method 2, the ±20% goal for normalized and fractional bias was met on 98% and 97% of the days, respectively. The poorest performance was associated with evaluating the model using method 3. Even using this strictest methodology, however, the performance goals for normalized and fractional bias were passed on 85% of the primary episode days.

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Table E-35. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics (%) for CAMS 3, September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	53.00	56.21	6.06	5.88	6.06	5.88
9/14/1999	56.00	70.02	**25.04**	**22.25**	25.04	22.25
9/15/1999	78.00	89.62	14.90	13.86	14.90	13.86
9/16/1999	73.00	79.73	9.22	8.81	9.22	8.81
9/17/1999	98.00	102.26	4.35	4.25	4.35	4.25
9/18/1999	97.00	98.17	1.21	1.20	1.21	1.20
9/19/1999	101.00	104.52	3.49	3.43	3.49	3.43
9/20/1999	102.00	103.21	1.19	1.18	1.19	1.18

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	53.00	52.95	-0.09	-0.09	0.09	0.09
9/14/1999	56.00	55.79	-0.38	-0.38	0.38	0.38
9/15/1999	78.00	78.05	0.06	0.06	0.06	0.06
9/16/1999	73.00	73.03	0.04	0.04	0.04	0.04
9/17/1999	98.00	97.40	-0.61	-0.61	0.61	0.61
9/18/1999	97.00	97.00	0.00	0.00	0.00	0.00
9/19/1999	101.00	100.89	-0.11	-0.11	0.11	0.11
9/20/1999	102.00	103.21	1.19	1.18	1.19	1.18

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	53.00	51.49	-2.85	-2.89	2.85	2.89
9/14/1999	56.00	58.35	4.20	4.11	4.20	4.11
9/15/1999	78.00	79.62	2.08	2.06	2.08	2.06
9/16/1999	73.00	68.84	-5.70	-5.87	5.70	5.87
9/17/1999	98.00	88.69	-9.50	-9.97	9.50	9.97
9/18/1999	97.00	90.65	-6.55	-6.77	6.55	6.77
9/19/1999	101.00	98.81	-2.17	-2.19	2.17	2.19
9/20/1999	102.00	72.45	-28.97	-33.88	28.97	33.88

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Table E-36. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics (%) for CAMS 38, September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	57.00	56.73	-0.47	-0.47	0.47	0.47
9/14/1999	66.00	64.87	-1.71	-1.73	1.71	1.73
9/15/1999	83.00	86.06	3.69	3.62	3.69	3.62
9/16/1999	100.00	82.48	-17.52	-19.20	17.52	19.20
9/17/1999	109.00	102.26	-6.18	-6.38	6.18	6.38
9/18/1999	120.00	98.17	-18.19	-20.01	18.19	20.01
9/19/1999	110.00	104.63	-4.88	-5.00	4.88	5.00
9/20/1999	83.00	72.89	-12.18	-12.97	12.18	12.97

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	57.00	56.73	-0.47	-0.47	0.47	0.47
9/14/1999	66.00	64.87	-1.71	-1.73	1.71	1.73
9/15/1999	83.00	83.16	0.19	0.19	0.19	0.19
9/16/1999	100.00	82.48	-17.52	-19.20	17.52	19.20
9/17/1999	109.00	102.26	-6.18	-6.38	6.18	6.38
9/18/1999	120.00	98.17	-18.19	-20.01	18.19	20.01
9/19/1999	110.00	104.63	-4.88	-5.00	4.88	5.00
9/20/1999	83.00	72.89	-12.18	-12.97	12.18	12.97

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	57.00	55.57	-2.51	-2.54	2.51	2.54
9/14/1999	66.00	59.72	-9.52	-9.99	9.52	9.99
9/15/1999	83.00	77.19	-7.00	-7.25	7.00	7.25
9/16/1999	100.00	79.95	-20.05	-22.28	20.05	22.28
9/17/1999	109.00	95.70	-12.20	-12.99	12.20	12.99
9/18/1999	120.00	87.69	-26.93	-31.11	26.93	31.11
9/19/1999	110.00	99.42	-9.62	-10.10	9.62	10.10
9/20/1999	83.00	64.17	-22.69	-25.59	22.69	25.59

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Table E-37. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics (%) for Austin monitors – CAMS 3 & 38 (both are downwind monitors), September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	55.00	56.47	2.79	2.70	3.27	3.18
9/14/1999	61.00	67.45	11.66	10.26	13.37	11.99
9/15/1999	80.50	87.84	9.29	8.74	9.29	8.74
9/16/1999	86.50	81.11	-4.15	-5.19	13.37	14.01
9/17/1999	103.50	102.26	-0.92	-1.06	5.27	5.32
9/18/1999	108.50	98.17	-8.49	-9.41	9.70	10.61
9/19/1999	105.50	104.58	-0.70	-0.79	4.18	4.21
9/20/1999	92.50	88.05	-5.50	-5.90	6.68	7.07

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	55.00	54.84	-0.28	-0.28	0.28	0.28
9/14/1999	61.00	60.33	-1.04	-1.05	1.04	1.05
9/15/1999	80.50	80.61	0.13	0.13	0.13	0.13
9/16/1999	86.50	77.76	-8.74	-9.58	8.78	9.62
9/17/1999	103.50	99.83	-3.40	-3.50	3.40	3.50
9/18/1999	108.50	97.59	-9.10	-10.01	9.10	10.01
9/19/1999	105.50	102.76	-2.50	-2.56	2.50	2.56
9/20/1999	92.50	88.05	-5.50	-5.90	6.68	7.07

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	55.00	53.53	-2.68	-2.72	2.68	2.72
9/14/1999	61.00	59.04	-2.66	-2.94	6.86	7.05
9/15/1999	80.50	78.41	-2.46	-2.60	4.54	4.65
9/16/1999	86.50	74.40	-12.87	-14.07	12.87	14.07
9/17/1999	103.50	92.20	-10.85	-11.48	10.85	11.48
9/18/1999	108.50	89.17	-16.74	-18.94	16.74	18.94
9/19/1999	105.50	99.12	-5.89	-6.15	5.89	6.15
9/20/1999	92.50	68.31	-25.83	-29.73	25.83	29.73

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Table E-38. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics (%) for CAMS 23, September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	66.00	56.73	-14.05	-15.11	14.05	15.11
9/14/1999	75.00	73.79	-1.61	-1.63	1.61	1.63
9/15/1999	92.00	97.21	5.66	5.51	5.66	5.51
9/16/1999	93.00	88.59	-4.74	-4.86	4.74	4.86
9/17/1999	82.00	91.47	11.55	10.92	11.55	10.92
9/18/1999	102.00	110.88	8.71	8.34	8.71	8.34
9/19/1999	94.00	118.52	26.09	23.08	26.09	23.08
9/20/1999	106.00	112.50	6.13	5.95	6.13	5.95

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	66.00	56.73	-14.05	-15.11	14.05	15.11
9/14/1999	75.00	73.79	-1.61	-1.63	1.61	1.63
9/15/1999	92.00	92.01	0.01	0.01	0.01	0.01
9/16/1999	93.00	88.59	-4.74	-4.86	4.74	4.86
9/17/1999	82.00	82.29	0.35	0.35	0.35	0.35
9/18/1999	102.00	102.16	0.16	0.16	0.16	0.16
9/19/1999	94.00	94.69	0.73	0.73	0.73	0.73
9/20/1999	106.00	105.99	-0.01	-0.01	0.01	0.01

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	66.00	54.88	-16.85	-18.40	16.85	18.40
9/14/1999	75.00	65.41	-12.79	-13.66	12.79	13.66
9/15/1999	92.00	82.80	-10.00	-10.53	10.00	10.53
9/16/1999	93.00	77.74	-16.41	-17.88	16.41	17.88
9/17/1999	82.00	77.80	-5.12	-5.26	5.12	5.26
9/18/1999	102.00	105.79	3.72	3.65	3.72	3.65
9/19/1999	94.00	90.81	-3.39	-3.45	3.39	3.45
9/20/1999	106.00	105.71	-0.27	-0.27	0.27	0.27

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Table E-39. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics (%) for CAMS 58, September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	61.00	57.07	-6.44	-6.66	6.44	6.66
9/14/1999	67.00	70.82	5.70	5.54	5.70	5.54
9/15/1999	88.00	87.19	-0.92	-0.92	0.92	0.92
9/16/1999	83.00	86.38	4.07	3.99	4.07	3.99
9/17/1999	82.00	91.67	11.79	11.14	11.79	11.14
9/18/1999	108.00	110.88	2.67	2.63	2.67	2.63
9/19/1999	96.00	118.52	23.46	21.00	23.46	21.00
9/20/1999	100.00	106.71	6.71	6.49	6.71	6.49

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	61.00	57.07	-6.44	-6.66	6.44	6.66
9/14/1999	67.00	67.01	0.01	0.01	0.01	0.01
9/15/1999	88.00	87.19	-0.92	-0.92	0.92	0.92
9/16/1999	83.00	83.06	0.07	0.07	0.07	0.07
9/17/1999	82.00	81.93	-0.09	-0.09	0.09	0.09
9/18/1999	108.00	108.53	0.49	0.49	0.49	0.49
9/19/1999	96.00	95.72	-0.29	-0.29	0.29	0.29
9/20/1999	100.00	99.51	-0.49	-0.49	0.49	0.49

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	61.00	53.22	-12.75	-13.62	12.75	13.62
9/14/1999	67.00	63.68	-4.96	-5.08	4.96	5.08
9/15/1999	88.00	73.64	-16.32	-17.77	16.32	17.77
9/16/1999	83.00	80.83	-2.61	-2.65	2.61	2.65
9/17/1999	82.00	82.77	0.94	0.93	0.94	0.93
9/18/1999	108.00	94.55	-12.45	-13.28	12.45	13.28
9/19/1999	96.00	115.42	20.23	18.37	20.23	18.37
9/20/1999	100.00	90.40	-9.60	-10.08	9.60	10.08

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Table E-40. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics (%) for CAMS 59, September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	72.00	62.13	-13.71	-14.72	13.71	14.72
9/14/1999	67.00	56.70	-15.37	-16.65	15.37	16.65
9/15/1999	91.00	70.87	-22.12	-24.87	22.12	24.87
9/16/1999	85.00	76.10	-10.47	-11.05	10.47	11.05
9/17/1999	82.00	73.04	-10.93	-11.56	10.93	11.56
9/18/1999	84.00	77.42	-7.83	-8.15	7.83	8.15
9/19/1999	96.00	90.71	-5.51	-5.67	5.51	5.67
9/20/1999	97.00	103.84	7.05	6.81	7.05	6.81

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	72.00	62.13	-13.71	-14.72	13.71	14.72
9/14/1999	67.00	56.70	-15.37	-16.65	15.37	16.65
9/15/1999	91.00	70.87	-22.12	-24.87	22.12	24.87
9/16/1999	85.00	76.10	-10.47	-11.05	10.47	11.05
9/17/1999	82.00	73.04	-10.93	-11.56	10.93	11.56
9/18/1999	84.00	77.42	-7.83	-8.15	7.83	8.15
9/19/1999	96.00	90.71	-5.51	-5.67	5.51	5.67
9/20/1999	97.00	97.01	0.01	0.01	0.01	0.01

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	72.00	57.06	**-20.75**	**-23.15**	20.75	23.15
9/14/1999	67.00	52.09	**-22.25**	**-25.04**	22.25	25.04
9/15/1999	91.00	66.07	-27.40	-31.74	27.40	31.74
9/16/1999	85.00	73.35	-13.71	-14.71	13.71	14.71
9/17/1999	82.00	67.48	-17.71	-19.43	17.71	19.43
9/18/1999	84.00	65.96	-21.48	-24.06	21.48	24.06
9/19/1999	96.00	79.28	-17.42	-19.08	17.42	19.08
9/20/1999	97.00	99.84	2.93	2.89	2.93	2.89

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Table E-41. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics (%) for CAMS 678, September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	67.00	63.05	-5.90	-6.07	5.90	6.07
9/14/1999	64.00	60.99	-4.70	-4.82	4.70	4.82
9/15/1999	79.00	78.00	-1.27	-1.27	1.27	1.27
9/16/1999	81.00	76.83	-5.15	-5.28	5.15	5.28
9/17/1999	70.00	75.71	8.16	7.84	8.16	7.84
9/18/1999	84.00	88.35	5.18	5.05	5.18	5.05
9/19/1999	91.00	96.07	5.57	5.42	5.57	5.42
9/20/1999	107.00	108.27	1.19	1.18	1.19	1.18

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	67.00	63.05	-5.90	-6.07	5.90	6.07
9/14/1999	64.00	60.99	-4.70	-4.82	4.70	4.82
9/15/1999	79.00	78.00	-1.27	-1.27	1.27	1.27
9/16/1999	81.00	76.83	-5.15	-5.28	5.15	5.28
9/17/1999	70.00	70.14	0.20	0.20	0.20	0.20
9/18/1999	84.00	85.89	2.25	2.22	2.25	2.22
9/19/1999	91.00	91.06	0.07	0.07	0.07	0.07
9/20/1999	107.00	107.02	0.02	0.02	0.02	0.02

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	67.00	61.47	-8.25	-8.61	8.25	8.61
9/14/1999	64.00	56.38	-11.91	-12.66	11.91	12.66
9/15/1999	79.00	69.83	-11.61	-12.32	11.61	12.32
9/16/1999	81.00	70.67	-12.75	-13.62	12.75	13.62
9/17/1999	70.00	69.50	-0.71	-0.72	0.71	0.72
9/18/1999	84.00	77.14	-8.17	-8.51	8.17	8.51
9/19/1999	91.00	85.83	-5.68	-5.85	5.68	5.85
9/20/1999	107.00	96.44	-9.87	-10.38	9.87	10.38

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Table E-42. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics (%) for San Antonio downwind monitors (CAMS 23 & 58), September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	63.50	56.90	-10.24	-10.88	10.24	10.88
9/14/1999	71.00	72.31	2.04	1.96	3.66	3.58
9/15/1999	90.00	92.20	2.37	2.29	3.29	3.22
9/16/1999	88.00	87.49	-0.33	-0.43	4.41	4.42
9/17/1999	82.00	91.57	11.67	11.03	11.67	11.03
9/18/1999	105.00	110.88	5.69	5.49	5.69	5.49
9/19/1999	95.00	118.52	24.77	22.04	24.77	22.04
9/20/1999	103.00	109.61	6.42	6.22	6.42	6.22

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	63.50	56.90	-10.24	-10.88	10.24	10.88
9/14/1999	71.00	70.40	-0.80	-0.81	0.81	0.82
9/15/1999	90.00	89.60	-0.45	-0.46	0.47	0.47
9/16/1999	88.00	85.83	-2.33	-2.39	2.41	2.46
9/17/1999	82.00	82.11	0.13	0.13	0.22	0.22
9/18/1999	105.00	105.35	0.32	0.32	0.32	0.32
9/19/1999	95.00	95.21	0.22	0.22	0.51	0.51
9/20/1999	103.00	102.75	-0.25	-0.25	0.25	0.25

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	63.50	54.05	-14.80	-16.01	14.80	16.01
9/14/1999	71.00	64.55	-8.87	-9.37	8.87	9.37
9/15/1999	90.00	78.22	-13.16	-14.15	13.16	14.15
9/16/1999	88.00	79.29	-9.51	-10.26	9.51	10.26
9/17/1999	82.00	80.29	-2.09	-2.16	3.03	3.10
9/18/1999	105.00	100.17	-4.37	-4.82	8.08	8.46
9/19/1999	95.00	103.12	8.42	7.46	11.81	10.91
9/20/1999	103.00	98.06	-4.94	-5.18	4.94	5.18

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Table E-43. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics (%) for San Antonio upwind monitors (CAMS 59 & 678), September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	69.50	62.59	-9.80	-10.40	9.80	10.40
9/14/1999	65.50	58.85	-10.04	-10.73	10.04	10.73
9/15/1999	85.00	74.44	-11.69	-13.07	11.69	13.07
9/16/1999	83.00	76.47	-7.81	-8.17	7.81	8.17
9/17/1999	76.00	74.38	-1.38	-1.86	9.54	9.70
9/18/1999	84.00	82.89	-1.33	-1.55	6.51	6.60
9/19/1999	93.50	93.39	0.03	-0.12	5.54	5.54
9/20/1999	102.00	106.06	4.12	4.00	4.12	4.00

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	69.50	62.59	-9.80	-10.40	9.80	10.40
9/14/1999	65.50	58.85	-10.04	-10.73	10.04	10.73
9/15/1999	85.00	74.44	-11.69	-13.07	11.69	13.07
9/16/1999	83.00	76.47	-7.81	-8.17	7.81	8.17
9/17/1999	76.00	71.59	-5.36	-5.68	5.56	5.88
9/18/1999	84.00	81.66	-2.79	-2.96	5.04	5.19
9/19/1999	93.50	90.89	-2.72	-2.80	2.79	2.87
9/20/1999	102.00	102.02	0.01	0.01	0.01	0.01

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	69.50	59.27	-14.50	-15.88	14.50	15.88
9/14/1999	65.50	54.24	**-17.08**	-18.85	17.08	18.85
9/15/1999	85.00	67.95	-19.50	-22.03	19.50	22.03
9/16/1999	83.00	72.01	-13.23	-14.17	13.23	14.17
9/17/1999	76.00	68.49	-9.21	-10.07	9.21	10.07
9/18/1999	84.00	71.55	-14.82	-16.29	14.82	16.29
9/19/1999	93.50	82.56	-11.55	-12.46	11.55	12.46
9/20/1999	102.00	98.14	-3.47	-3.75	6.40	6.63

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Table E-44. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics (%) for San Antonio monitors (CAMS 23, 58, 59, 678), September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	66.50	59.75	-10.02	-10.64	10.02	10.64
9/14/1999	68.25	65.58	-4.00	-4.39	6.85	7.16
9/15/1999	87.50	83.32	-4.66	-5.39	7.49	8.14
9/16/1999	85.50	81.98	-4.07	-4.30	6.11	6.30
9/17/1999	79.00	82.97	5.14	4.58	10.61	10.36
9/18/1999	94.50	96.88	2.18	1.97	6.10	6.04
9/19/1999	94.25	105.96	12.40	10.96	15.16	13.79
9/20/1999	102.50	107.83	5.27	5.11	5.27	5.11

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	66.50	59.75	-10.02	-10.64	10.02	10.64
9/14/1999	68.25	64.62	-5.42	-5.77	5.43	5.78
9/15/1999	87.50	82.02	-6.07	-6.76	6.08	6.77
9/16/1999	85.50	81.15	-5.07	-5.28	5.11	5.32
9/17/1999	79.00	76.85	-2.61	-2.77	2.89	3.05
9/18/1999	94.50	93.50	-1.23	-1.32	2.68	2.76
9/19/1999	94.25	93.05	-1.25	-1.29	1.65	1.69
9/20/1999	102.50	102.38	-0.12	-0.12	0.13	0.13

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	66.50	56.66	-14.65	-15.95	14.65	15.95
9/14/1999	68.25	59.39	-12.98	-14.11	12.98	14.11
9/15/1999	87.50	73.09	-16.33	-18.09	16.33	18.09
9/16/1999	85.50	75.65	-11.37	-12.22	11.37	12.22
9/17/1999	79.00	74.39	-5.65	-6.12	6.12	6.58
9/18/1999	94.50	85.86	-9.60	-10.55	11.45	12.38
9/19/1999	94.25	92.84	-1.57	-2.50	11.68	11.69
9/20/1999	102.50	98.10	-4.20	-4.46	5.67	5.91

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Table E-45. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics (%) for CAMS 62, September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	57.00	60.41	5.98	5.81	5.98	5.81
9/14/1999	N/A	N/A	N/A	N/A	N/A	N/A
9/15/1999	78.00	81.86	4.95	4.83	4.95	4.83
9/16/1999	70.00	76.98	9.97	9.50	9.97	9.50
9/17/1999	89.00	91.89	3.25	3.20	3.25	3.20
9/18/1999	83.00	76.84	-7.42	-7.71	7.42	7.71
9/19/1999	86.00	89.41	3.97	3.89	3.97	3.89
9/20/1999	78.00	82.58	5.87	5.70	5.87	5.70

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	57.00	56.97	-0.05	-0.05	0.05	0.05
9/14/1999	N/A	N/A	N/A	N/A	N/A	N/A
9/15/1999	78.00	78.06	0.08	0.08	0.08	0.08
9/16/1999	70.00	70.07	0.10	0.10	0.10	0.10
9/17/1999	89.00	88.86	-0.16	-0.16	0.16	0.16
9/18/1999	83.00	76.84	-7.42	-7.71	7.42	7.71
9/19/1999	86.00	86.12	0.14	0.14	0.14	0.14
9/20/1999	78.00	78.12	0.15	0.15	0.15	0.15

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	57.00	55.72	-2.25	-2.27	2.25	2.27
9/14/1999	N/A	N/A	N/A	N/A	N/A	N/A
9/15/1999	78.00	70.27	-9.91	-10.43	9.91	10.43
9/16/1999	70.00	73.52	5.03	4.91	5.03	4.91
9/17/1999	89.00	75.97	-14.64	-15.80	14.64	15.80
9/18/1999	83.00	72.92	-12.14	-12.93	12.14	12.93
9/19/1999	86.00	83.16	-3.30	-3.36	3.30	3.36
9/20/1999	78.00	78.12	0.15	0.15	0.15	0.15

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Table E-46. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics (%) for CAMS 601, September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	64.07	55.73	-13.02	-13.92	13.02	13.92
9/14/1999	56.23	58.65	4.30	4.21	4.30	4.21
9/15/1999	72.90	74.12	1.67	1.66	1.67	1.66
9/16/1999	70.94	76.39	7.68	7.40	7.68	7.40
9/17/1999	103.29	94.71	-8.31	-8.67	8.31	8.67
9/18/1999	87.12	88.14	1.17	1.16	1.17	1.16
9/19/1999	85.65	87.36	2.00	1.98	2.00	1.98
9/20/1999	87.12	97.28	11.66	11.02	11.66	11.02

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	64.07	55.73	-13.02	-13.92	13.02	13.92
9/14/1999	56.23	56.42	0.34	0.34	0.34	0.34
9/15/1999	72.90	72.26	-0.88	-0.88	0.88	0.88
9/16/1999	70.94	71.30	0.51	0.51	0.51	0.51
9/17/1999	103.29	94.71	-8.31	-8.67	8.31	8.67
9/18/1999	87.12	86.16	-1.10	-1.11	1.10	1.11
9/19/1999	85.65	86.12	0.55	0.55	0.55	0.55
9/20/1999	87.12	87.05	-0.08	-0.08	0.08	0.08

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	64.07	52.79	-17.61	-19.31	17.61	19.31
9/14/1999	56.23	54.16	-3.68	-3.75	3.68	3.75
9/15/1999	72.90	67.46	-7.46	-7.75	7.46	7.75
9/16/1999	70.94	72.28	1.89	1.87	1.89	1.87
9/17/1999	103.29	88.34	-14.47	-15.60	14.47	15.60
9/18/1999	87.12	78.53	-9.86	-10.37	9.86	10.37
9/19/1999	85.65	80.53	-5.98	-6.16	5.98	6.16
9/20/1999	87.12	90.63	4.03	3.95	4.03	3.95

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Table E-47. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics (%) for Central Texas Downwind Monitors (CAMS 3, 23, 38, 58), September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	59.25	56.69	-3.73	-4.09	6.75	7.03
9/14/1999	66.00	69.88	6.85	6.11	8.52	7.79
9/15/1999	85.25	90.02	5.83	5.52	6.29	5.98
9/16/1999	87.25	84.30	-2.24	-2.81	8.89	9.22
9/17/1999	92.75	96.92	5.38	4.98	8.47	8.17
9/18/1999	106.75	104.53	-1.40	-1.96	7.69	8.05
9/19/1999	100.25	111.55	12.04	10.62	14.48	13.13
9/20/1999	97.75	98.83	0.46	0.16	6.55	6.65

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	59.25	55.87	-5.26	-5.58	5.26	5.58
9/14/1999	66.00	65.37	-0.92	-0.93	0.93	0.94
9/15/1999	85.25	85.10	-0.16	-0.16	0.30	0.30
9/16/1999	87.25	81.79	-5.54	-5.99	5.59	6.04
9/17/1999	92.75	90.97	-1.63	-1.68	1.81	1.86
9/18/1999	106.75	101.47	-4.39	-4.84	4.71	5.16
9/19/1999	100.25	98.98	-1.14	-1.17	1.50	1.53
9/20/1999	97.75	95.40	-2.87	-3.07	3.47	3.66

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	59.25	53.79	-8.74	-9.36	8.74	9.36
9/14/1999	66.00	61.79	-5.77	-6.16	7.86	8.21
9/15/1999	85.25	78.31	-7.81	-8.37	8.85	9.40
9/16/1999	87.25	76.84	-11.19	-12.17	11.19	12.17
9/17/1999	92.75	86.24	-6.47	-6.82	6.94	7.29
9/18/1999	106.75	94.67	-10.55	-11.88	12.41	13.70
9/19/1999	100.25	101.12	1.26	0.66	8.85	8.53
9/20/1999	97.75	83.18	-15.38	-17.46	15.38	17.46

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Table E-48. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics (%) for Central Texas Upwind Monitors (CAMS 59, 62, 601, 678), September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	65.02	60.33	-6.66	-7.23	9.65	10.13
9/14/1999	62.41	58.78	-5.26	-5.75	8.13	8.56
9/15/1999	80.23	76.21	-4.19	-4.91	7.50	8.16
9/16/1999	76.74	76.58	0.51	0.14	8.32	8.31
9/17/1999	86.07	83.84	-1.96	-2.30	7.66	7.81
9/18/1999	84.53	82.69	-2.23	-2.41	5.40	5.52
9/19/1999	89.66	92.44	3.21	2.97	5.97	5.80
9/20/1999	92.28	97.99	6.44	6.18	6.44	6.18

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	65.02	59.47	-8.17	-8.69	8.17	8.69
9/14/1999	62.41	58.04	-6.58	-7.04	6.80	7.27
9/15/1999	80.23	74.80	-6.05	-6.74	6.09	6.78
9/16/1999	76.74	73.58	-3.75	-3.93	4.06	4.23
9/17/1999	86.07	81.69	-4.80	-5.05	4.90	5.15
9/18/1999	84.53	81.34	-3.81	-3.97	4.37	4.52
9/19/1999	89.66	88.50	-1.19	-1.23	1.57	1.60
9/20/1999	92.28	92.30	0.03	0.03	0.07	0.07

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	65.02	56.66	-12.37	-13.50	12.37	13.50
9/14/1999	62.41	54.43	-12.27	-13.43	12.27	13.43
9/15/1999	80.23	68.70	-13.72	-15.15	13.72	15.15
9/16/1999	76.74	72.67	-4.63	-5.10	8.08	8.48
9/17/1999	86.07	76.09	-10.79	-11.81	12.62	13.61
9/18/1999	84.53	73.87	-12.64	-13.67	12.64	13.67
9/19/1999	89.66	82.71	-7.53	-8.02	7.53	8.02
9/20/1999	92.28	91.82	-0.16	-0.27	3.72	3.77

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Table E-49. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics (%) for Central Texas Monitors (CAMS 3, 23, 38, 58, 59, 62, 601, 678), September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	62.13	58.51	-5.19	-5.66	8.20	8.58
9/14/1999	64.46	65.12	1.66	1.03	8.35	8.12
9/15/1999	82.74	83.12	0.82	0.30	6.90	7.07
9/16/1999	81.99	80.44	-0.87	-1.34	8.60	8.76
9/17/1999	89.41	90.38	1.71	1.34	8.06	7.99
9/18/1999	95.64	93.61	-1.81	-2.19	6.55	6.78
9/19/1999	94.96	101.22	6.77	6.01	9.37	8.68
9/20/1999	95.02	98.41	3.45	3.17	6.50	6.41

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	62.13	57.67	-6.72	-7.14	6.72	7.14
9/14/1999	64.46	62.22	-3.35	-3.55	3.45	3.65
9/15/1999	82.74	79.95	-3.11	-3.45	3.19	3.54
9/16/1999	81.99	77.68	-4.64	-4.96	4.83	5.14
9/17/1999	89.41	86.33	-3.21	-3.36	3.35	3.50
9/18/1999	95.64	91.52	-3.96	-4.26	4.68	4.98
9/19/1999	94.96	93.74	-1.16	-1.20	1.54	1.57
9/20/1999	95.02	93.85	-1.42	-1.52	1.77	1.86

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	62.13	55.28	-10.48	-11.35	10.48	11.35
9/14/1999	64.46	58.54	-8.70	-9.44	9.90	10.61
9/15/1999	82.74	73.36	-10.95	-11.97	11.47	12.48
9/16/1999	81.99	74.65	-8.04	-8.78	9.77	10.47
9/17/1999	89.41	80.78	-9.18	-9.85	9.41	10.09
9/18/1999	95.64	84.15	-11.73	-12.92	12.66	13.84
9/19/1999	94.96	91.66	-3.42	-3.98	8.47	8.57
9/20/1999	95.02	87.22	-8.04	-9.15	9.81	10.90

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Table E-50. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics (%) for Corpus Christi Monitors - CAMS 4 & 21, September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	79.00	62.34	-19.60	**-22.29**	19.60	22.29
9/14/1999	83.00	69.91	-15.78	-17.13	15.78	17.13
9/15/1999	88.50	79.92	-9.58	-10.32	9.58	10.32
9/16/1999	84.00	79.98	-4.77	-4.91	4.77	4.91
9/17/1999	83.50	79.11	-5.27	-5.41	5.27	5.41
9/18/1999	92.00	99.94	8.64	8.28	8.64	8.28
9/19/1999	93.00	104.72	13.05	12.10	13.05	12.10
9/20/1999	84.00	86.88	3.58	3.49	3.58	3.49

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	79.00	62.34	-19.60	**-22.29**	19.60	22.29
9/14/1999	83.00	69.91	-15.78	-17.13	15.78	17.13
9/15/1999	88.50	79.92	-9.58	-10.32	9.58	10.32
9/16/1999	84.00	79.98	-4.77	-4.91	4.77	4.91
9/17/1999	83.50	79.11	-5.27	-5.41	5.27	5.41
9/18/1999	92.00	92.10	0.11	0.11	0.11	0.11
9/19/1999	93.00	92.95	-0.06	-0.06	0.06	0.06
9/20/1999	84.00	84.13	0.15	0.15	0.15	0.15

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	79.00	52.75	**-31.68**	**-38.39**	31.68	38.39
9/14/1999	83.00	62.39	**-24.76**	**-28.33**	24.76	28.33
9/15/1999	88.50	66.43	-24.94	-28.49	24.94	28.49
9/16/1999	84.00	68.27	-18.75	-20.72	18.75	20.72
9/17/1999	83.50	71.04	-14.92	-16.13	14.92	16.13
9/18/1999	92.00	91.27	-0.84	-0.95	4.59	4.63
9/19/1999	93.00	97.16	5.07	4.65	7.92	7.54
9/20/1999	84.00	72.78	-13.28	-14.24	13.28	14.24

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Table E-51. Peak Predicted/observed 8-hour Average Concentrations and Ozone Metrics for CAMS 87, September 13 – 20, 1999.

Methodology 1:

Date	MAXOBS1HR	MAXPRD1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	86.00	51.09	**-40.59**	**-50.93**	**40.59**	**50.93**
9/14/1999	76.00	67.43	-11.28	-11.95	11.28	11.95
9/15/1999	92.00	88.02	-4.33	-4.42	4.33	4.42
9/16/1999	87.00	84.09	-3.34	-3.40	3.34	3.40
9/17/1999	93.00	90.29	-2.91	-2.96	2.91	2.96
9/18/1999	94.00	85.76	-8.77	-9.17	8.77	9.17
9/19/1999	92.00	91.37	-0.68	-0.69	0.68	0.69
9/20/1999	110.00	91.67	-16.66	-18.18	16.66	18.18

Methodology 2:

Date	MAXOBS1HR	NEAR1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	86.00	51.09	**-40.59**	**-50.93**	**40.59**	**50.93**
9/14/1999	76.00	67.43	-11.28	-11.95	11.28	11.95
9/15/1999	92.00	88.02	-4.33	-4.42	4.33	4.42
9/16/1999	87.00	84.09	-3.34	-3.40	3.34	3.40
9/17/1999	93.00	90.29	-2.91	-2.96	2.91	2.96
9/18/1999	94.00	85.76	-8.77	-9.17	8.77	9.17
9/19/1999	92.00	91.37	-0.68	-0.69	0.68	0.69
9/20/1999	110.00	91.67	-16.66	-18.18	16.66	18.18

Methodology 3:

Date	MAXOBS1HR	CAMXPS1HR	Norm Bias	Fractional Bias	Norm Error	Fractional Error
9/13/1999	86.00	47.76	**-44.47**	**-57.18**	**44.47**	**57.18**
9/14/1999	76.00	61.97	-18.46	-20.34	18.46	20.34
9/15/1999	92.00	76.21	-17.16	-18.77	17.16	18.77
9/16/1999	87.00	81.47	-6.36	-6.56	6.36	6.56
9/17/1999	93.00	84.99	-8.61	-9.00	8.61	9.00
9/18/1999	94.00	76.46	-18.66	-20.58	18.66	20.58
9/19/1999	92.00	88.35	-3.97	-4.05	3.97	4.05
9/20/1999	110.00	87.70	-20.27	-22.56	20.27	22.56

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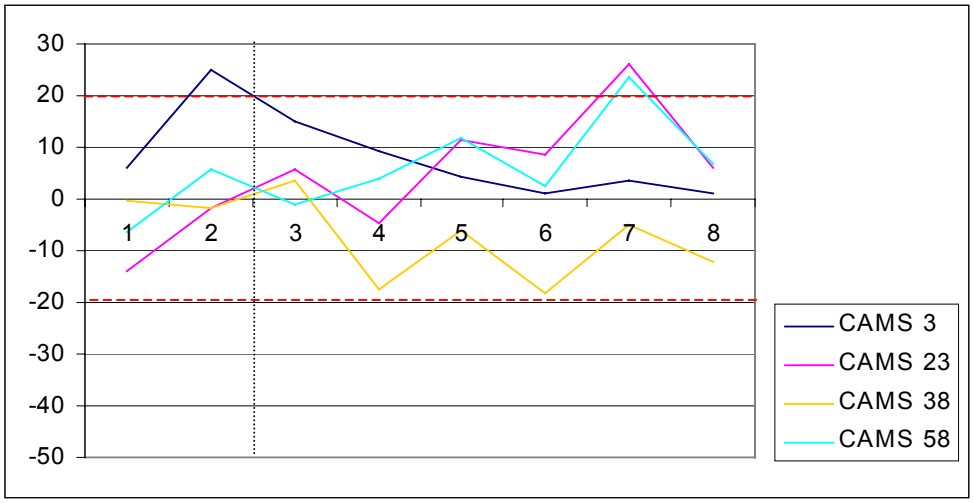
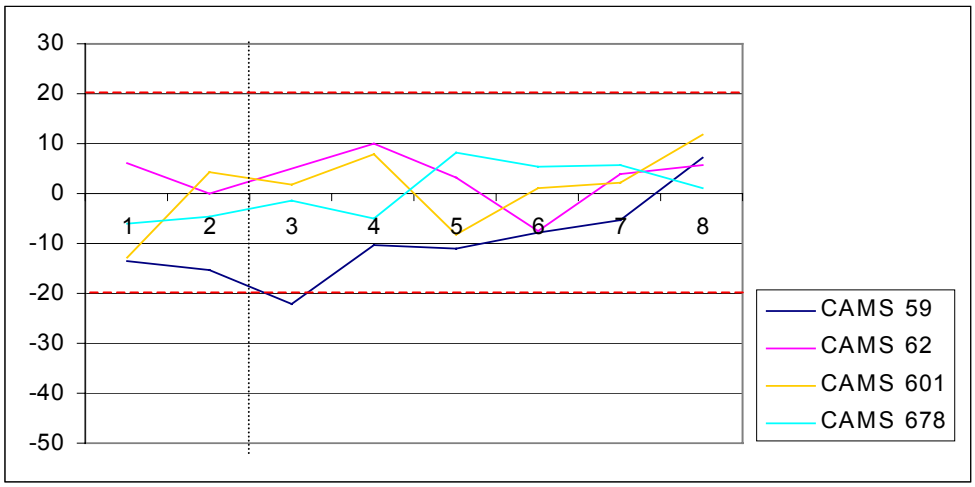
Figure E-33. Normalized Bias for Downwind, Upwind, and Coastal Monitors Calculated using Method 1, September 13- 20, 1999.

Downwind Monitors:



Upwind Monitors:



Coastal Monitors:

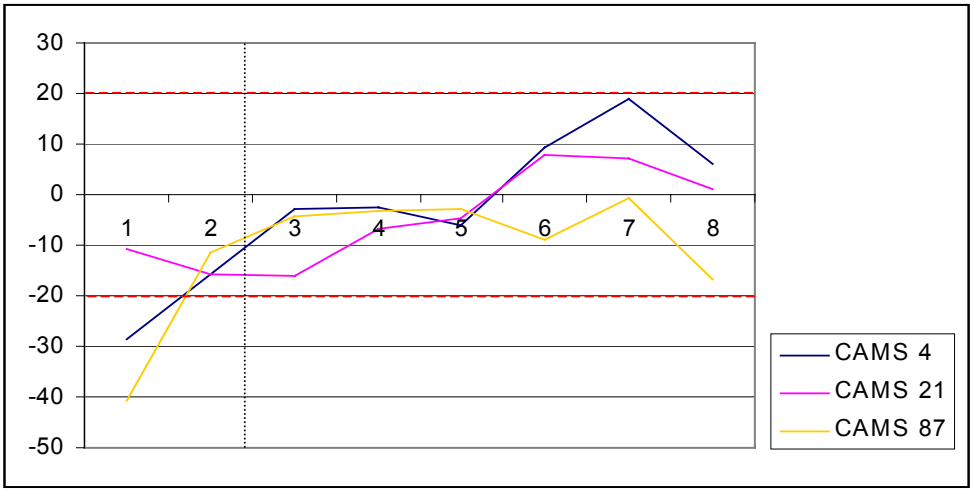


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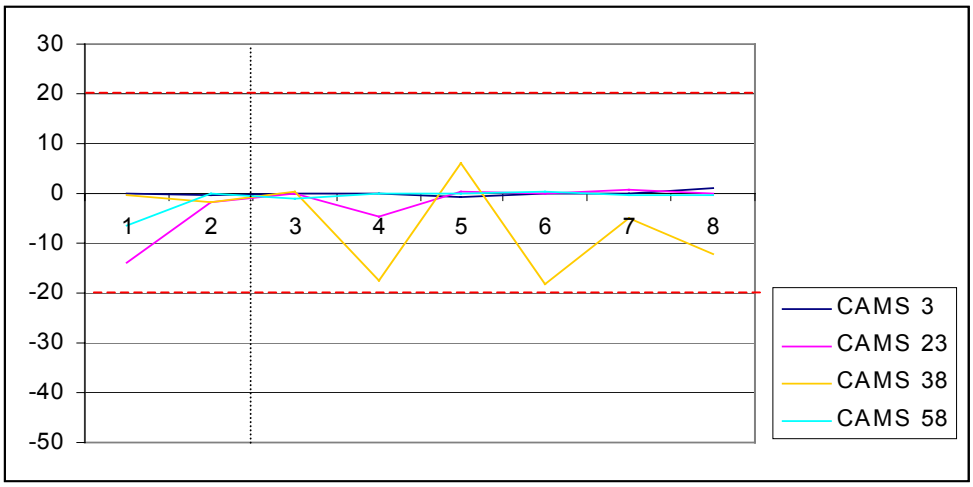
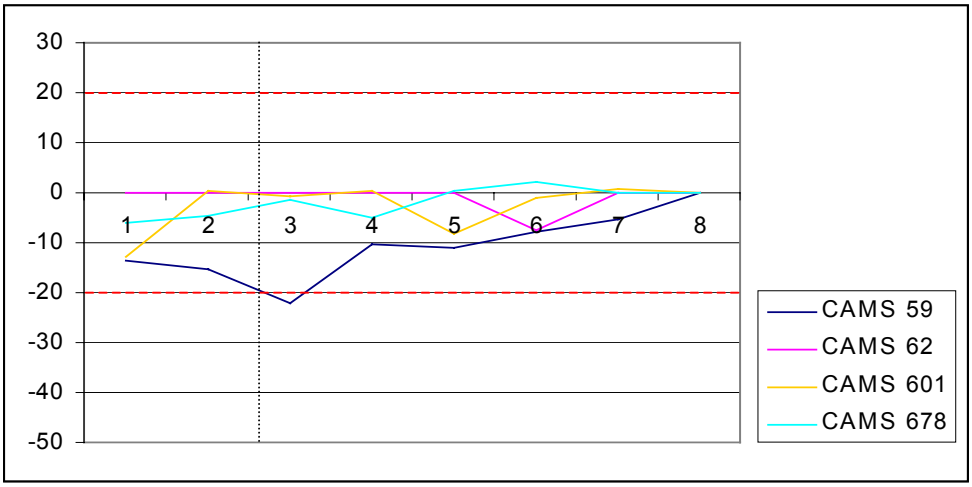
Figure E-34. Normalized Bias for Downwind, Upwind, and Coastal Monitors Calculated using Method 2, September 13- 20, 1999.

Downwind Monitors:



Upwind Monitors:



Coastal Monitors:

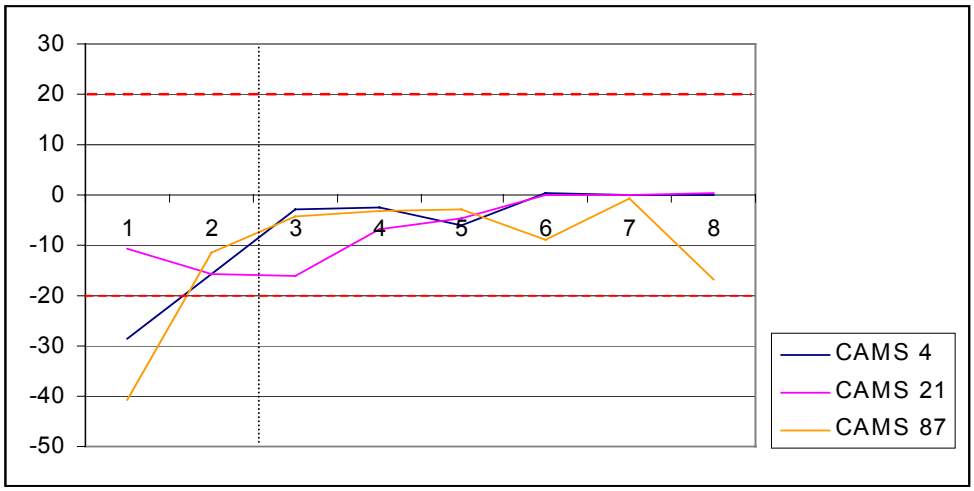


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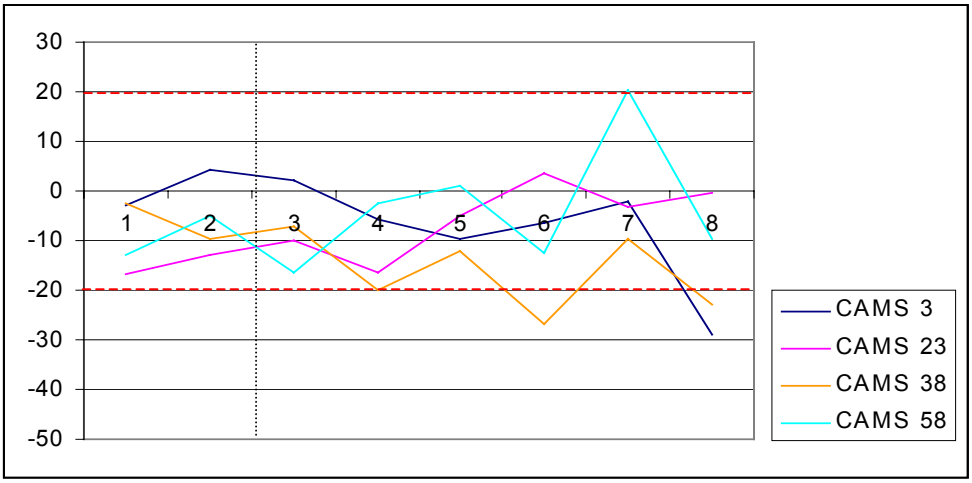
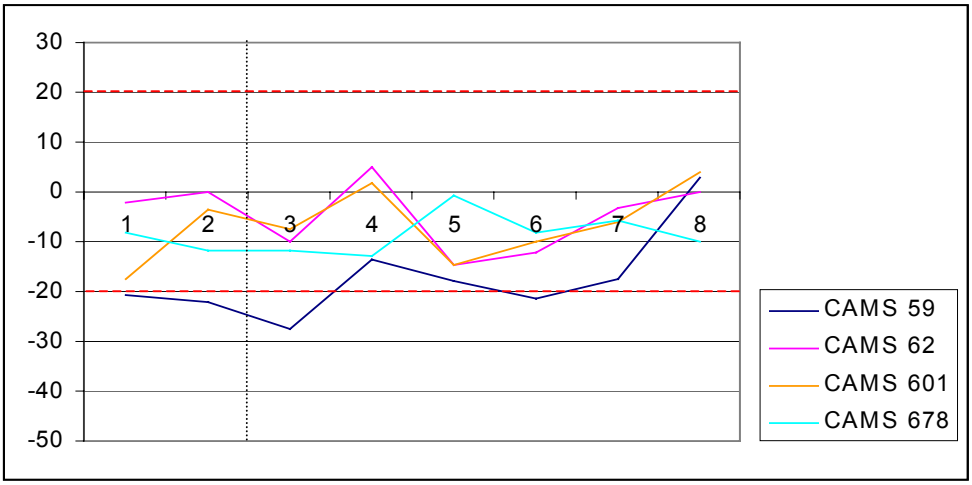
Figure E-35. Normalized Bias for Downwind, Upwind, and Coastal Monitors Calculated using Method 3, September 13- 20, 1999.

Downwind Monitors:



Upwind Monitors:



Coastal Monitors:

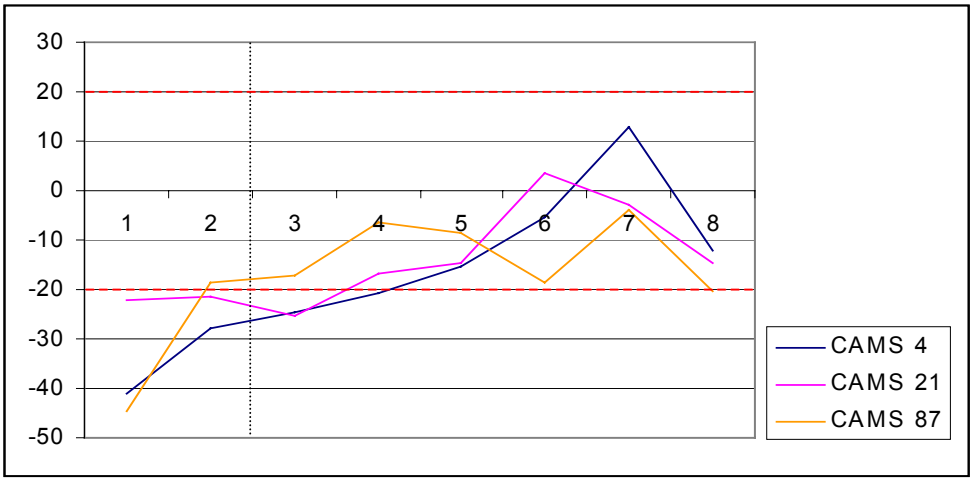


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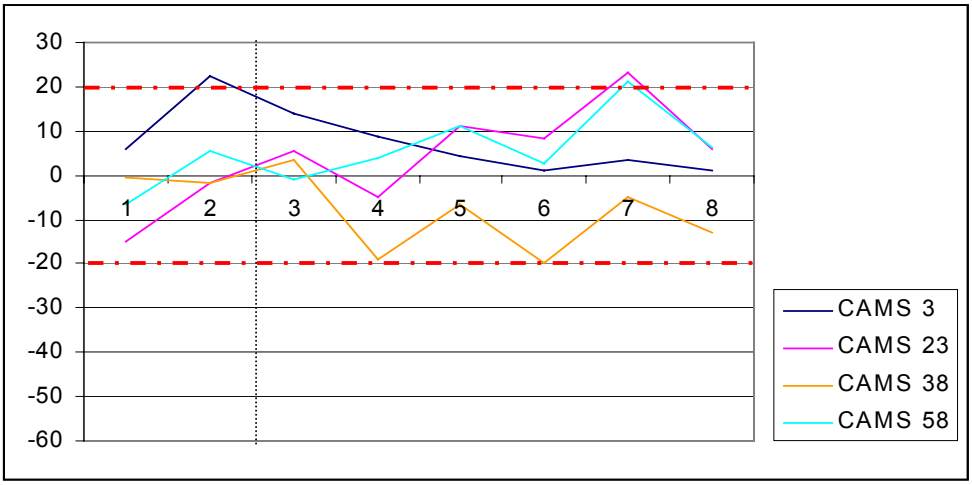
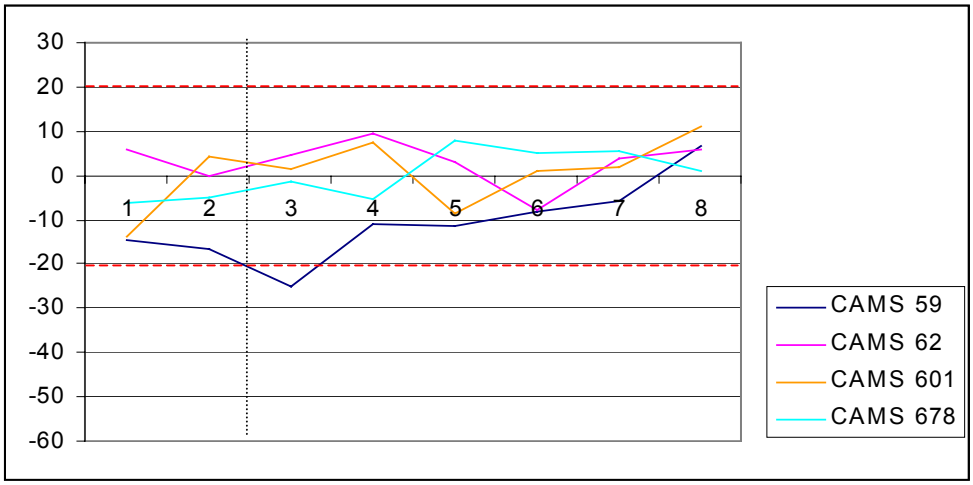
Figure E-36. Fractional Bias for Downwind, Upwind, and Coastal Monitors Calculated using Method 1, September 13- 20, 1999.

Downwind Monitors:



Upwind Monitors:



Coastal Monitors:

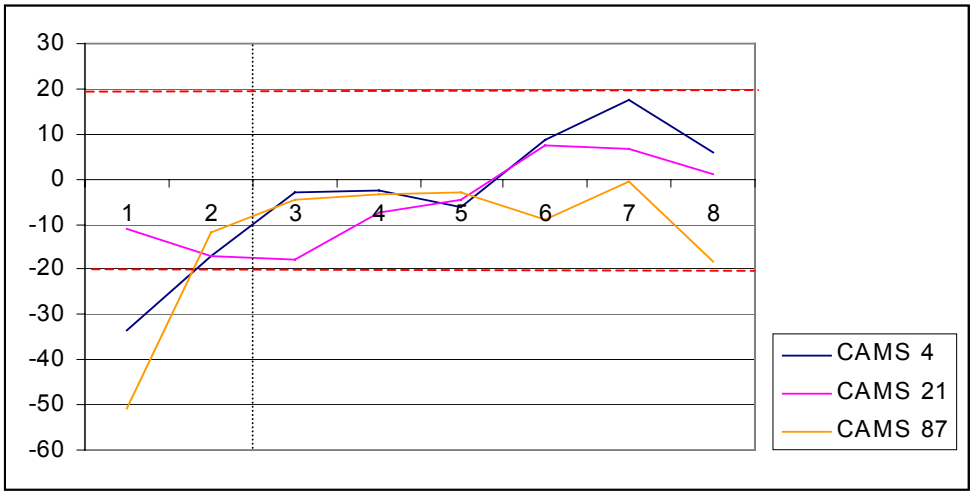


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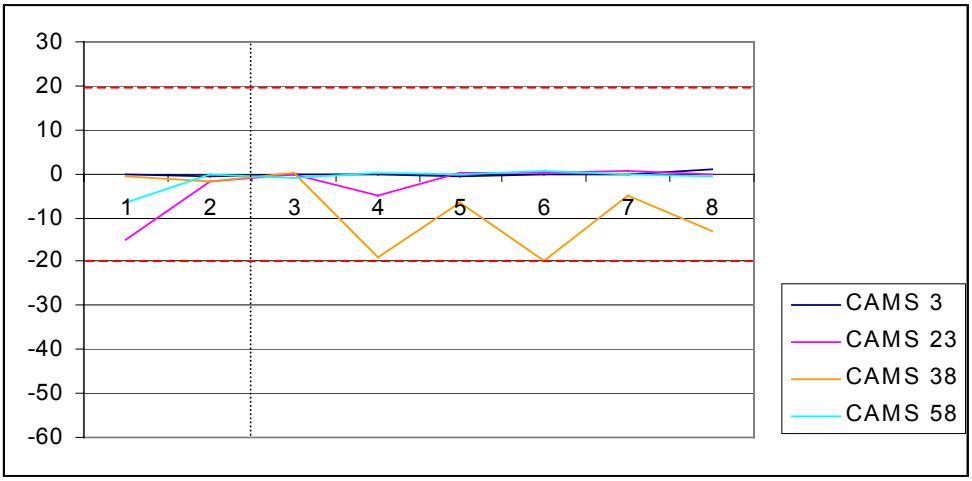
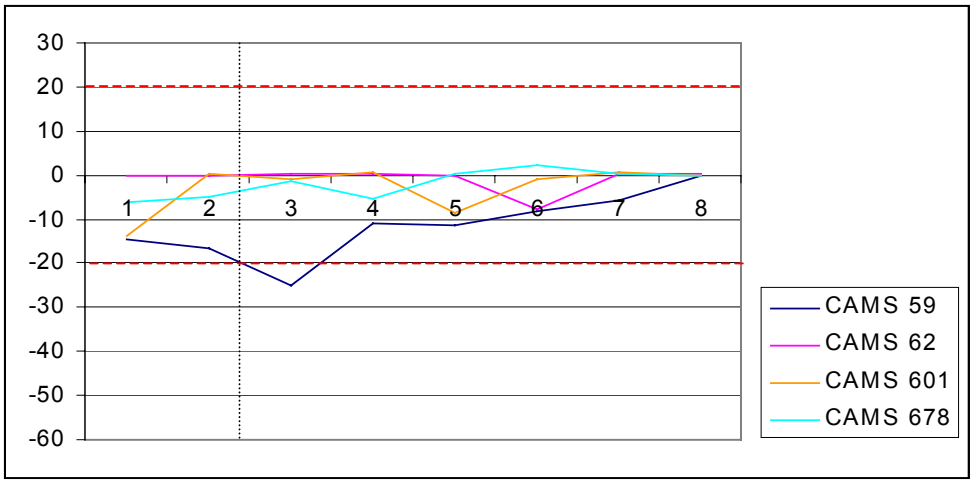
Figure E-37. Fractional Bias for Downwind, Upwind, and Coastal Monitors Calculated using Method 2, September 13- 20, 1999.

Downwind Monitors:



Upwind Monitors:



Coastal Monitors:

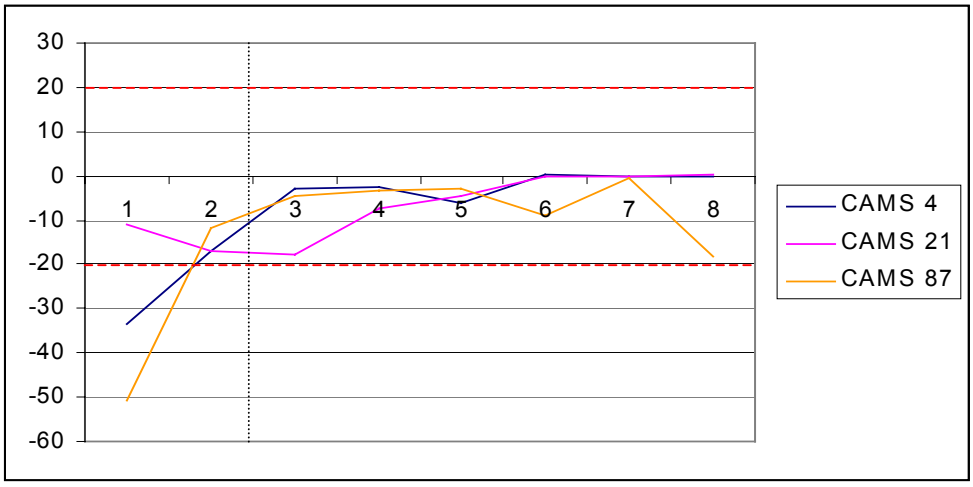


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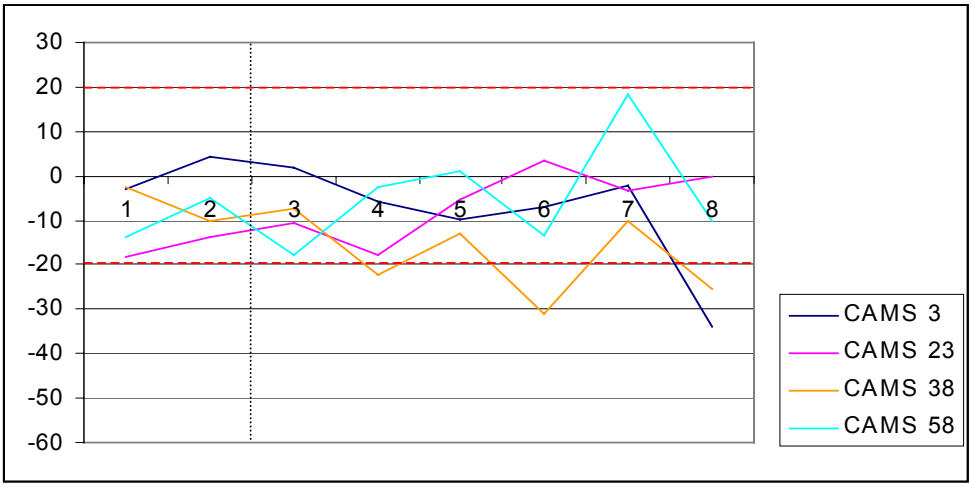
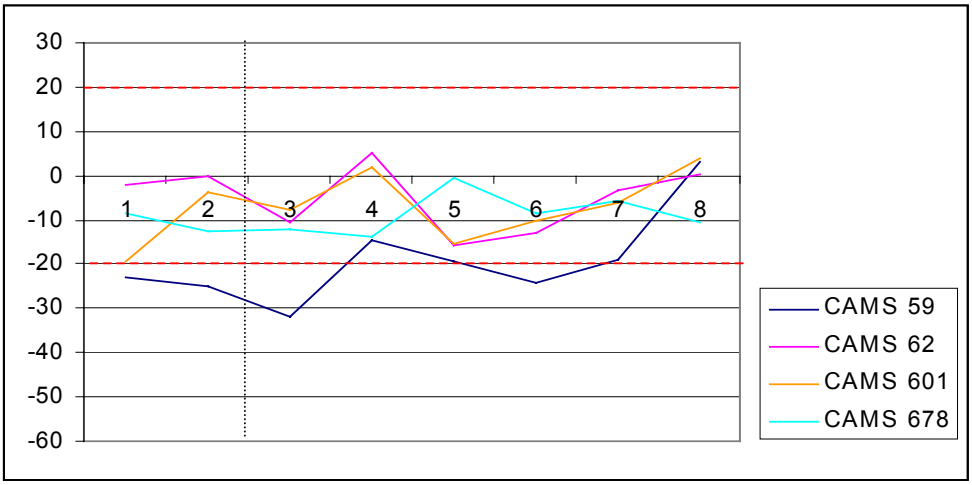
Figure E-38. Fractional Bias for Downwind, Upwind, and Coastal Monitors Calculated using Method 3, September 13- 20, 1999.

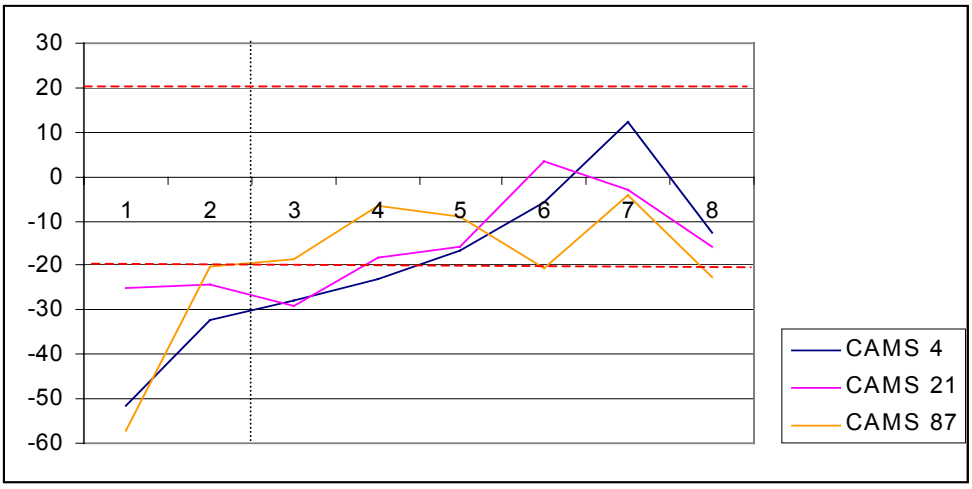
Downwind Monitors:



Upwind Monitors:



Coastal Monitors:



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Graphic Analyses
EPA also recommends the use of graphics to evaluate model performance (EPA 1999). These recommendations include the use of time series plots, tile plots, scatter plots and Q-Q plots. Results of all four graphics analyses are provided in this section.

Scatter/Q-Q Plots
Scatter and Q-Q plots were developed using the ENVIRON software program described in the ozone metrics section. Scatter and Q-Q data are combined into single plots for each methodology. Results of scatter and Q-Q analyses using the three methodologies for data at CAMS 23, CAMS 58, and the group of Central Texas monitors are provided in figures E-39 through E-41. Eight-hour average observed/predicted data points are designated by blue "+" signs. Q-Q points are designated by magenta circles. Eight-hour scatter/Q-Q plots for other monitors and groups of monitors, as well as one-hour plots will be made available to the TCEQ and EPA on compact disc.

Each scatter plot demonstrates moderate to large correlation coefficients, although there are a few observed/predicted data points that fall outside the ±20% indicator lines. Quantile points on the Q-Q plots follow the 1:1 reference line fairly well for each monitor and monitor group, with no points falling outside the ±20% indicator lines. The results from these analyses indicate a high degree of correlation between the paired predicted and observed data.

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Figure E-39. Scatter / Q-Q Plots for CAMS 23 Calculated using Three Methodologies.

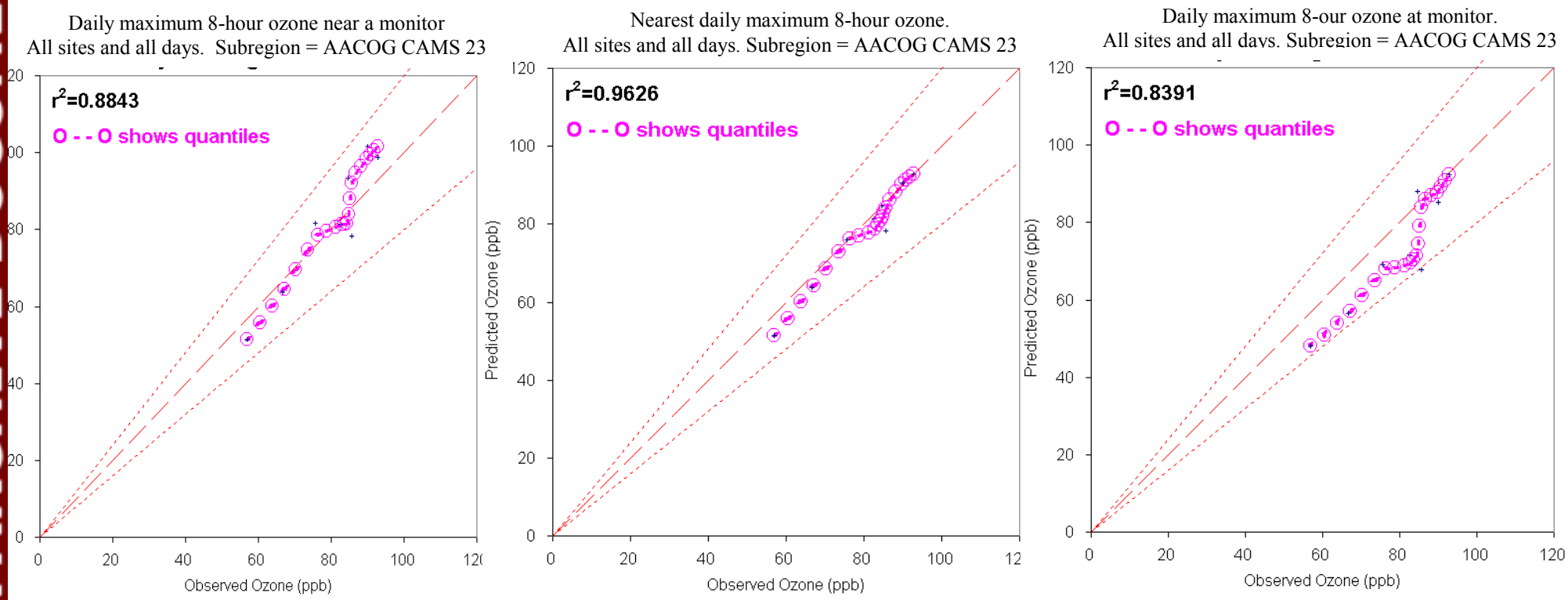

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Figure E-40. Scatter / Q-Q Plots for CAMS 58 Calculated using Three Methodologies.

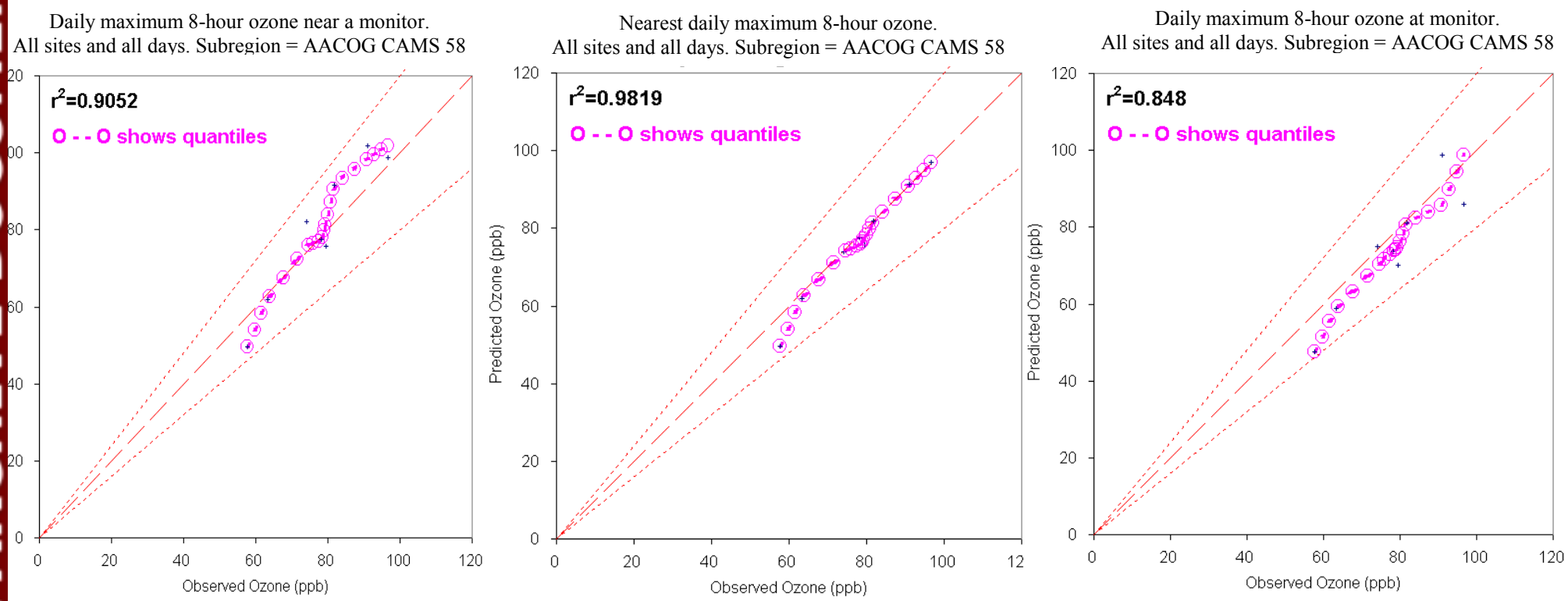

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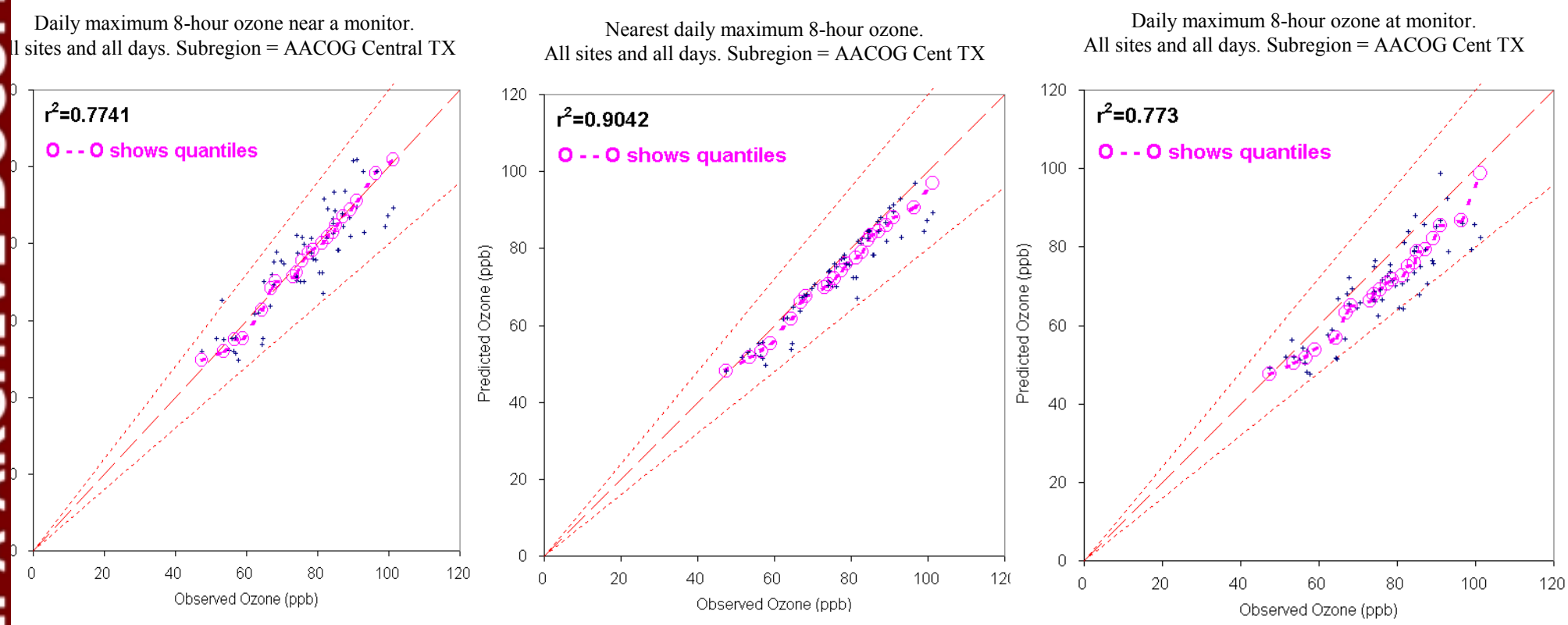
Figure E-41. Scatter / Q-Q Plots for the Eight Central Texas Monitors (CAMS 3, 23, 38, 58, 59, 62, 601, 678) Calculated using Three Methodologies.



Tile Plots

Tile plots provide an indication of where the model is or isn't performing correctly. These plots are visual representations of the model's predictions and provide such information as when and where the model predicts urban plumes. The following tile plots (figures E-42 through E-47) represent the 8-hour daily maximum concentrations within the modeling domain for each day of the primary episode.

As demonstrated by these plots, urban plumes are replicated well, both in terms of intensity and spatial allocation. Peak ozone concentrations are predicted downwind of city centers and major point sources in these tile plots.

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Figure E-42. Predicted Daily Maximum 8-hour Ozone Concentrations within the 4-km Subdomain for Wednesday, September 15, 1999.

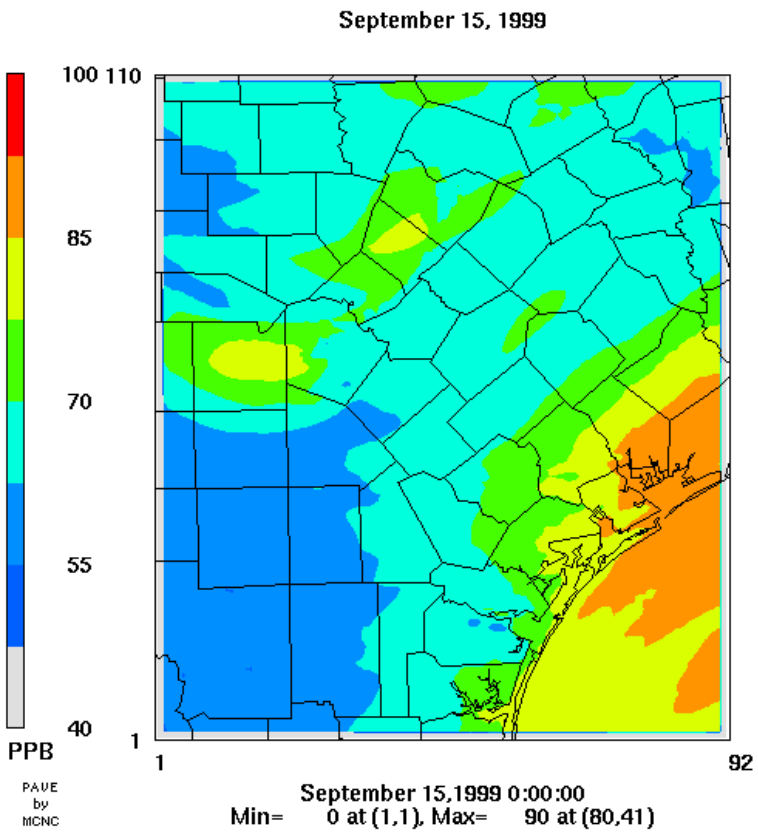

Figure E-43. Predicted Daily Maximum 8-hour Ozone Concentrations within the 4-km Subdomain for Thursday, September 16, 1999.

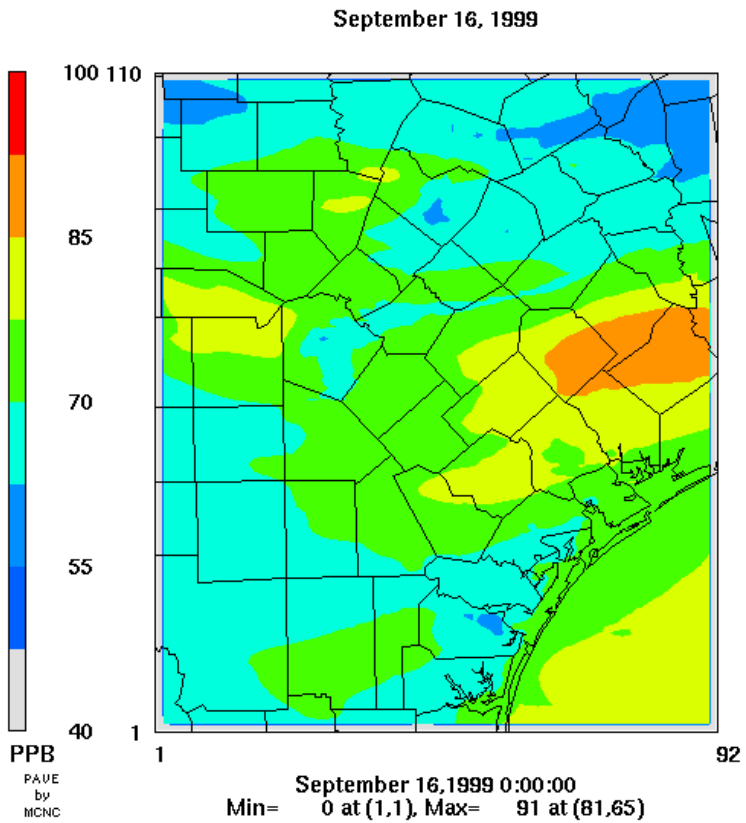

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Figure E-44. Predicted Daily Maximum 8-hour Ozone Concentrations within the 4-km Subdomain for Friday, September 17, 1999.

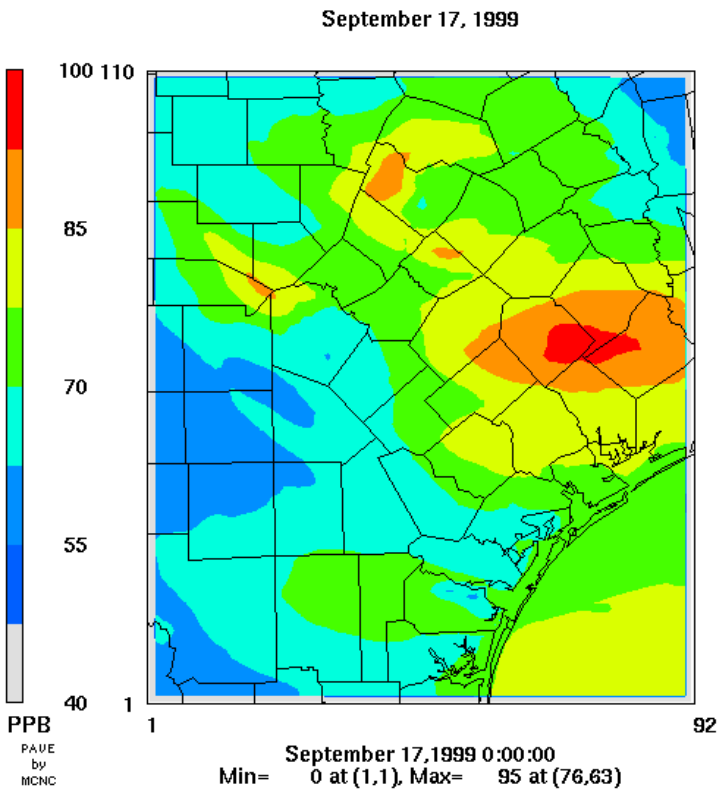

Figure E-45. Predicted Daily Maximum 8-hour Ozone Concentrations within the 4-km Subdomain for Saturday, September 18, 1999.

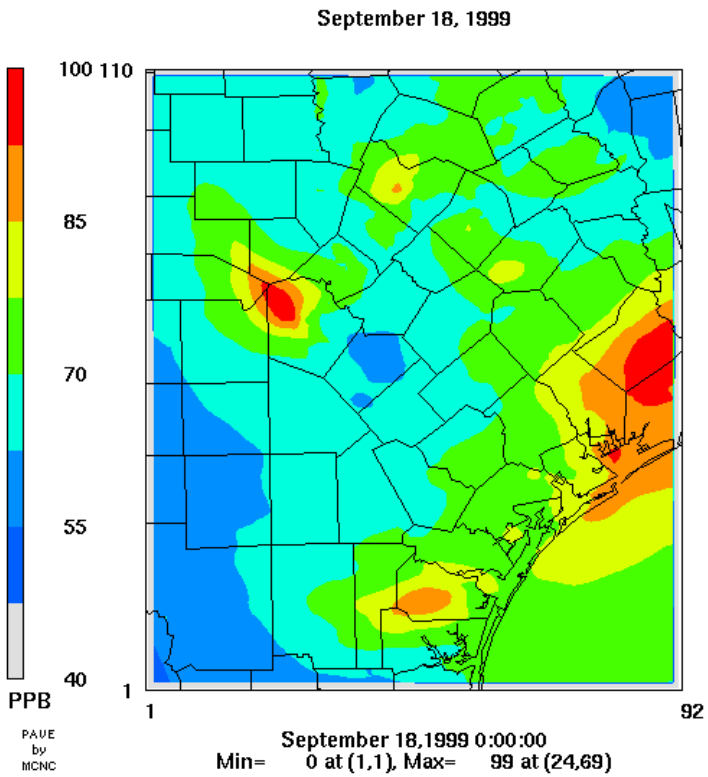

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Figure E-46. Predicted Daily Maximum 8-hour Ozone Concentrations within the 4-km Subdomain for Sunday, September 19, 1999.

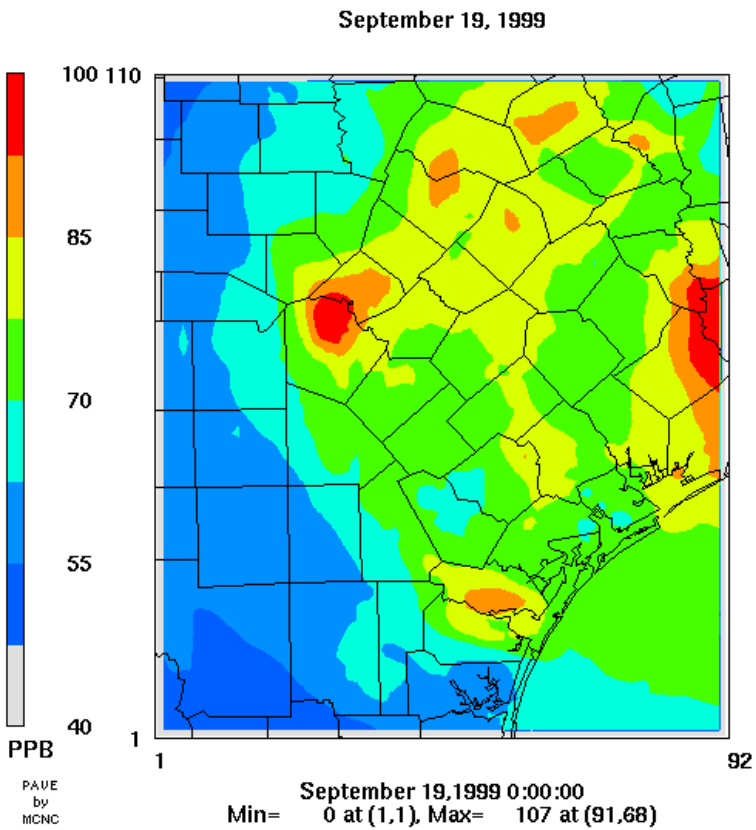
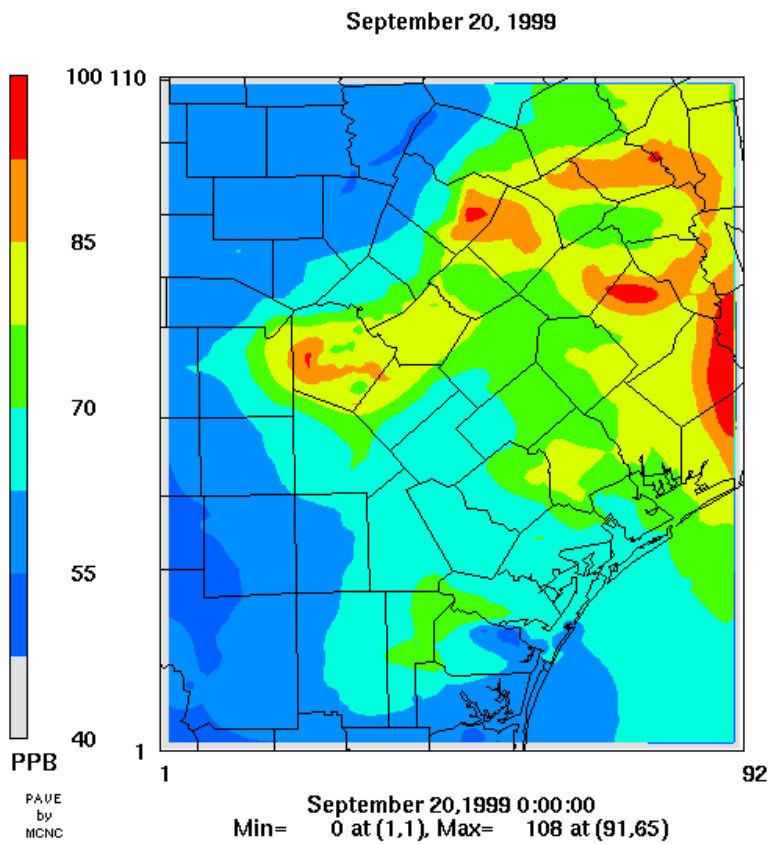


Figure E-47. Predicted Daily Maximum 8-hour Ozone Concentrations within the 4-km Subdomain for Monday, September 20, 1999.



Diagnostic Evaluations

Diagnostic tests are conducted throughout model development to assist with identifying and troubleshooting performance problems. An important method of conducting diagnostic evaluations involves the use of sensitivity tests. These tests are conducted by perturbing various types of model input. For example, sensitivity tests were conducted on the 1999 episode by altering the model's boundary conditions. As a result of these tests, some boundary conditions were modified from default values to measurements collected during studies of background concentrations (described in appendix B).

Sensitivity tests may also be used to evaluate the base and future case runs to ensure the model responds appropriately to changes in emissions inputs and to estimate the impact of control strategies. This section presents the results of conducting sensitivity runs on the 1999 base case as a means of assessing the responsiveness of the model and providing an indication of which type of emissions reductions may be most useful for improving air quality in the San Antonio region.

Zero-out Runs: Urban Areas

One sensitivity evaluation involved removing the anthropogenic VOC and NOx emissions for the 8-county Houston area from the photochemical model. Similarly, two other sensitivity runs were conducted by removing anthropogenic precursor emissions for the 5-county Austin area and 2-county Corpus Christi area from the model. All three of these urban areas were upwind of the SAER on at least one September 1999 episode day.

The results of removing anthropogenic emissions were averaged over the 6-day primary episode period (September 15 – 20th) for each of the three sensitivity runs. Figure E-48 provides the estimated average reductions in ozone concentrations within the SAER after removing the anthropogenic emissions for Austin, Corpus Christi, and Houston from the model. As indicated, removing Houston's precursor emissions had the greatest impact on estimated ozone concentrations in the San Antonio region (2.72 ppb), followed by Corpus Christi (0.64 ppb), and Austin (0.27 ppb).

These outcomes are consistent with the meteorological conditions that existed during the episode. Although Austin is closer in proximity to San Antonio, back trajectory information indicates that wind parcels traveled through Houston and Corpus Christi more often during the September 1999 episode than through Austin. In addition, Houston is a much larger source of precursor emissions than either Corpus Christi or Austin.

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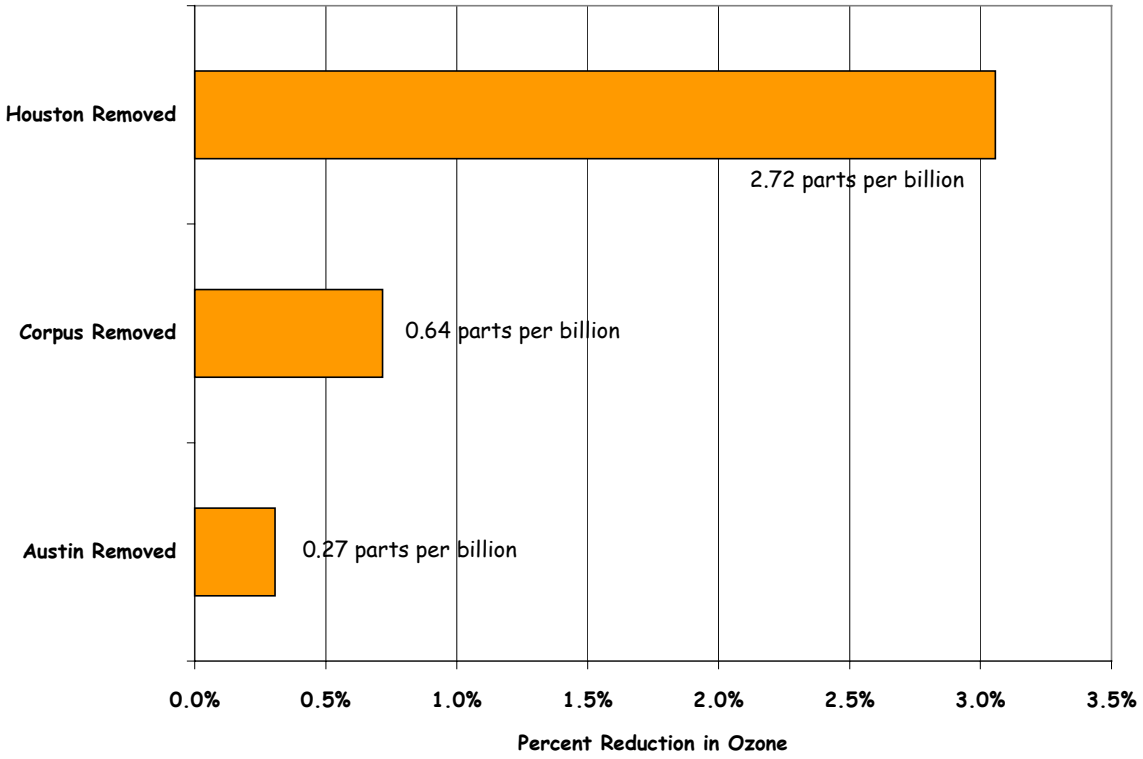
Figure E-48. Predicted Reduction in Ozone Concentrations (%) in the SAER after Removing Austin, Corpus Christi, and Houston Anthropogenic NOx and VOC Emissions from the Photochemical Model. (Average reductions for September 15 – 20, 1999).



Incremental Removal of VOC and NOx Precursors

Across-the-board sensitivity runs were conducted by removing 25%, 50%, 75%, and 100% of the local (4-county SAER) NOx emissions, VOC emissions, and combinations of the two, from the CAMx Run 17b model. Figures E-49 through E-54 provide the results of the across-the-board reduction runs for each day of the primary episode. These graphs provide the model's ozone concentration predictions at CAMS 23, the controlling monitor, as the result of reducing local precursor emissions, compared to the monitor's design value.

Due to time constraints, VOC/NOx reduction analyses were not conducted on the final run, CAMx Run 18. However, several precursor sensitivity runs were conducted on a prior version of the September 1999 model, CAMx Run 17b. The primary difference between CAMx Run 17b and CAMx Run 18, for the 1999 base cases,[4] was the use of a refined MOBILE6 on-road EI in the latter model, as described in section 3.4 of the Executive Summary. Rerunning all the sensitivity tests again on Run 18 would have added an enormous amount of work. Based upon experience, it was assumed that the

[4] The 2007 projection developed from CAMx Run 18a incorporates a refined regional EI (described in Section 3.6 of the Executive Summary); however, the regional EIs for Runs 17b and 18a 1999 base cases are identical.

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general findings and directional guidance determined from previous runs would remain stable with relatively small emissions adjustments.

As indicated by the VOC/NOx sensitivity runs, reductions of NOx, VOC, or a combination of NOx and VOC effectively reduced ozone concentrations at the 25% reduction level on most episode days. An exception occurs on September 17th, when the model predicts a NOx reduction disbenefit as the result of removing 25% and 50% of the anthropogenic SAER emissions. Because of the NOx reduction disbenefit predicted on the 17th and 20th, reducing VOC emissions alone, not a combination of VOC and NOx reductions, was the most effective method of reducing ozone concentrations on those episode days. Another point that is evident from these analyses is that, in general, VOC reductions were more effective than NOx reductions over the range of controls required to demonstrate attainment.

Figure E-49. Predicted Ozone Concentrations at CAMS 23 after Removing Local (4-county SAER) NOx and VOC Emissions from Simulation 17b, September 15, 1999.

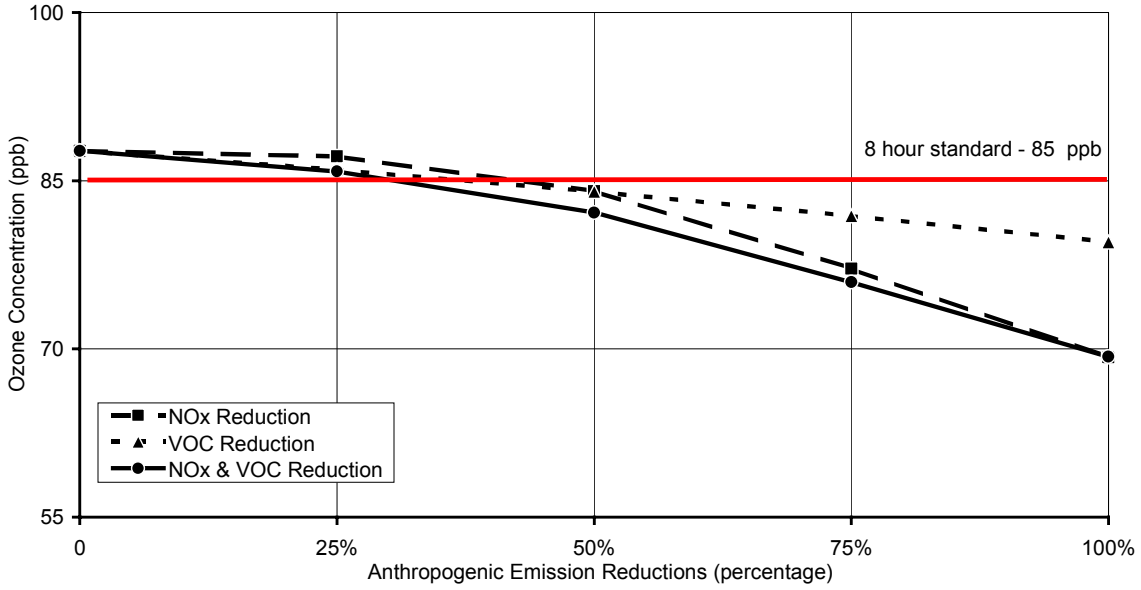

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Figure E-50. Predicted Ozone Concentrations at CAMS 23 after Removing Local (4-county SAER) NOx and VOC Emissions from Simulation 17b, September 16, 1999.

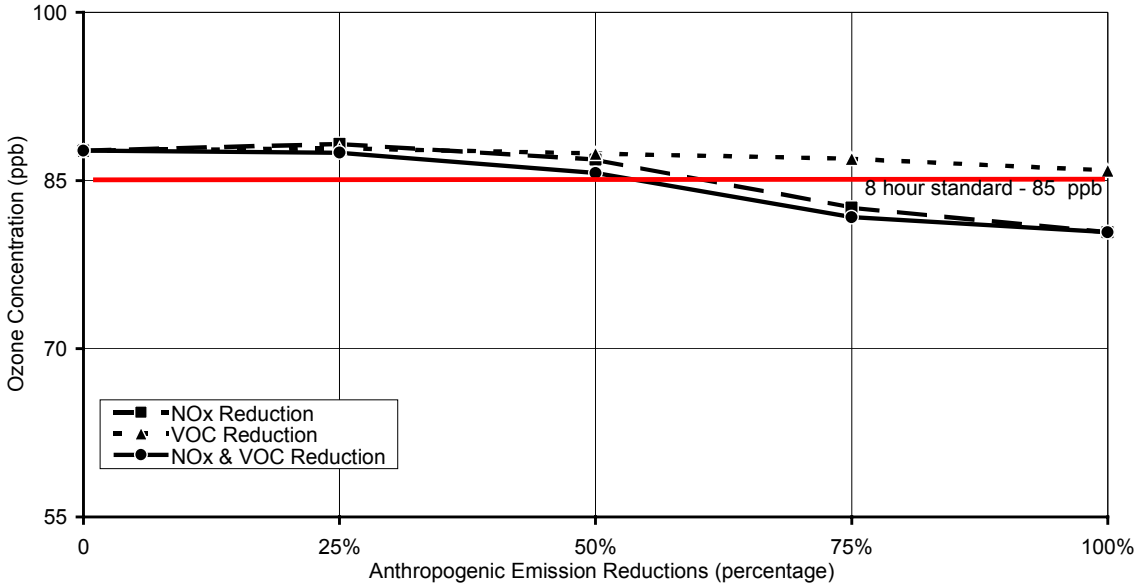

Figure E-51. Predicted Ozone Concentrations at CAMS 23 after Removing Local (4-county SAER) NOx and VOC Emissions from Simulation 17b, September 17, 1999.

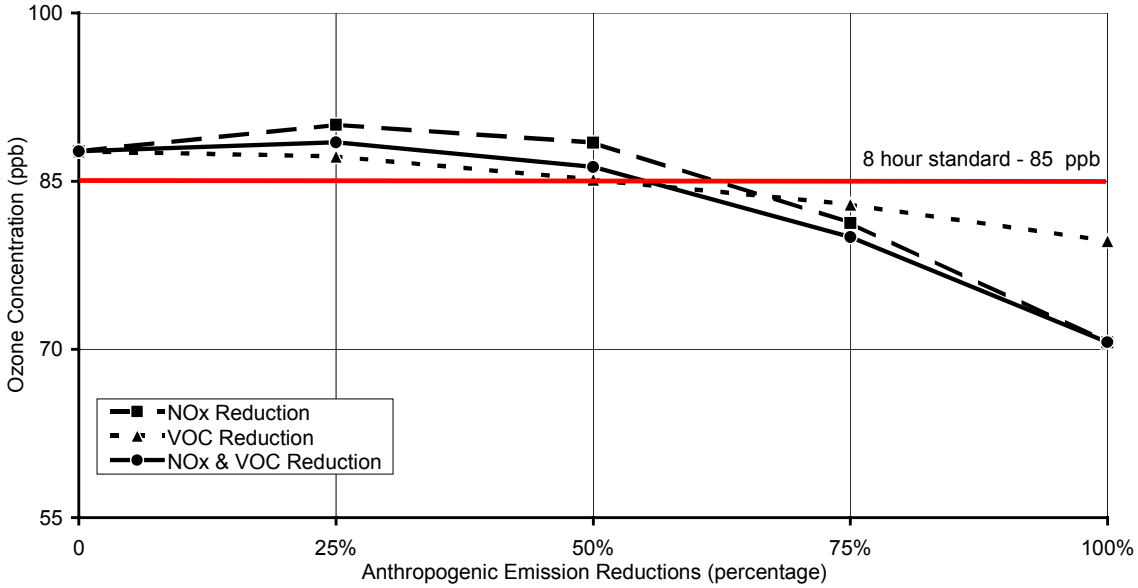

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Figure E-52. Predicted Ozone Concentrations at CAMS 23 after Removing Local NOx and VOC Emissions from Simulation 17b, September 18, 1999.

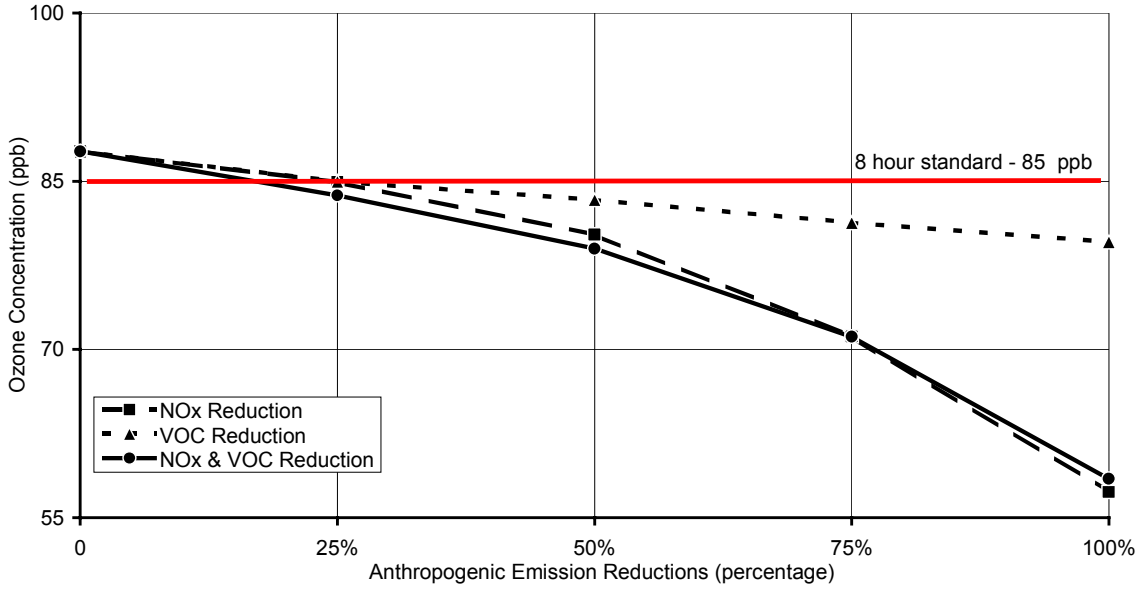

Figure E-53. Predicted Ozone Concentrations at CAMS 23 after Removing Local NOx and VOC Emissions from Simulation 17b, September 19, 1999.

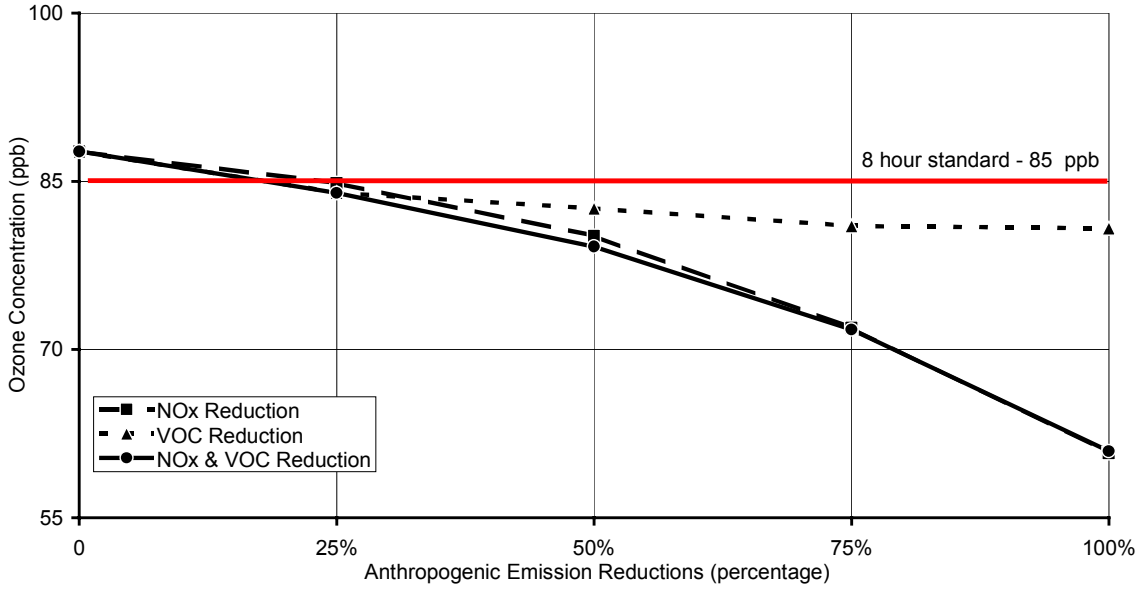

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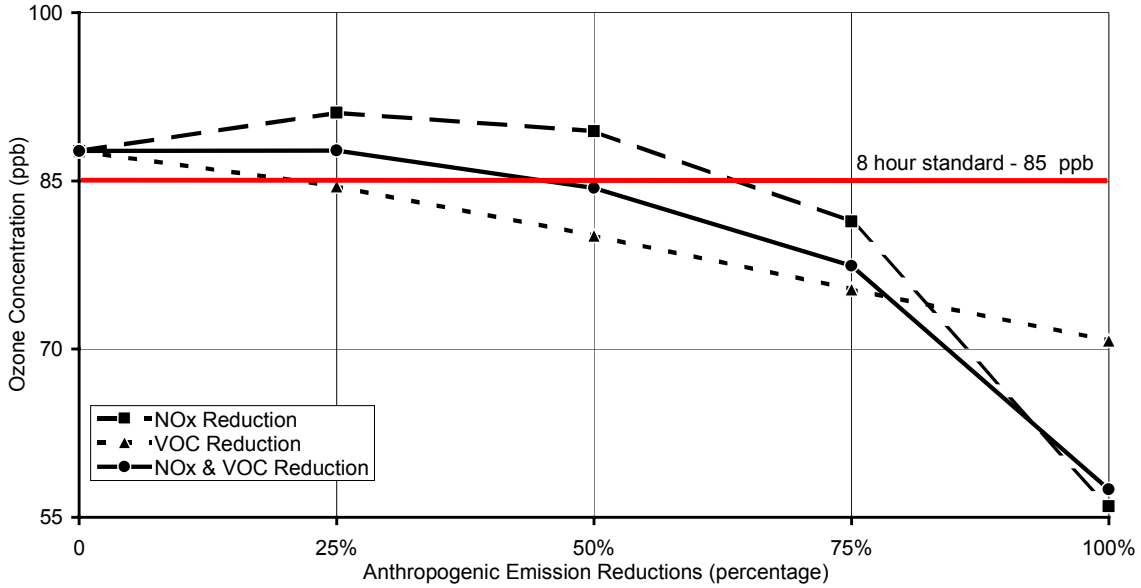
Figure E-54. Predicted Ozone Concentrations at CAMS 23 after Removing Local NOx and VOC Emissions from Simulation 17b, September 20, 1999.



COMPARISONS BETWEEN UT AUSTIN AND AACGO 1999 BASE CASES

Although the original September 1999 model was developed by ENVIRON and refined through a collaboration between ENVIRON and UT Austin (meteorological model and air quality input refinements), the model was eventually provided to the NNA partners (or their contractors) for further modifications. These modifications included refinement of the emissions inventory inputs, development of the future case, and clean air strategy analyses. Because the model was modified by more than one agency during this process, there was a concern that the various agencies' models would become dissimilar and provide different predictions for the base case, future case, and control strategy runs.

A great amount of effort was spent ensuring that the Austin and San Antonio base and future cases contained identical input. Often this involved discussions between the two agencies, as well as TCEQ, regarding the most appropriate EI data for local and regional areas. Discrepancies in emissions inputs were corrected prior to the final AACOG run and the final UT run.

An analysis was conducted by AACOG staff to determine any differences between the final 1999 run refined by UT Austin and the final run refined by AACOG, based on ozone predictions near two Austin monitors. The results of these analyses are provided in table E-52. The table lists peak predictions within the 7x7 array of cells near the Murchison and Audubon monitors for the AACOG (highlighted in yellow) and UT 1999 base cases.

As shown, the differences between predictions by AACOG's final run (labeled 1999_sos.f) and UT's final run (labeled 1999_v3) are insignificant. With regards to the Murchison monitor, the average difference (six episode days) in ozone concentrations between the two 1999 base cases was 0.00 ppb, while the average difference at the

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Audubon monitor was 0.05 ppb. The 2007 future cases developed by AACOG and UT Austin were similarly compared. These comparisons are provided in appendix G.

The performance of the September 1999 photochemical model was thoroughly analyzed and tested by AACOG staff, both in terms of 1-hour and 8-hour predictions, using a variety of EPA-recommended performance evaluations. Because the model is being used by other Texas NNA regions, performance analyses have been conducted by other agencies as well. Each has concluded that the September 1999 model meets EPA-acceptance criteria for attainment demonstration modeling. Furthermore, comparisons between the 1999 base case refined by AACOG and the 1999 base case refined by UT Austin provides additional, independent verification of the quality of the model in terms of performance.

Table E-52. Comparison of Predicted Peak 8-hour Concentrations for Final UT and AACOG Base Case Runs.

Monitor	UT **1999_v3**	AACOG **1999_sos.f**	Average Difference	**Days**	Date
MURCHISON	84.6	84.6	0.00	6	9/15 – 9/20
AUDU	81	80.9	0.05	6	9/15 – 9/20
Monitor	UT **1999_v3**	AACOG **1999_sos.f**	Daily Difference	Days	Date
MURC	77.8	77.8	0.0	1	9/15
MURC	75.5	75.4	0.1	1	9/16
MURC	86.8	86.7	0.1	1	9/17
MURC	84.5	84.4	0.1	1	9/18
MURC	89.6	89.7	-0.1	1	9/19
MURC	93.6	93.6	0.0	1	9/20
AUDU	76.2	76.1	0.1	1	9/15
AUDU	78.2	78.2	0.0	1	9/16
AUDU	87.4	87.4	0.0	1	9/17
AUDU	84.5	84.4	0.1	1	9/18
AUDU	89.4	89.5	-0.1	1	9/19
AUDU	70.1	70.2	-0.1	1	9/20

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APPENDIX F

2007 FUTURE YEAR MODELING EMISSIONS INVENTORY DEVELOPMENT

SAN ANTONIO EAC REGION ATTAINMENT DEMONSTRATION

MARCH 2004

AACOG
Alamo Area Council
Of Governments

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BACKGROUND

The Early Action Compacts (EAC) for both Austin and San Antonio require attainment of the National Ambient Air Quality Standards (NAAQS) by 2007. For this reason, development of an accurate 2007 Emission Inventory (EI) is an important part of air quality modeling for attainment demonstration. The impacts of all federal and state air quality policies on emissions of ozone precursors and the pollution control strategies adopted by the nonattainment and EAC areas, included in the photochemical modeling domain, were taken into account when the air quality projections were made for the San Antonio area.

General Refinements to the 2007 Emission Inventory Inputs

All the adjustments and refinement applied to the 1999 EI are also reflected in the 2007 EI. These adjustments and fine tunings have been documented and can be found in Appendix D of this State Implementation Plan (SIP) document.

Adjustments to Temporal Input Data

The adjustment factors were either provided by ENVIRON, or extracted from Texas Commission on Environmental Quality (TCEQ) and EPA default files, or were developed in-house based on the information from local surveys and local data. The EPA default data can be found online.[1] The local weekly and monthly adjustments were based on survey results from the 1999 Net Emission Trends (NET) emissions inventories.

All hourly data was either provided by ENVIRON or extracted from TCEQ default files; there were no survey-based adjustments to the hourly data. The temporal adjustments for tanker truck unloading, Source Classification Code (SCC) 2501060053, were provided by the EPA. These temporal allocations are contained in the following files:
month_prof_042902.db
temporal.pdf
tprl_xref_030701.dbf
tprl_xref_0307 01.xls
week_prof_121400.dbf
wkd_diurnal_prof_121400.dbf[2]

ON-ROAD SOURCE EMISSIONS FOR 2007 PROJECTION

The mobile sources in 2007 EI account for all federal motor vehicle control programs, including the effects of offset Heavy Duty Diesel Vehicle (HDDV) defeat devices, the low emissions rebuild program, and the HDDV 2004 standard pull-ahead. Emissions from on-road sources are calculated using the EPA's MOBILE6 model.

Regional

On-road emissions for states included in the modeling domain are contained within the 36 km grid system and were provided by TCEQ. ENVIRON, a consultant company, provided emissions for the rural counties of Texas using MOBILE5, which are the best available at this time for these counties.

Mobile source projections for areas outside of Texas were developed with MOBILE6 and were provided by TCEQ to Alamo Area Council Of Governments (AACOG).

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[1] Available at: http://www.epa.gov/ttn/chief/emch/temporal/
[2] Email from Gary McGaughy (UT Austin) received on 2/9/04, "Fwd: latest draft 2007 files."

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On-Road Mobile Sources of Texas
The Texas link- based information received from Texas Transportation Institute (TTI) was adjusted to account for two state programs: the Texas Low-Emissions Diesel (LED) Fuel program and the Texas Regional Low Reid Vapor Pressure Gasoline Program. The MOBILE6 model contains options for user-specified alternate diesel fuel parameters. This model in conjunction with a post-processing step involved applying adjustment factors to the model's outputs for NOx emissions were used to estimate the effects of TX-LED fuel on the on-road emissions.

AACOG staff integrated MOBILE6 on-road files into the photochemical model for all major urban areas of Texas, when available. The TCEQ directory, "MOBILE6 On-Road Emission Data for Texas Near Nonattainment Area Ozone Episodes Emissions for 1999 Base Case & 2007 Future Case" (updated on December 5, 10, and 13, 2002; originally posted on October 2, 2002), contains MOBILE6-based on-road mobile source emissions data that were used to support photochemical modeling efforts for the Texas near - nonattainment areas of:
- Austin 3-county Region
- Corpus Christi
- San Antonio (Bexar County only)
- Tyler-Longview
- Victoria

The ozone episode for the Austin, Corpus Christi, San Antonio, and Victoria areas extends from Monday September 13, 1999 through Monday September 20, 1999. The ozone episode for the Tyler-Longview area extends from Friday August 13, 1999 through Sunday August 22, 1999. Inventory data exist for both the 1999 "base cases" and 2007 "future cases" of these episodes. Four "day type" inventories are provided for each area and calendar year:
- Weekday (Monday-Thursday)
- Friday
- Saturday
- Sunday

The inventories were developed under contract to the TCEQ TTI and converted into a photochemical model-ready format by TCEQ staff using the 2X version of the Emissions Preprocessor System (EPS2X).

TTI provided AACOG with 2007 on-road emissions for an average September weekday, Friday, Saturday, and Sunday. Since the 1999 modeling episode, including ramp-up period, spanned eight days, the average September weekday file was adjusted to account for temperature differences between Monday (September 13, 1999), Tuesday (September 14, 1999), Wednesday (September 15, 1999), Thursday (September 16, 1999), and Monday (September 20, 1999). This methodology was the same as that used for estimating the 1999 weekday on-road EI.

San Antonio Region
In August 2003, TTI completed the MOBILE6 version 2 gridded on-road input files for Bexar County. The files were made available by the TCEQ and provided in model-ready

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format on that agency's file transfer protocol (ftp) web site.[3] The TTI files provided on-road emissions for an average September weekday, Friday, Saturday, and Sunday. Pollutant specific factors were used to convert the emissions from the 1999 county-wide MOBILE5 totals to 2007 county-wide MOBILE6 ver. 2 totals for Comal, Guadalupe, and Wilson counties.

Austin Region
The emission files for Bastrop and Caldwell contain pollutant specific factors for converting from the 1999 county-wide M5 totals to 2007 county-wide M6 ver. 2 totals. Travis, Hays, and Williamson county on-road emissions were developed by TCEQ and based on TTI emission estimates.

The TTI files for Austin contained an adjustment made to one roadway. 45% of the MoPac NOx emissions were removed to account for the lesser emissions on MoPac freeway as compared to the greater emissions on the IH-35 expressway. This adjustment was made because the two roads were both categorized as freeways, exaggerating the NOx emissions on MoPac.

Houston/Galveston Region
MOBILE6 on-road files were also obtained for the Houston area.[4] However, the Houston on-road emission rates were estimated for an August 2007 timeframe. Therefore, several adjustments were necessary to make the files suitable for use in the September 2007 episode.

The August 2007 vehicle emission rates were adjusted to reflect the correct month. This was accomplished using the MOBILE6 model. Two runs were conducted for Houston using MOBILE6: one with appropriate settings (such as hourly temperature) for the August 2007 episode and one with appropriate settings for a September 2007 timeframe. The percent difference between the two was applied, in concert with a Vehicle Miles Traveled (VMT) adjustment to account for the difference between total VMT for the two runs, to the 2000 Houston link-based on-road emission file.

The 2007 MOBILE6 LBASE input files aggregate the 28 vehicle-types (EPA) into 13 (LDGV & LDGT1-4, HDGV2b, HDGV3, DHGV4-8b, LDDV & LDDT12 & LDDT34, HDDV22, HDDV3, HDDV4-7, HDDV8a-b, MC, HDGB, HDDBT, and HDDBS) categories; the 13 roadway-types are aggregated into 2 (freeway & arterial) categories.[5]

[3] Available: ftp://ftp.tceq.state.tx.us (April 4, 2003)
[4] Email: from Chris Kite (TCEQ) received 12/10/02 (NNA areas) and 02/28/03 (Houston area).
[5] Email: from Chris Kite (TCEQ) received 02/28/03, "MOBILE6 LBASE Input Files for Houston."

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Table F-1. Photochemical Model Jobs & Files for 2007 EI Development of On-Road Sources.

Region	Job Scripts	Input Files	Description
Regional (outside Texas)		emiss.mv.regional.Mobile6.fy07.xxx	TCEQ processing of emissions.
Texas Rural Counties *CAPCO Counties:* Bastrop & Caldwell *AACOG Counties:* Comal , Guadalupe, & Wilson	pream.txnna.4km.HPMS	AMS.mv.HPMS.hourly.xxx.yyyyyy.a0	Process of 1999 MOBILE5 emissions developed by ENVIRON.
	cntlem.txnna.4km.mobile5.HPMS.2007	mvfactors.nonlink.2007.yyyyyy	Contain pollutant specific factors for converting from the 1999 county-wide M5 totals to 2007 county-wide M6 ver. 2 totals (Bastrop, Caldwell, Comal, Guadalupe, & Wilson).[6] Also projects other Texas rural county emissions from 1999 to 2007 MOBILE5.
Houston counties: Fort Bend Harris Waller	lbase.mobile6.4km.2007.houston chmspl.mobile6.4km.2007.houston grdem.mobile6.4km.2007.houston	mobile6.2007.55mph.$county.yyyyyy.lbase_in	Processing of 2007 emissions. 55mph scenario advised by TCEQ.[7]
	cntlem.mobile6.4km.houston.2007	ctl.onroad.LINKS.daily.yyyyyy	Project emissions from August 2007 to September 2007.[8]
Bexar and Victoria county	lbase.mobile6.4km.2007.LINKS.b chmspl.mobile6.4km.2007.LINKS.b grdem.mobile6.4km.2007.LINKS.b	m6.2007.$county.xxx.yyyyyy.lbase_in	Process the MOBILE6 on-road emission inventory by UT based on TTI emissions data.[9]
	cntlem.mobile6.4km.LINKS.2007	madjin.dummy.$county.yyyyyy	Adjusts mobile6 on-road emission inventory for individual episode weekdays 2007 for Bexar County.[10]

[6] Email: Alba Webb (UT Austin) received 11/17/03: "RE:2007 Mobile6.2 Files for Austin/San Antonio",
[7] Email: from Chris Kite (TCEQ) received 02/28/03, “MOBILE6 LBASE Input Files for Houston.”
[8] Email: from Chris Kite (TCEQ) received 02/28/03, “MOBILE6 LBASE Input Files for Houston.”
[9] Email: from Gary McGaughy (UT Austin) received 09/25/03, “FWD: 2007 Mobile6.2 Files for Austin/San Antonio.”

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Corpus Christi 2-county region	lbase.mobile6.4km.2007.corpus chmspl.mobile6.4km.2007.corpus grdem.mobile6.4km.2007.corpus	m6.2007.Corpus_2County.xxx.yyyyyy.lbase_in	Process the mobile6 on-road emission inventory based on TTI emissions data.[11]
Gregg and Smith counties	lbase.mobile6.12km.LINKS.2007 chmspl.mobile6.12km.LINKS.2007 grdem.mobile6.12km.LINKS.2007	m6.2007.Tyler_2County.xxx.08yy.lbase_in	AACOG process of MOBILE6 emissions with local data for August 2007.
	cntlem.mobile6.12km.LINKS.2007	ctl.onroad.LINKS.daily.yyyyyy	Project emissions from August 2007 to September 2007.
Houston/Galveston 8-county region	lbase.mobile6.12km.houston.2007 chmspl.mobile6.12km.houston.2007 grdem.mobile6.12km.houston.2007	mobile6.2007.55mph.$county.hourly.08yy.lbase_in	Process of MOBILE6 emissions based on TTI processing with local data for August 2007. [12]
	cntlem.mobile6.12km.houston.2007	ctl.onroad.LINKS.daily.yyyyyy embr.chmspl.mv.LINKS.12km.$county.hourly.xxx.yyyyyy.a0	Project emissions from Aug. 2007 to Sept. 2007.
Houston-Galveston 8-County region, Gregg county and Rural Counties	mrguam.mobile6.12km.mv.2007	emiss.mv.mobile6.12km.gregg.xxx.yyyyyy.a0 emiss.mv.mobile6.12km.brazoria.xxx.yyyyyy.a0 emiss.mv.mobile6.12km.chambers.xxx.yyyyyy.a0 emiss.mv.mobile6.12km.fortbend.xxx.yyyyyy.a0 emiss.mv.mobile6.12km.galveston.xxx.yyyyyy a0 emiss.mv.mobile6.12km.harris.xxx.yyyyyy a0 emiss.mv.mobile6.12km.liberty.xxx.yyyyyy.a0 emiss.mv.mobile6.12km.montgomery.xxx.yyyyyy.a0 emiss.mv.mobile6.12km.waller.xxx.yyyyyy.a0 emiss.mobile5.mv.HPMS.12km.2007.$hpms_xxx.yyyyy.a0	Script for running MRGUAM module Mobile emission inventory (12km level)
All Texas Counties	mrguam.mobile6.4km.mv.2007	emiss.mv.mobile6.4km.bexar.xxx.yyyyyy.a0 emiss.m6.links.4km.Austin_3County.roadnox.yyyyyy emiss.mv.LINKS.4km.nueces.xxx.yyyyyy.a0 emiss.mv.LINKS.4km.sanpatricio.xxx.yyyyyy.a0 emiss.mv.links.4km.vic.yyyyyy emiss.mv.LINKS.4km.fortbend.xxx.yyyyyy.a0	Script for running MRGUAM module for the Mobile emission inventory (4km level) in 2007. Austin files provided by UT and based on TTI emission data, contain IH-35/MoPac adjustment.[13] Victoria

[10] Email: from Gary McGaughy (UT Austin) received 09/25/03, "FWD: 2007 Mobile6.2 Files for Austin/San Antonio."
[11] Email: from Chris Kite (TCEQ) received 08/29/03, "1999 Gridded Onroad Mobile CAMx Files for NNA Subdomain."
[12] Email: from Chris Kite (TECQ) received 02/28/03, "MOBILE6 LBASE Input Files for Houston."
[13] Email from Alba Webb (UT) received 01/16/04, "Revised Mobile files."

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		emiss.mv.LINKS.4km.harris.xxx.yyyyyy.a0 emiss.mv.LINKS.4km.waller.xxx. yyyyyy.a0 emiss.mv.mobile5.HPMS.2007.$hpms_day. yyyyyy.a0	emission files provided by UT based on TTI emission data.[14]
Texas and Regional	mrguam.mv.all_reg.mobile6.2007	emiss.mv.all_counties.12km.yyyyyy.a0 emiss.mv.regional.Mobile6.fy07.xxx	Merge Mobile emissions for the Regional Grid, 2007.[15]

[14] Email from Alba Webb (UT) received 03/11/04, "RE: Gifs attached."
[15] Email: from Ron Thomas (TCEQ) received 12/03/03, "more HDD 2007 EI parts."

BIOGENIC SOURCE EMISSIONS FOR 2007 PROJECTION
Emission rates that result from natural processes in vegetation and soils were developed for the year 1999 by TCEQ technical staff using the GLOBEIS mode (TNRCC). Because changes in biogenic emissions are very difficult to predict, the EPA recommends the use of identical biogenic emission rates between base year and future year models. Therefore, the 2007 simulation incorporates TCEQ's 1999 biogenic emissions input files.

POINT SOURCE EMISSIONS FOR 2007 PROJECTION
TCEQ maintains comprehensive, annual point source databases for the State of Texas. In addition, the state agency develops point source projections for use in modeling, SIP development, and other applications. AACOG staff obtained the 2007 Texas electric-generating unit (EGU) and non-electric generating unit (NEGU) emission files developed for the Houston SIP and used the data to update the 2007 emission inventory inputs. These files were supplemented with local data when available. Some examples of local data used are the 2007 emission projections for Lackland Air Force Base hospital EGUs and the City Public Service power plants, which were provided to AACOG by the facilities' staff and incorporated in the 2007 simulation.

Since emission projections must account for growth and control factors, the 2007 point source emissions were developed based on the anticipated impacts of two Texas laws promulgated in 1999: Senate Bill 7 and Senate Bill 766. Senate Bill 7 limits NOx emissions from grandfathered electric generating facilities and Senate Bill 766 increases emission fees on grandfathered non-electric generating facilities.

Bexar County
Tessman Road Land Fill Gas (LFG) Power Station
The proposed Tessman Road LFG Power Station is located in Bexar County near Converse, TX. Emissions from station are based on six Deutz TBG 620 V16 engines producing electricity from methane and other landfill gases.

Comparison of the Deutz Engine to Flare Burning
AACOG Solid Waste Advisory Committee (SWAC) stated in the memorandum to the Board of Directors, dated November 29, 2001, that the project will not create a significant impact on the air quality of the area. While the NOx emissions increase, the VOCs and Particular Matter emissions show decreases from the estimated levels for flare burning.

Table F-2. Estimated Emissions of Deutz Engines and those of Flare Burning at the Tessman Rd LFG Power Plant.

Pollutant	Deutz Engine : 6 Engines (tons/day)	Flame Burning Equivalent to 6 Engines (tons/day)
NOx	0.179	0.065
CO	0.596	0.352
VOC	0.049	0.073
PM	0.027	0.055

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Toyota Facility

Toyota proposed to build the plant in two phases. Estimates from plant construction emissions are not included. The emissions discussed in this appendix are from operation of the plant only.[16]

Phase 1 - Emission estimations from production for period beginning with Start of Production (SOP) in 2006 until Phase 2 SOP:

- VOC = 5 tons/day * 250 days/yr. = 1250 tons per year (Emissions mainly from painting, cleaning, sealers, adhesives, & Natural Gas Combustion.)
- NOx = 0.34 tons/day * 365 days/yr. = 125 tons per year (Emissions mainly from Nat. Gas boilers/space heaters/misc. process heating; this rate is a maximum and will decrease in the summer months.)
- CO = 0.2 tons/day * 365 days/yr. = 73 tons per year (Emissions from same Nat. Gas sources listed above.)
- SO2 = 1-2 TPY (Emissions from same emitters as Nat. Gas sources listed above.)
- PM = 0.16 tons/day * 250 days/yr. = 40 tons per year (Emissions mainly from combustion, painting, and welding.)

Phase 2 - Production estimation following Phase 2 SOP beginning between 2008-2010 All emissions are projected to double with Phase 2 SOP.

[16] Toyota Motor Manufacturer North America (TMMNA), November 18, 2002.

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Table F-3. Photochemical Model Jobs & Files for 2007 EI Development of Point Sources.

Counties/Region	Job Script	Input Files	Description
Regional		lo_pt.grdem.Aug30.reg_12km.reg_egu_hdd2007_noTX lo_pt.grdem.Aug30.reg_12km.reg_negu_hdd2007_noTX pstpnt.out.Aug30.reg_12km.reg_egu_hdd2007_noTX pstpnt.out.Aug30.reg_12km.reg_negu_hdd2007_noTX	HDD EI: Two top files are for low level emissions (<30m above the ground). Two bottom files are for high level emissions (>30m above the ground).
Texas Counties	pts.TX_egus.2007.v15b	tceq_egu_2007_02102004.afs	TCEQ processing emissions data for S and PO.[17]
		control.07TX-HG_egu	SB7 and Ch. 117 NOx rules for EGUs in TX outside of HGA.
		control.HG_NOxCap_EGU	Houston/Galveston 8-county EGUs to the levels of the 2007 & 2010 NOx Cap (MECT), 88% EGU NOx reduction from 2000.
		control.austin_egu	Austin Area NOx control factors for facility specific value.[18]
	pts.TX_new_egus.2007.v15b	afs.hgmcr2004.new_egu_TX.lcp.austin	TCEQ processing of Texas S and PO NEW EGU 2007 point sources. (Original file: afs.hgmcr2004.new_egu_TX.lcp[19]).[20]*
	mrguam.pts.nna4km.2007	emiss.pt.TX_negu.008030.2007.v15b emiss.pt.TXnna4km_minorpts.99po.xxx emiss.pt.TXnna4km_offshore.xxx emiss.pt.hrly_egu.000830.2007.v15b	Merging point sources in NNA Texas 4km modeling domain. Elevated CPS emissions not merged. Offshore emissions were not increased.
	pts.TX_egus.2007.v15b[21]	tceq_egu_2007_02102004.afs	Processing of Texas 2007 S and PO for existing EGUs.
	pts.TX_negu.2007.v15b	afs.tx_negu.agg_re.000818-000906.v15b.3pols.lcp	TCEQ processing of Non-EGUs.[22]
		control.00-07.DFW.NEGU.NOx	Cntlem package for DFW NEGUs.

[17] Ron Thomas & Gabriel Cantu (TCEQ), 2/9/04.
[18] Thomas Pavlovic (UT Austin), 02/11/04.
[19] Ron Thomas & Gabriel Cantu (TCEQ), 2/9/04.
[20] Email: from Gary McGaughey (UT Austin) received 02/12/04, "2007 TX pt source data and jobs."
[21] Ron Thomas and Gabriel Cantu (TCEQ) 02/06/2004
[22] Email: from Gary McGaughey (UT Austin) received 02/12/04, "2007 TX pt source data and jobs." Input data received from Ron Thomas and Gabriel Cantu 02/06/2004

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Texas Counties	pts.TX_negu.2007.v15b (continued)	control.2007.BPA.NEGU	Includes survey results and BPA NOx emission factors, Chapter 117 limitations to obtain 2000-2007 control factors.
		control.HG_07NOxCap_NEGU	HGA 8-co NEGUs to the levels of the 2007 NOx a 52% reduction from 2000.
		TIPIEGASGrowthFactors00to07	Project from 2000 to 2007 using TIPI factors, EGAS where TIPI data was unavailable.
		AgreedOrdersControlFactors00to07	This packet controls emissions according to Agreed Orders from 2000 emissions to 2007.
		ctl.alco	Control factors set to provide 28.50 TCEQ tpd to 26.66 tpd.[23]
		ctl.lehigh	NOx control factors to revise Lehigh Cement Kiln.[24]
Bexar County	afs.toyota	afs.toyota.2007	Process of the afs (geo-coded) for Toyota Phase1.
	afs.tessman	afs.tessman.2007	Process of the afs (geo-coded) emissions from Tessman Road LFG Power Station.
Regional	mrguam.pts.all_reg.2007	emiss.pt.hrly_egu.000830.2007.v15b emiss.pt.hrly_new_egu.000830.2007.v15b emiss.pt.TX_negu.008030.2007.v15b emiss.pt.TX_offshore.xxx lo_pt.grdem.Aug30.reg_12km.reg_egu_hdd2007_noTX lo_pt.grdem.Aug30.reg_12km.reg_negu_hdd2007_noTX	Regional low- level point sources where developed by TCEQ.[25]

*The input afs file is the originals TCEQ file with NOx emissions for AE Sand Hills multiplied by factor of 1.0798 to bring the total from the TCEQ value of 0.9502 tpd to 1.0260 tpd. (Thomas Pavlovik, 2/11/04).

[23] Email: from Thomas 02/12/2004.
[24] Email: from Gary McGaughey (UT Austin), received 02/12/04, “2007 TX pt source data and jobs.” Original data supplied by Bill Gill (CAPCO).
[25] Email: from Ronald Thomas (TCEQ), received 01/12/04, "Updated 2007 HDD points.”

AREA SOURCE EMISSIONS FOR 2007 PROJECTION

Regional

Area emissions for states outside of Texas, but within the 36-km grid modeling domain, were projected to 2007. The Heavy Duty Diesel Emissions Inventory[26] (HDD EI) was used for emissions outside of the state of Texas.

San Antonio Region

Area source emission projections were calculated for 2007 using the Economic Growth Analysis System (E-GAS) model, with the exception of area source population based emissions. EPA endorses the use of E-GAS when emission growth estimates for area source are not readily obtainable by conducting surveys or taping other local sources. E-GAS generates surrogate growth indicators via the following information [Pechan, 2001]:

Constant dollar output/value added estimates for 172 economic sectors;
Physical output estimates, such as gasoline consumption, for some major emitting source categories;
Estimates of energy consumption by fuel type;
Population; and
Personal consumption expenditures for gasoline and oil

Using EGAS, the 2007 projected emissions were figured as follows:

x.xxxx tons/yr. (2007 VOC Emissions)	=	y.yyyy (Adjusted EGAS Growth Factor for 2007)	X	z.zzzz tons/yr. (1999 VOC Emissions)

The EGAS model supplied growth factors for projecting of all area source emissions except Architectural Surface Coatings and Consumer/Commercial Solvents. For these categories, population base projection methodology was used. The emissions were multiplied by the percent increase in population between 1999 and 2007.

Modeling performed by AACOG accounted for the State's Stage I Vapor Recovery Rule. The rule requires vapor recovery equipment for large retail gasoline outlets and bulk terminals.[27] A methodology for modeling the state low NOx water heater regulation, slated for implementation in 2002, has not yet been determined for this area. Therefore, this rule has not been included in the 2007 base case. It is anticipated that the low NOx water heater rule will have little affect on ozone levels in the San Antonio EAC Region (SAER).

Several state regulations were also accounted for in the development of the projected area source emissions as directed by TCEQ. Rate of Progress control factors (ENVIRON) were used for several area sources in developing the 2007 projections. The controls account for reduced pollutant emissions by improved future techniques and/or regulations. The following list details the categories subject to the rate of progress control factors:

LUST
Architectural Coatings
Traffic Markings
High Performance Maintenance

[26] Email from R. Thomas.
[27] Available online: http://tnrcc.state.tx.us/exec/media/press/o6-99cleangas.html

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Other Specific Purpose Coatings

Another regulation is the Regulation V Rule which affects only “Factory Finished Wood” in the “Surface Coatings” subcategory. The emissions were ensured to reflect an emission reduction by 99%.

Degreasing

The reductions applied to degreasing equipment are based on the Texas Administrative Code (TAC) Chapter 106 and 115. The emission reductions of 85% apply only to the growth from 1999 to 2007. This calculated to a 5.128 tons/day reduction which is 30.52% of the 2007 base case emissions. Appendix I of this SIP covers the degreasing control strategy in more detail.

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Table F-4. Photochemical Model Jobs & Files for 2007 EI Development of Area Sources.

Region	Job Script	Input Files	Description
Regional (outside Texas)		emiss.ar.regional.hdd.fy07.xxx	Processing of emission files.[28]
Regional	mrguam.ar.all_reg.07po	emiss.ar.reg_tx.net07.02062004.xxx emiss.nr.reg_tx.net07.02062004.xxx emiss.ar.regional.hdd.fy07.xxx emiss.offr.regional.NonRoad.fy07.xxx emiss.offr.reg_hdd_nonNR.fy07.xxx	Merges Area and Non-road emissions for the Regional Grid in 2007. Includes updated regional HDD (non-Texas) emissions for 2007.
Texas counties	ar.reg_tx.eps2.2007.02062004	ams.TX_07.area07_b3	Process of the regional area source inside of Texas. Input: TCEQ 2007 Area Source Updates, Feb. 2004, received from Jim Mackay.
AACOG 12-County Region	ar.sa.07	ams.aacog.area.b	Process of the ams non-population based.
		ctl.aacog.area.egas	Project with EGAS growth factors (PECHAN).
		ctl.aacog.area.pop	Zero-out population-based emissions.
		ctl.aacog.area.rop	Rate of progress controls.
		ctl.stage1_125.aacog	Accounts for Stage I reductions.
	ar.sa.pop.07	ams.aacog.area.2007	Processing of the ams population based.
		ctl.aacog.area.rop	Rate of progress controls.
	afsar.sa.07	afs.capco.aacog.area	Process of the afs (geo-coded) with local data for 2007. No CAPCO (1999 AACOG EI).
		ctl.aacog.area.egas	Non-population-based area sources projected with EGAS growth factors (PECHAN).
		ctl.aacog.area.rop	Rate of progress controls. [29]
		ctl.stage1_125.aacog	Stage1 controls at 125,000 gallons or more throughput.
		ctl.degreasing.eq.2007	Degreasing reductions applied to growth from 1999 to 2007 only.
		ctl.aacog.obvr.0709xxx	OBVR controls (4 county San Antonio EAC region) based on Mobile6 database.

[28] Email: from Gary McGaughey (UT Austin), received 02/16/04, "RE: 2007 TX pt source data and jobs," containing TCEQ 2007 Nonroad Source Updates (02/04) from Jim Mackay, located at ftp://ftp.tnrcc.state.tx.us/pub/OEPAA/TAD/Modeling/file_transfer/TxareaNR/files

[29] Package to apply Rate of Progress (ROP) Controls, prepared by Steven Smeltzer, June. 17, 2003, AACOG. Also applying ROP controls seven area source cataegories in the San Antonio 4 county area prepared by ENVIRON, Aug. 28, 2001

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Austin 5-county Metropolitan Statistical Area (MSA)	afsar.austin.07	2007_weekday_area_capco_02242004.afs	Process of the afs (geo-coded) area sources for Austin 5 county area with local data for 2007.[30]
	ar.aust.07.b	2007_weekday_area_capco_02242004_withlawn.ams	Process of the ams area sources for Austin 5 county area with local data for 2007
Corpus Christi 2-County Region	ar.cc.07	ams-area-nsp.prn	Process the area emissions with local data.
		ctl.area.regional	EGAS 4.0 Model Projection of regional EI from 1999 to 2007 (PECHAN).
Victoria 7-County Region		Vict_area_2007.ams Vct_2007_fire.ams	Emissions files provided by UT, includes local data.[31]

[30] Source: Gary McGaughey (UT Austin) Feb. 24, 2004
[31] Email: from Gary McGaughey (UT Austin), received 11/16/03.

NON-ROAD SOURCE EMISSIONS FOR 2007 PROJECTION

Non-road projected 2007emissions for states outside of Texas, but within the 36-km grid-system modeling domain, were provided by TCEQ. The Heavy Duty Diesel Emissions Inventory (HDD EI) was used for emissions outside of the state of Texas.

AACOG Region

To project the non-road emissions for the AACOG counties, the EPA's NONROAD Model was employed. NONROAD runs were conducted for a typical summer day (weekday and weekend day) in 1999 and in 2007. A projection factor resulted from the ratio of the 1999 results to 2007 results by SCC. The factors were then applied to the 1999 emissions to form estimates for 2007. The exceptions to this are where local data was incorporated.

Diesel Construction & Quarry Equipment

The 1999 data for quarry equipment was updated with local surveys, permit data and aerial photography as described in Appendix D, 1999 Base Case Emission Inventory Development.

Tractors and Combines

The 1999 data for quarry equipment was processed separately because they were combined into one category for 2007; thus emissions could not be projected from the 1999 emissions.

Toyota Facility Non-Road Emission Estimates for 2007

Table F-5 summarizes the 2007 non-road emissions estimates for the planned Toyota production plant in Bexar County, Texas. The subsequent documentation explains the methodology in calculating the emissions.

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Table F-5. 2007 Non-Road Source Emissions for Toyota Facility by SCC.

SCC	Equipment description	Est Equip Pop	NOx Emissions (tons/day)	CO Emissions (tons/day)	VOC Emissions (tons/day)
2265003020	4-Str Forklifts	2.3	0.001134	0.057436	0.002539
2267003020	LPG – Forklifts	39.6	0.083179	0.312698	0.000107
2268003020	CNG – Forklifts	4.6	0.005978	0.022539	0.000008
2270003020	Dsl – Forklifts	12.7	0.013099	0.017362	0.001344
2265003010	4-Str Aerial Lifts	4.0	0.000315	0.023246	0.000822
2267003010	LPG - Aerial Lifts	2.1	0.001034	0.003813	0.000001
2270003010	Dsl - Aerial Lifts	4.1	0.001159	0.001003	0.000239
2260003030	2-Str Sweepers/Scrubbers	0.4	0.000001	0.000106	0.000017
2265003030	4-Str Sweepers/Scrubbers	2.3	0.000237	0.019885	0.000599
2267003030	LPG - Sweepers/Scrubbers	0.7	0.000740	0.002769	0.000001
2268003030	CNG - Sweepers/Scrubbers	0.0	0.000000	0.000000	0.000000
2270003030	Dsl - Sweepers/Scrubbers	4.2	0.006187	0.004507	0.000826
2265003070	4-Str Terminal Tractors	0.7	0.000135	0.006891	0.000301
2267003070	LPG - Terminal Tractors	0.1	0.000466	0.001741	0.000001
2268003070	CNG - Terminal Tractors	0.0	0.000000	0.000000	0.000000
2260003040	2-Str Other General Industrial Eqp	0.0	0.000000	0.000000	0.000000
2265003040	4-Str Other General Industrial Eqp	9.8	0.000203	0.038259	0.001020
2267003040	LPG - Other General Industrial Eqp	0.2	0.000220	0.000826	0.000000
2268003040	CNG - Other General Industrial Eqp	0.0	0.000000	0.000000	0.000000
2270003040	Dsl - Other General Industrial Eqp	8.3	0.007399	0.002255	0.000618
2265003050	4-Str Other Material Handling Eqp	0.2	0.000025	0.001946	0.000065
2267003050	LPG - Other Material Handling Eqp	0.1	0.000055	0.000204	0.000000
2270003050	Dsl - Other Material Handling Eqp	0.6	0.000431	0.000286	0.000072
TOTAL			**0.121999**	**0.517774**	**0.008580**

Equipment Categories

The equipment categories chosen in this non-road emissions estimate are the same categories used in the Industrial Equipment Section of EPA's NONROAD Model.

Equipment Populations

The first step in this process is the estimation of plant equipment populations for each equipment category. A ratio of the number of Toyota employees to the number of manufacturing employees (~SIC 20) in Texas was used to estimate the plant equipment population. The populations for each category were calculated based on the following formula:

Equipment (Type N) Population =Equipment Population In Texas
x (Toyota Plant Employees
/ Industrial Workers in Texas)

Example:

The Texas equipment population for diesel-powered forklifts was 6,227. The number of manufacturing employees in Texas was 982,205. The estimated Toyota plant

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employment population is 2000. Using this information, an estimate of diesel powered forklifts for the planned Toyota Plant can be calculated as follows:

Toyota Diesel Fork Lift Population =6,227 Diesel Forklifts in Texas
x (2,000 Toyota Emp./ 982,205 Ind. Workers in TX.)
=12.68 Diesel Forklifts for Toyota

Emissions

A run of the NONROAD model was conducted to estimate CO, NOx, and VOC emissions for a typical weekday in the summer season 2007 for the state of Texas. A ratio of the estimated equipment population for Toyota and the equipment population of Texas was then used in the calculation of emissions. The emissions for each category were based on the following formula:

Emissions (Tons/Day) of Equip (Type N) =Texas Emissions
x (Est. Toyota Equip Population
/ Texas Equip Population)

Example:
Toyota NOx Emissions of Diesel Forklifts =6.4319 Texas NOx tons/day
x (12.68 Dsl. Toyota / 6227 Dsl. TX. Forklifts)
=0.0131 tons/Day of NOx

Houston/Galveston Region & Rural Texas Counties

The Houston/Galveston county emissions were processed with the Texas rural county files and are based on TEXAQS. There are several control-packages that account for minor adjustments to these emission files. This is the same method used in the Houston SIP. The first is the Nonroad TCAS gas controls for Texas attainment counties. The California Spark control package is for the Houston/Galveston area and applies to large construction, Industrial, commercial, & lawn and garden sources. The next control package is also for the Houston/ Galveston area and applies to gas can emission reductions. The last one is for the VMEP Plus factor any applies to Houston counties. This factor reduces the NOx by about 33 t/d and the VOCs by about 1.86 t/d from the nonroad emissions. Refer to Table F-3 for the specifics on these control packages.

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Table F-6. Photochemical Model Jobs & Files for 2007 EI Development of Non-Road Sources.

Counties	Job Script	Input Files	Description
Regional (outside Texas)		emiss.offr.reg_hdd_nonNR.fy07.xxx emiss.offr.regional.NonRoad.fy07.xxx	Process emission files.[32]
Texas Counties	nr.reg_tx.eps2.2007.02062004	ams.TX_07.NR07_b4b	Process 2007 nonroad source updates (orig. 02/04 Jim Mackay).[33]
		control.nonr.att.tcas_gas.07	Nonroad TCAS gas controls for TX attainment counties.
		control.nonr.HG.CaliSpark	California Sparkplug Engines rule:lg const., ind., and comm. HDG 2/4 stk gas vehicles to get 2.8 t/d NOx, 7.58 t/d VOC.[34]
		control.nonr.HG.gascan	Hou./Gal. Gas-can 0.757 VOC reduction factors: 1-(0.45*0.54) .[35]
		control.nonr.hg.VMEPplus	Voluntary Mobile Emission Reduction Program (VMEP): TERP, accelerated Tier2/Tier3 purchases, water heater rule, and stationary compression ignition (CI) engines for HGA.
Victoria 7-County Region		VCT07_NR02Ayyyyyy.VOC_TPD.ams Vict_nr.ams2007	Emission processing. Top file contains day-specific emissions data. Bottom file is average data.
Corpus Christi 2-County Region	nr.cc.07	ams-nonroad-nsp.prn	Processing of the ams emissions for non-geocoded emissions (ENVIRON).
		ctl.othercounties.nonroad	Project emissions to from 1999 to 2007 (based on Nonroad Model.
CAPCO 5-county MSA	afs_nr.aust.2007	2007_nonroad_final_capco.afs.xxx	Process the afs (geo-coded) non-road sources with local data.[36]
	nr.austin.07	2007_nonroad_final_capco.ams.xxx	Process the geo-coded non-road sources for Austin 5 county area with local data.
CAPCO Rural counties	nr.capco.07	ams.capco.nonroad.b	Processing of the ams emissions with local data (CAPCO EI)
CAPCO Rural counties	nr.capco.07	ctl.othercounties.nonroad	Project emissions from 1999 to 2007 (Nonroad Model based). Cntlem Package to update Non-Road Sources for all Texas counties with Non-Road Model, 2000
AACOG 12-County Region	afs.toyota	afs.toyota.2007	Process of the afs (geo-coded) non-road and area sources for Toyota Phase1.[37]

[32] Email: from Gary McGaughey (UT Austin) received 02/16/04, "RE: 2007 TX pt source data and jobs," containing TCEQ 2007 Nonroad Source Updates (02/04) from Jim Mackay, located at ftp://ftp.tnrcc.state.tx.us/pub/OEPAA/TAD/Modeling/file_transfer/TxareaNR/files
[33] Email: from Alba Webb (UT Austin) received 02/12/04, "RE: 2007 TX pt source data and jobs."
[34] Alison Pollack (TCEQ) information, 07/10/00.
[35] Karla (TCEQ), received 01/21/03.
[36] Email: from Gary McGaughey (UT Austin) received 01/26/04, "RE: Area and Nonroad ams/afs and cntlem files."

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AACOG 12-County Region	afs_nr.sa.2007	afs.nonroad.capco.aacog.a	Processing of the afs (geo-coded) emissions with local data.
		ctl.zero.austin	Remove Austin emissions (in different job script.)
		ctl.construction.99	Adjust diesel construction equipment emissions for recalculation of equipment population.
		clt.aacog.nonroad	Project emissions from 1999 to 2007 with the Nonroad Model.
		ctl.aacog	Cntlem Package to update Non-Road Sources in the regional area with Non-Road Model & Railroad Equipment.
	afs.quarry.2007	afs.quarry.aacog	Processing of the afs (geo-coded) quarry emission with 2007 local data.
		ctl.aacog.nonroad	Project emissions from 1999 to 2007 with the Nonroad Model.
	afs_tractor.combine.sa.07	afs.tractors_combines.sa	Processing of the geo-coded emission sources with local data.
		ctl.aacog.nonroad	Project emissions from 1999 to 2007 with the Nonroad Model.
	nr.sa.07	ams.aacog.nonroad.b	Processing of the ams emissions with local data.
		ctl.construction.99	Adjust diesel construction equipment emissions for recalculation of equipment population.
		clt.aacog.nonroad	Project emissions from 1999 to 2007 with the Nonroad Model.
	tractors_combines.sa.2007	ams.tractors_combines.sa	Processing of the ams emissions for the non-geocoded emissions.
		clt.aacog.nonroad	Project emissions from 1999 to 2007 with the Nonroad Model.

[37] The area sources are based on permitted values provided by Toyota , and non-road sources are based on employment data and the Non-road Model 2002 version 2.2.0 (industrial equipment - SIC Code 20).

Table D-7. 2007 Emissions by Source Category for Texas for Sept. 13 (Monday)

County FIPS Code	Non-Road Emissions		Area Emissions		Mobile Emissions		Point Emissions	
	NOx	VOC	NOx	VOC	NOx	VOC	NOx	VOC
48001	3.8	0.5	0.5	6.3	2.0	1.5	2.4	1.3
48005	1.9	2.3	0.3	6.5	4.8	2.3	6.1	10.5
48007	0.8	4.9	0.3	1.5	0.7	0.4	1.1	0.8
48009	0.5	0.4	0.2	15.9	0.7	0.5	0.0	0.0
48011	0.4	0.0	0.0	0.1	0.2	0.1	0.0	0.0
48015	5.9	0.7	1.1	3.5	3.3	1.0	0.1	1.2
48023	0.7	0.5	0.3	2.2	0.4	0.2	0.0	0.0
48025	0.7	0.2	1.3	8.6	1.2	0.6	1.4	0.0
48027	10.5	3.2	0.7	16.0	11.6	6.1	0.4	2.8
48033	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
48035	4.8	1.2	0.1	1.8	0.7	0.5	5.7	0.2
48037	6.8	1.6	0.3	7.9	8.6	3.5	0.6	1.9
48039	6.9	4.7	5.0	15.1	6.2	3.4	33.3	23.4
48041	3.5	2.2	1.0	11.7	6.5	3.2	4.0	0.2
48045	0.1	0.0	0.0	0.5	0.1	0.0	0.0	0.0
48047	0.2	0.7	1.5	2.4	0.8	0.6	2.0	1.0
48049	1.6	1.1	2.7	10.2	1.8	1.2	0.5	1.7
48051	4.4	0.5	0.7	6.5	1.1	0.5	2.0	0.9
48059	3.2	0.2	0.5	5.5	3.2	0.9	0.6	0.1
48061	7.0	10.7	0.8	18.5	8.8	7.7	2.5	2.3
48063	1.8	0.8	0.0	1.2	0.6	0.3	0.0	0.0
48065	2.3	0.1	0.7	2.7	0.5	0.2	1.4	0.3
48067	5.7	1.1	0.3	3.8	2.1	1.2	6.4	8.7
48071	0.9	2.9	6.2	5.2	3.8	1.8	8.2	11.0
48073	3.6	0.6	0.6	5.7	2.1	1.5	7.4	0.7
48075	2.3	0.2	0.1	1.4	0.9	0.4	0.0	0.0
48077	2.2	0.5	0.3	6.4	1.7	1.1	0.6	0.2
48081	0.1	0.4	0.2	1.7	0.3	0.2	3.1	0.5
48083	1.3	0.3	1.7	5.9	0.7	0.5	0.3	0.0
48085	20.3	6.2	2.3	15.8	16.0	8.8	3.1	1.4
48087	0.5	0.1	1.5	2.7	0.2	0.1	0.0	0.0
48089	1.9	1.0	1.1	3.5	4.5	1.2	2.3	1.4
48093	0.8	0.3	0.7	2.8	0.9	0.6	0.0	0.0
48095	0.5	0.4	0.2	2.0	0.4	0.3	0.1	0.0
48097	3.1	1.3	0.3	11.0	3.1	1.7	0.0	0.2
48099	1.0	0.3	0.2	3.6	1.4	1.2	0.0	0.3
48101	0.3	0.1	0.2	0.9	0.2	0.1	0.0	0.0
48105	0.1	0.4	16.9	23.0	1.6	0.5	0.6	0.0
48107	0.2	0.0	0.0	1.0	0.1	0.1	0.0	0.0
48113	62.9	29.3	17.8	73.6	89.4	44.9	14.3	13.2
48119	0.2	0.0	0.0	0.7	0.4	0.2	0.0	0.0
48121	9.6	5.1	2.5	19.0	14.8	7.8	2.0	1.9
48125	0.3	0.1	0.0	1.2	0.3	0.1	0.0	0.0
48127	0.1	0.1	0.6	3.1	0.5	0.3	0.6	0.1
48129	2.5	0.8	0.0	0.8	1.3	0.5	0.0	0.0
48131	0.9	0.1	2.1	6.3	0.7	0.5	1.1	1.7

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48133	3.3	0.4	3.9	8.7	4.1	1.1	1.2	0.6
48137	0.0	0.0	1.5	2.2	0.1	0.1	5.1	1.9
48139	11.2	2.2	0.3	10.3	6.3	3.0	39.1	5.7
48143	0.8	0.6	1.1	4.7	1.7	1.0	0.6	0.3
48145	3.7	0.3	0.1	2.4	1.0	0.6	0.0	0.0
48147	1.1	0.4	0.3	3.9	1.5	0.9	16.5	0.4
48151	2.0	0.2	0.1	3.0	0.3	0.2	0.4	0.1
48153	0.3	0.0	0.0	0.5	0.1	0.1	0.0	0.0
48155	0.3	0.1	0.3	1.2	0.2	0.1	0.0	0.0
48157	6.5	2.9	1.7	14.6	9.4	4.8	16.0	3.5
48159	0.4	0.5	0.2	1.7	1.1	0.5	0.5	0.2
48161	2.3	0.3	3.8	7.6	3.2	1.1	45.0	5.1
48167	4.3	9.2	4.3	12.1	5.7	3.3	24.4	37.3
48169	0.4	0.0	0.0	1.9	0.2	0.1	0.0	0.0
48177	2.2	0.8	0.1	2.8	2.8	0.9	0.0	0.4
48179	3.3	0.4	4.4	15.4	2.1	1.0	18.5	8.8
48181	7.3	2.9	0.7	13.4	7.3	3.8	1.5	0.2
48183	5.0	1.3	2.5	18.8	6.3	3.3	9.8	4.3
48185	7.5	0.7	1.1	3.1	1.5	0.7	24.9	1.5
48191	1.5	0.2	0.0	1.2	0.5	0.2	0.0	0.0
48193	0.4	0.1	0.1	1.3	0.4	0.3	0.0	0.0
48195	0.4	0.1	1.1	1.9	0.1	0.1	2.0	0.2
48197	2.7	0.2	0.2	2.1	0.8	0.4	0.4	0.1
48199	2.7	0.4	0.5	4.8	2.2	1.3	1.3	1.9
48201	51.7	26.6	20.6	115.7	96.9	57.5	84.3	142.6
48203	5.1	1.3	2.7	10.9	9.6	2.8	34.0	20.1
48207	1.2	0.3	0.2	3.3	0.5	0.3	3.2	0.1
48211	3.5	0.2	5.2	5.9	0.4	0.2	7.7	2.0
48213	3.6	2.1	1.1	8.0	2.9	2.0	6.5	0.7
48215	13.9	12.7	6.1	32.8	16.0	14.3	8.5	2.8
48217	5.8	1.4	0.2	4.6	4.4	1.8	0.0	0.2
48221	0.7	0.4	1.1	3.1	1.4	0.8	20.5	0.7
48223	1.9	0.7	0.1	4.2	3.6	1.6	1.0	0.1
48225	2.2	0.9	0.2	2.8	1.3	0.6	0.0	1.9
48227	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48231	2.5	2.0	0.3	9.6	5.8	2.8	0.3	0.1
48233	0.1	0.0	0.8	3.7	0.2	0.1	0.0	0.0
48235	0.1	0.0	0.8	5.4	0.2	0.1	1.2	0.3
48237	0.1	0.1	4.6	11.4	0.5	0.3	2.9	1.5
48241	5.3	1.2	0.3	3.0	1.9	1.2	7.3	3.0
48245	7.3	4.9	8.4	18.0	13.4	6.6	65.5	66.9
48247	0.1	0.3	0.7	1.5	0.2	0.2	0.7	0.1
48249	1.8	0.4	1.4	5.0	2.3	1.2	5.0	1.5
48251	7.5	1.0	0.3	8.7	4.6	2.5	5.7	0.8
48253	1.2	0.3	0.1	5.0	1.3	0.7	3.0	0.1
48257	3.9	1.0	0.2	10.7	4.9	2.6	10.5	2.3
48261	1.7	5.4	0.4	1.3	0.7	0.5	1.5	0.7
48263	0.1	0.0	0.0	1.7	0.1	0.1	2.6	0.2
48267	0.1	1.0	0.0	0.8	1.8	0.5	0.1	0.0

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48269	0.1	0.0	0.2	1.9	0.2	0.1	0.0	0.0
48271	2.6	0.1	0.0	0.3	0.3	0.2	0.0	0.0
48273	1.4	2.9	1.1	4.1	1.5	0.9	9.2	2.4
48275	0.9	0.2	0.3	2.6	0.3	0.2	0.0	0.0
48277	6.0	1.1	0.2	6.7	2.4	1.5	6.3	1.2
48281	1.1	0.2	0.0	1.4	1.0	0.6	0.0	0.0
48283	1.1	0.5	0.9	2.4	1.4	0.6	0.0	0.0
48289	3.8	0.3	1.1	3.8	2.8	1.0	0.8	0.3
48291	3.1	1.0	0.5	5.5	2.8	1.6	4.3	2.4
48293	3.0	0.6	1.3	4.6	0.8	0.6	34.4	0.9
48295	1.6	0.1	3.8	5.5	0.2	0.1	1.1	0.1
48297	3.9	1.4	1.3	3.4	1.8	0.9	2.8	3.5
48307	1.0	0.2	0.2	2.0	0.6	0.4	0.0	0.0
48309	8.7	4.0	0.6	16.7	11.8	6.0	35.7	0.7
48311	1.0	0.4	2.4	4.6	0.1	0.1	0.5	0.3
48313	0.4	0.1	0.2	1.6	1.8	0.6	0.4	0.0
48315	1.6	0.6	0.3	1.7	0.6	0.4	7.0	0.9
48319	0.1	0.3	0.0	0.6	0.2	0.2	0.0	0.0
48321	7.7	6.4	1.2	6.2	1.8	0.9	8.5	1.3
48323	0.4	0.6	0.4	3.6	1.4	0.9	0.1	0.0
48327	0.1	0.0	0.0	0.7	0.3	0.2	0.0	0.0
48331	6.8	0.5	0.1	7.8	1.5	0.8	13.2	0.2
48333	0.9	0.1	0.0	0.9	0.5	0.3	0.0	0.0
48335	0.9	0.2	0.0	8.3	1.9	0.5	22.9	0.4
48337	3.7	0.7	0.3	9.4	1.3	0.9	0.3	0.9
48339	4.3	3.4	1.8	12.8	11.8	6.0	4.6	3.4
48343	1.4	0.5	0.0	1.8	1.2	0.5	0.5	0.4
48345	0.3	0.0	0.0	0.8	0.2	0.1	0.0	0.0
48347	1.3	1.2	0.9	7.2	3.8	1.8	2.8	5.6
48349	4.9	1.3	0.2	8.5	3.0	1.5	5.4	2.6
48351	0.5	0.5	0.2	1.8	0.7	0.5	4.2	3.1
48353	2.8	0.3	0.3	4.6	2.9	0.9	7.5	0.4
48355	54.5	22.7	0.9	49.8	14.0	8.3	78.1	29.7
48357	1.8	0.3	3.8	7.9	0.6	0.3	3.2	0.3
48361	4.1	1.5	0.5	3.9	5.9	2.5	42.5	16.7
48363	3.6	1.6	5.7	9.6	1.6	0.9	6.1	0.6
48365	1.7	1.1	8.0	13.3	2.0	1.1	13.0	4.1
48367	4.3	1.1	3.9	8.9	4.5	2.3	6.9	1.1
48373	0.8	2.1	0.5	3.8	3.4	1.6	2.5	6.2
48379	0.2	0.7	0.1	0.7	0.6	0.3	0.2	0.0
48385	0.1	0.6	0.0	0.4	0.2	0.1	0.0	0.0
48387	0.6	0.2	0.0	2.0	0.8	0.5	2.2	0.0
48391	3.1	1.1	1.6	5.2	1.2	0.6	5.0	2.9
48393	2.1	0.1	2.4	3.2	0.2	0.1	0.6	0.0
48395	6.9	0.5	0.4	2.5	1.3	0.6	6.9	0.8
48397	1.3	0.7	0.1	2.5	2.2	1.1	0.0	0.0
48399	1.2	0.3	0.2	4.7	0.6	0.4	0.2	0.1
48401	4.9	1.1	4.7	8.4	2.2	1.5	62.9	3.4
48403	1.5	2.1	0.0	1.0	0.7	0.3	0.2	1.0

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48405	1.2	0.9	0.0	0.8	0.6	0.3	0.0	0.0
48407	0.2	0.8	0.2	1.5	1.6	0.7	0.0	0.0
48409	21.7	16.0	0.2	16.2	3.5	2.0	12.2	1.4
48411	0.3	0.4	0.0	0.9	0.3	0.2	0.0	0.0
48413	0.2	0.0	2.5	3.8	0.2	0.1	0.9	0.2
48415	3.8	0.4	0.1	10.5	1.3	0.7	4.5	1.8
48417	0.3	0.1	0.9	8.8	0.4	0.2	1.1	0.2
48419	2.1	0.7	0.9	3.7	1.7	0.7	0.5	0.0
48423	6.5	2.5	1.0	13.7	10.8	6.2	4.1	9.3
48425	0.2	1.0	0.0	0.5	0.4	0.2	0.0	0.0
48427	1.0	0.3	4.2	7.3	1.5	1.3	4.8	0.5
48429	0.7	0.5	2.9	8.0	0.5	0.3	0.2	0.1
48431	0.1	0.0	2.4	6.5	0.3	0.2	0.0	0.0
48433	0.3	0.1	0.0	2.9	0.2	0.1	0.0	0.0
48435	0.1	0.1	13.1	12.8	1.8	0.5	5.3	1.1
48439	52.3	18.0	9.0	58.1	63.2	31.4	9.9	10.0
48441	6.0	2.9	0.5	14.9	9.7	4.3	0.1	1.4
48447	0.4	0.1	0.3	4.5	0.1	0.1	0.0	0.0
48449	1.7	0.8	0.1	3.1	3.1	1.2	73.6	1.5
48451	2.6	1.9	0.6	11.6	5.1	2.6	2.0	0.1
48455	1.2	1.9	0.0	1.1	0.7	0.3	0.7	0.4
48457	0.2	0.8	0.1	2.0	0.8	0.5	0.0	0.0
48459	3.6	0.4	3.2	9.5	1.6	1.0	0.8	0.6
48463	4.5	2.2	0.1	2.6	1.1	0.9	0.0	0.0
48465	2.0	2.0	0.7	3.3	1.4	0.8	0.0	0.0
48467	3.1	0.5	0.3	5.3	4.5	2.3	0.9	0.9
48471	2.0	1.1	0.2	3.4	4.5	1.7	0.1	1.2
48473	2.2	1.2	0.4	2.0	1.1	1.2	2.6	0.7
48477	2.3	1.6	0.7	4.4	2.1	1.0	0.0	0.0
48479	4.2	2.3	12.7	22.6	6.9	4.4	2.7	0.2
48481	2.6	0.8	2.0	7.9	2.9	1.4	3.6	1.8
48483	0.6	0.1	3.3	5.6	2.6	0.6	0.9	0.0
48485	3.4	1.3	0.7	33.3	6.6	4.3	20.7	6.8
48487	2.9	0.4	0.5	6.1	1.4	0.9	17.7	0.2
48489	2.0	2.3	0.2	3.0	0.7	0.6	0.3	0.1
48497	5.6	1.0	13.0	18.4	3.1	1.9	8.3	2.2
48499	2.8	2.4	0.4	5.3	1.3	1.0	0.0	0.0
48503	0.8	0.6	1.3	14.0	0.8	0.5	13.1	1.5
48505	0.3	1.8	8.3	8.4	0.6	0.5	0.8	0.2
48507	0.3	0.1	0.5	2.7	0.6	0.4	0.0	0.0

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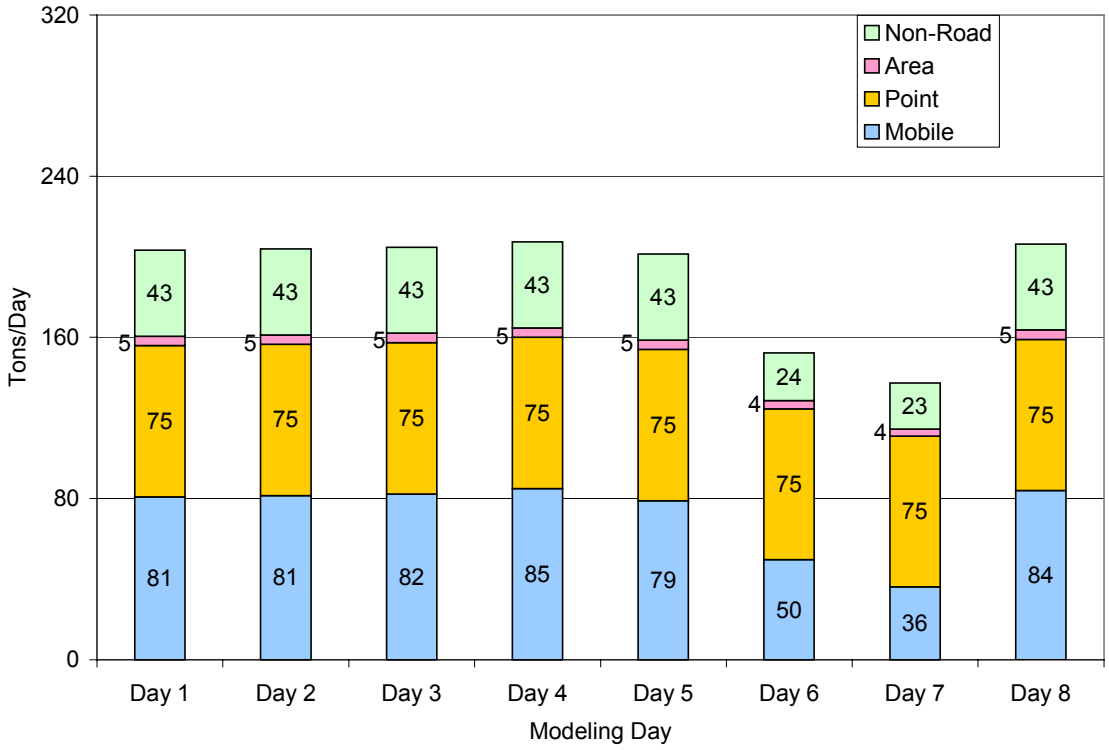
Figure F-1. 2007 Estimated NOx Emissions in Tons/Day for the San Antonio EAC Region during the September Episode.



Modeling Day	Mobile	Point	Area	Non-Road	Total
Day 1	80.8	75.1	4.7	42.6	203.2
Day 2	81.5	75.1	4.7	42.6	206.2
Day 3	82.3	75.1	4.7	42.6	207.1
Day 4	85.0	75.1	4.7	42.6	209.7
Day 5	78.9	75.1	4.7	42.6	203.6
Day 6	49.7	74.7	4.1	23.7	152.2
Day 7	36.2	74.7	3.5	23.0	137.4
Day 8	84.0	75.1	4.7	42.6	208.7

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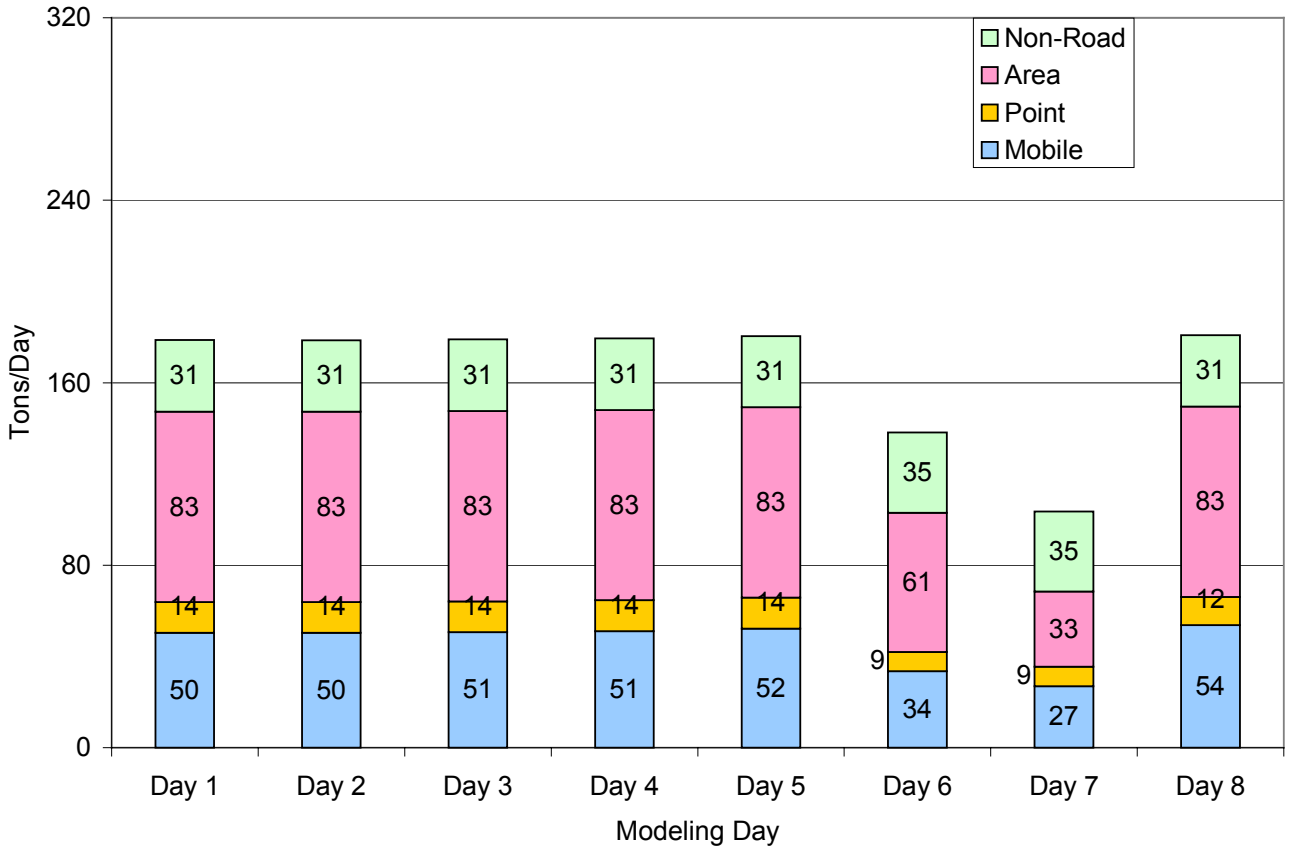
Figure F-2. 2007 Estimated VOC Emissions in Tons/Day for the San Antonio EAC Region during the September Episode.



Modeling Day	Mobile	Point	Area	Non-Road	Total
Day 1	50.4	13.5	83.4	31.3	178.6
Day 2	50.3	13.5	83.4	31.3	178.6
Day 3	50.7	13.5	83.4	31.3	178.9
Day 4	51.1	13.5	83.4	31.3	179.4
Day 5	52.2	13.5	83.4	31.3	180.5
Day 6	33.5	8.5	61.0	35.2	138.2
Day 7	26.9	8.5	33.0	35.0	103.5
Day 8	53.7	12.5	83.4	31.3	180.9

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APPENDIX G

2007 BASE CASE AND SENSITIVITY ANALYSES

SAN ANTONIO EAC REGION ATTAINMENT DEMONSTRATION

MARCH 2004

AACOG
Alamo Area Council
Of Governments

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INTRODUCTION

To create a 2007 future case on which to model attainment, certain adjustments were made to the 1999 base case. Meteorological fields, boundary/initial conditions, dry deposition algorithms, chemical mechanisms and other model configurations remained identical between the September 1999 and 2007 simulations. However, VOC, NOx, and CO emission estimations from anthropogenic sources were adjusted to account for such factors as anticipated growth/decline in population and employment and the impact of federal, state and regional emission reduction measures. The biogenic emissions inventory (EI) for the 2007 base was the same as that used for the 1999 base case, in accordance with EPA guidelines.

Tables G-1 and G-2 provide comparisons between the 1999 anthropogenic modeling EI developed for the four-county San Antonio Early Action Compact Region (SAER) and the 2007 anthropogenic modeling EI. Despite projections in population growth in all four SAER counties between 1999 and 2007, most emissions categories are expected to decrease between the base year and attainment year. Overall, anthropogenic VOC emissions for the SAER were projected to decrease by 20.88% between 1999 and 2007; likewise, anthropogenic NOx emissions were projected to decrease by 30.11% during the same timeframe.

Table G-1. Comparison of 1999 and 2007 Anthropogenic VOC Emissions in the Four-county SAER for a Typical Weekday (Wednesday).

County	On-Road (tpd)	Area / Non-road (tpd)	Point (tpd)	Total (tpd)
1999				
Bexar	75.52	111.98	6.30	193.80
Comal	6.15	6.70	0.34	13.20
Guadalupe	5.57	7.77	0.45	13.78
Wilson	1.57	3.73	0.07	5.37
Total (tpd)	88.81	130.18	7.17	226.15
2007				
Bexar	42.42	98.55	11.82	152.79
Comal	3.85	5.53	0.52	9.90
Guadalupe	3.42	6.98	1.10	11.50
Wilson	0.98	3.68	0.07	4.74
Total (tpd)	50.67	114.75	13.50	178.93
% Difference between 1999 and 2007				
Bexar	-43.83%	-11.99%	87.47%	-21.16%
Comal	-37.42%	-17.45%	50.94%	-24.98%
Guadalupe	-38.63%	-10.08%	145.00%	-16.58%
Wilson	-37.42%	-1.31%	0.00%	-11.82%
Total	-42.95%	-11.85%	88.44%	-20.88%

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Table G-2. Comparison of 1999 and 2007 Anthropogenic NOx Emissions in the Four-county SAER for a Typical Weekday (Wednesday).

County	On-Road (tpd)	Area / Non-road (tpd)	Point (tpd)	Total (tpd)
1999				
Bexar	119.57	39.39	88.59	247.55
Comal	11.64	3.57	12.16	27.38
Guadalupe	10.47	4.24	0.51	15.21
Wilson	1.89	0.93	0.00	2.82
Total (tpd)	143.58	48.12	101.26	292.96
2007				
Bexar	67.45	39.18	53.24	159.86
Comal	7.07	3.70	13.77	24.53
Guadalupe	6.47	3.40	8.07	17.95
Wilson	1.34	1.04	0.00	2.39
Total (tpd)	82.34	47.32	75.08	204.74
% Difference between 1999 and 2007				
Bexar	-43.59%	-0.53%	-39.90%	-35.42%
Comal	-39.30%	3.46%	13.22%	-10.39%
Guadalupe	-38.15%	-19.65%	1492.19%	17.99%
Wilson	-29.00%	12.17%	0.00%	-15.44%
Total	-42.65%	-1.67%	-25.85%	-30.11%

Figures G-1 through G-3 provide graphical comparisons of the anthropogenic NOx EIs for 1999 and 2007 by source category, both in terms of magnitude of concentrations and spatial allocation of plumes. Similarly, figures G-4 through G-6 provide graphical comparisons between estimated 1999 and 2007 anthropogenic VOC emissions inventories. As indicated by these pictures, on-road precursor emissions are concentrated in urban areas. By comparison, area/non-road and point source emissions are more dispersed. It is also evident that, overall, most anthropogenic emission categories are expected to decrease between 1999 and 2007.

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Figure G-1. Comparison of 1999 and 2007 Anthropogenic NOx Precursor Emissions from On-road Sources within the 4-km Subdomain on Wednesday, September 15th.

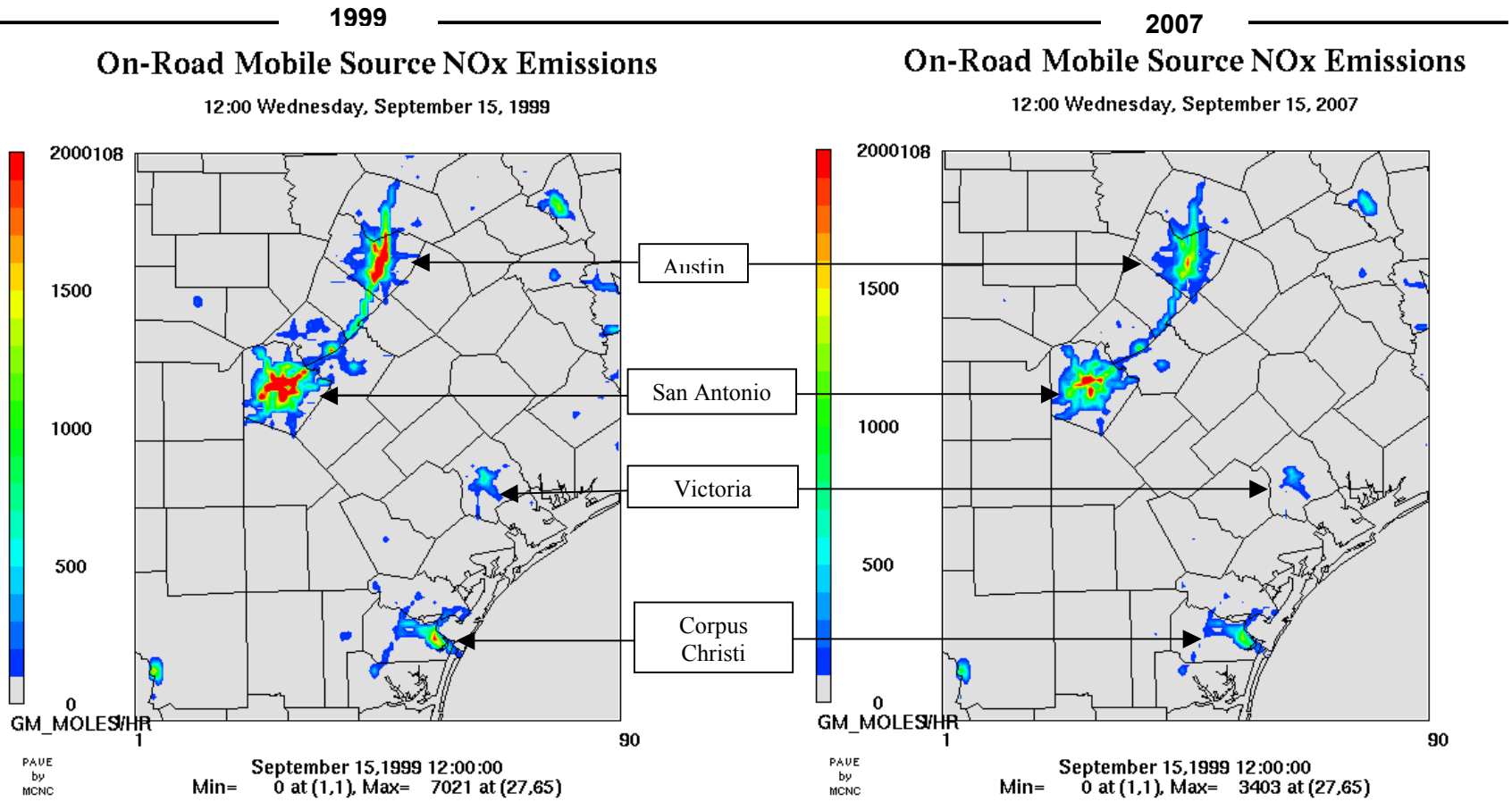

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Figure G-2. Comparison of 1999 and 2007 Anthropogenic NOx Precursor Emissions from Area/non-road Sources within the 4-km Subdomain on Wednesday, September 15th.

1999 **2007**

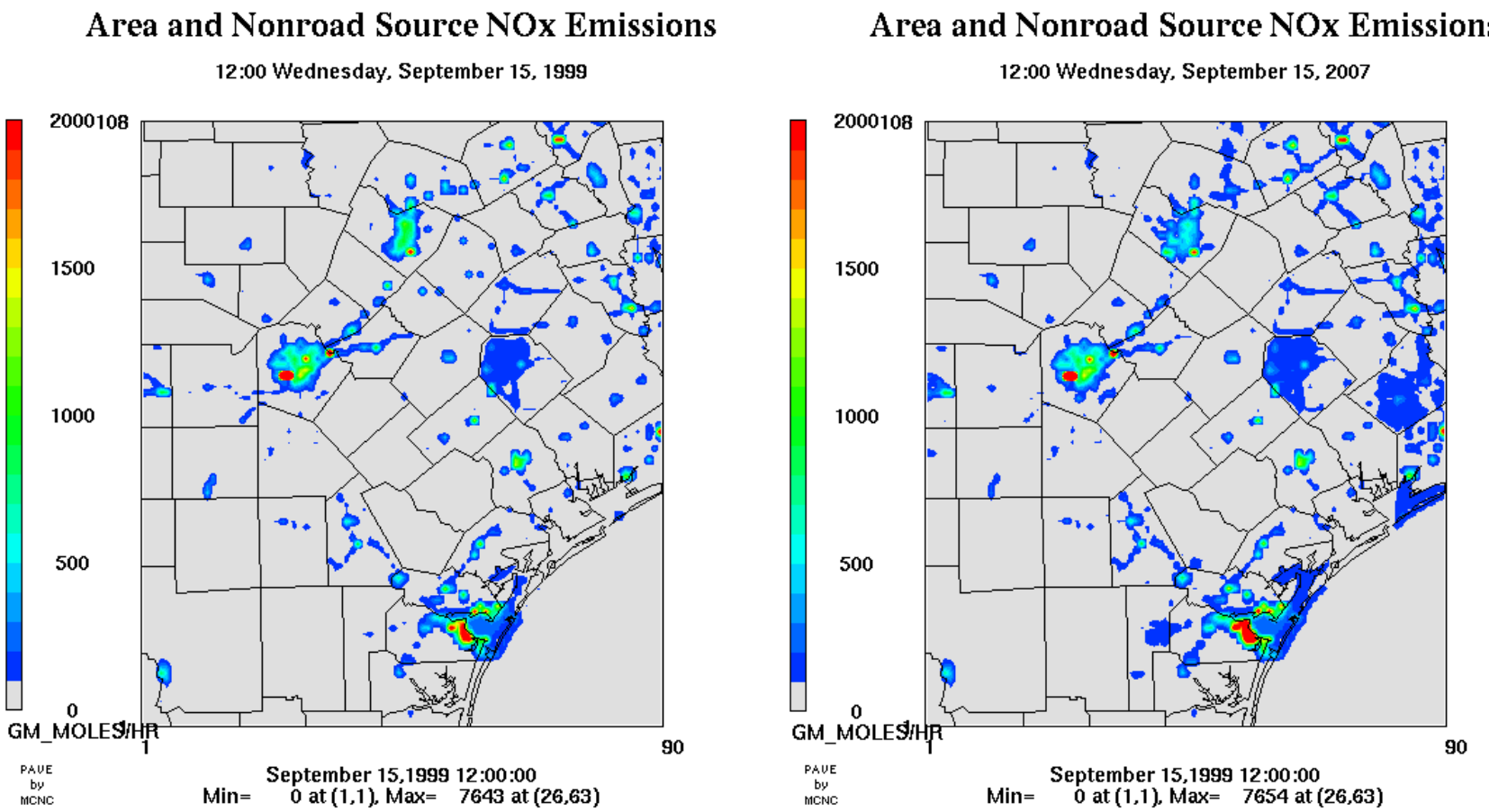

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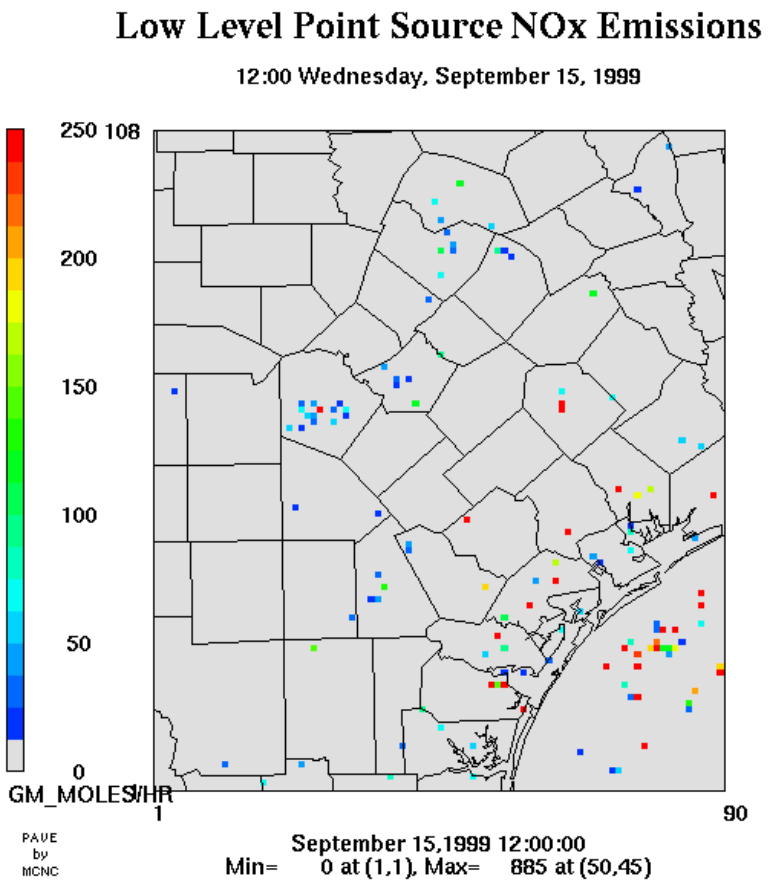
Figure G-3. Comparison of 1999 and 2007 Anthropogenic NOx Precursor Emissions from Low-level Point Sources within the 4-km Subdomain on Wednesday, September 15th.

1999



2007

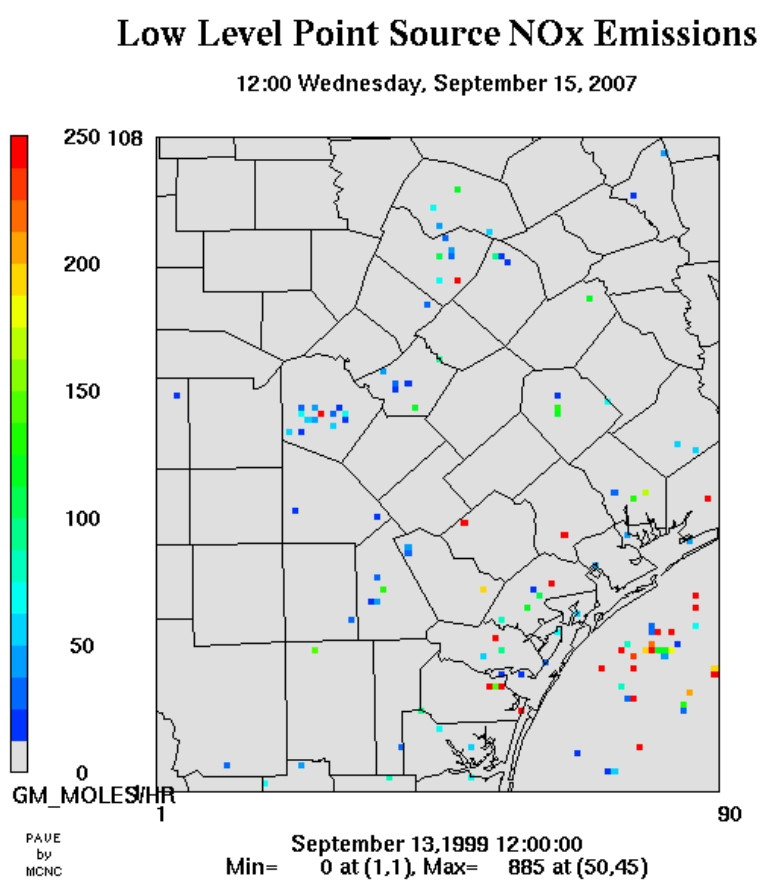


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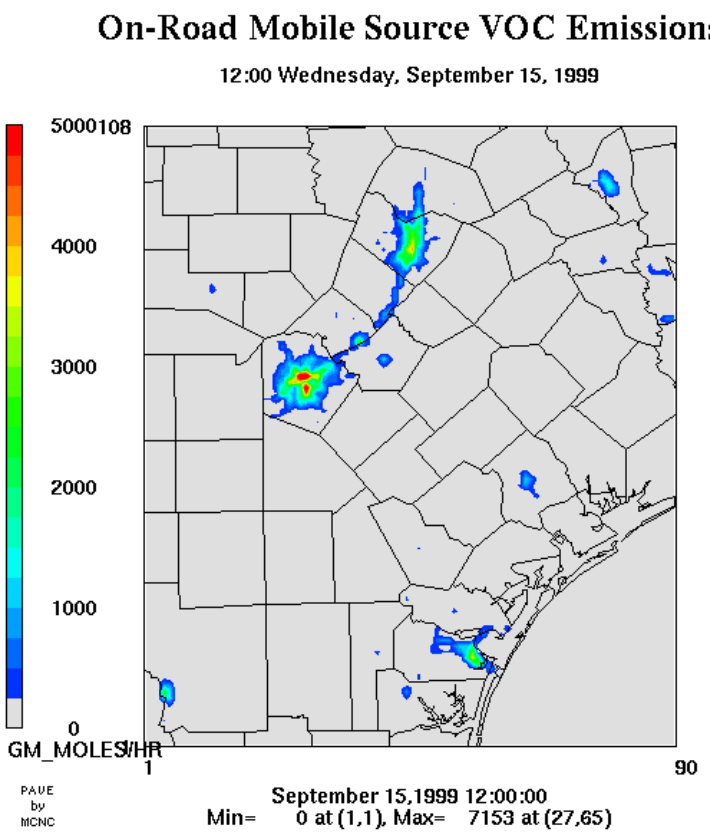
Figure G-4. Comparison of 1999 and 2007 Anthropogenic VOC Precursor Emissions from On-road Sources within the 4-km Subdomain on Wednesday, September 15th.

1999



2007

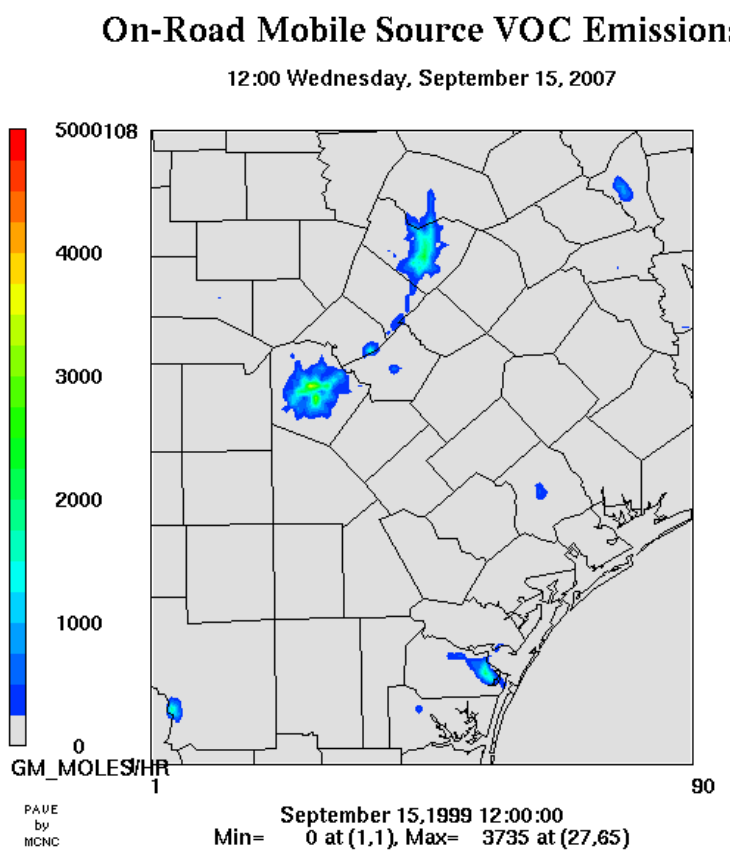


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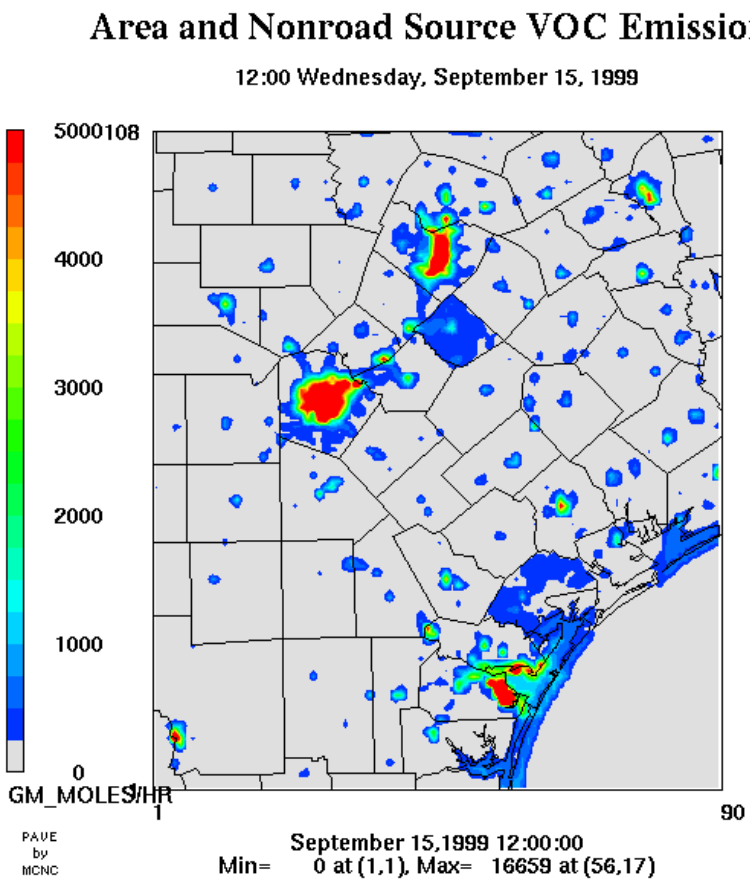
Figure G-5. Comparison of 1999 and 2007 Anthropogenic VOC Precursor Emissions from Area/non-road Sources within the 4-km Subdomain on Wednesday, September 15th.

1999 **2007**



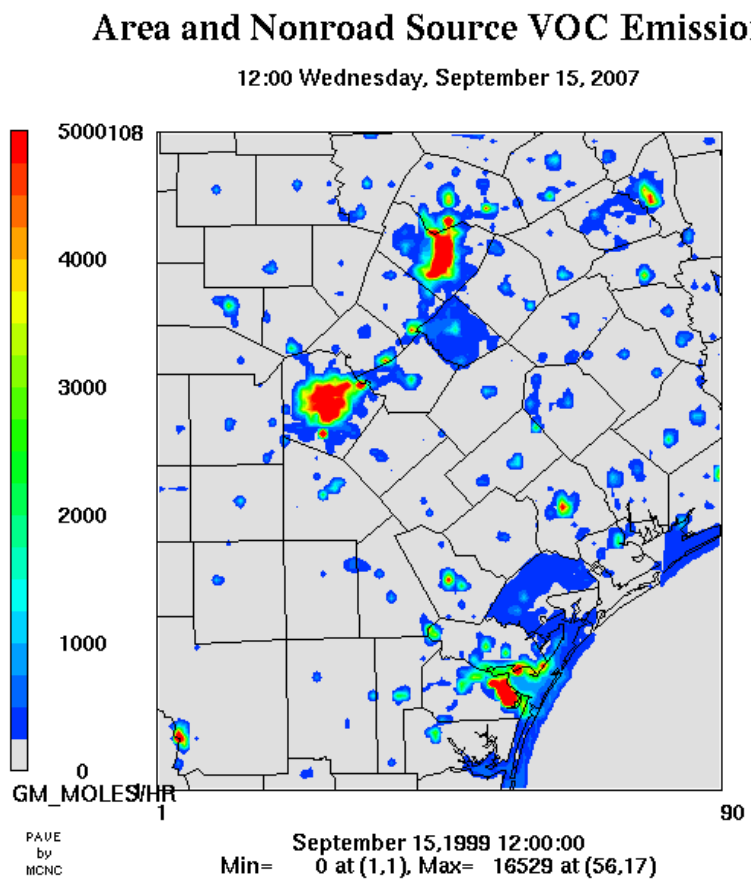


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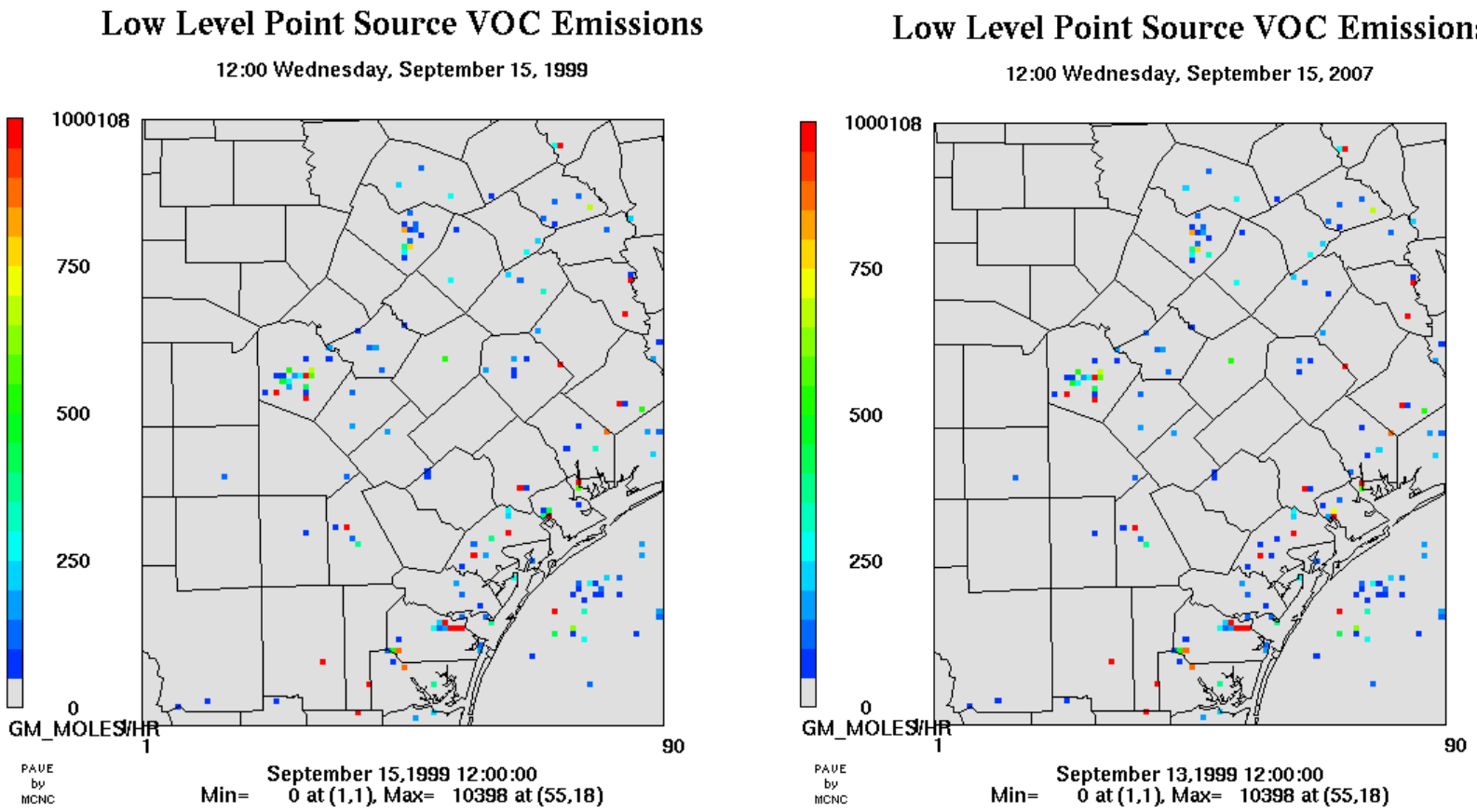
Figure G-6. Comparison of 1999 and 2007 Anthropogenic VOC Precursor Emissions from Low-level Point Sources within the 4-km Subdomain on Wednesday, September 15th.

1999 **2007**



2007 BASE CASE
Once the 1999 base case was modified by replacing the photochemical model's emissions inputs (i.e., replacing the 1999 local, state, and regional anthropogenic EI with a 2007 local, state, and regional EI), the model was rerun. The resulting episode projection represents the 2007 future case for the SAER.

The impact of modifying the anthropogenic local and regional emissions inventories between the 1999 base and 2007 future cases is demonstrated in table G-3. As shown, the 2007 projection predicts a decrease in ozone concentration at each San Antonio monitoring station (7x7 array of cells near monitor) compared to the 1999 base case predictions.

Table G-3. Comparison of 1999 and 2007 Predicted Maximum 8-hour Average Ozone Concentrations by Monitor, September 15th - 20th.

CAMS Station	1999 Predicted 8-hr Max. Ozone	2007 Predicted 8-hr Max. Ozone	1999-2007 Percent Change
CAMS 23	89.0 ppb	84.5 ppb	-5.0%
CAMS 58	87.8 ppb	82.8 ppb	-5.6%
CAMS 59	78.1 ppb	73.6 ppb	-5.7%
CAMS 678	80.1 ppb	77.4 ppb	-3.3%

2007 BASE CASE PERFORMANCE EVALUATION
Appendix E describes a variety of tests that were conducted on the 1999 base case in order to evaluate model performance. For a future case, such as the 2007 projection, methods of analyzing model performance are more limited. Ozone metrics and several other types of analyses that compare the model's predictions with actual measurements cannot be performed prior to compilation of those actual future measurements. As a consequence, performance analyses conducted on the 2007 future case were restricted to tile plots, comparisons between model refinements, and sensitivity runs.

Tile Plots
Tile plots provide an indication of where the model is or isn't performing correctly given known changes to modeling input in the future case. These plots are visual representations of the model's predictions and provide such information as when and where the model predicts urban plumes. The following tile plots (figures G-7 through G-12) represent comparisons between the 1999 and 2007 8-hour daily maximum ozone concentrations within the modeling domain for each day of the primary episode.

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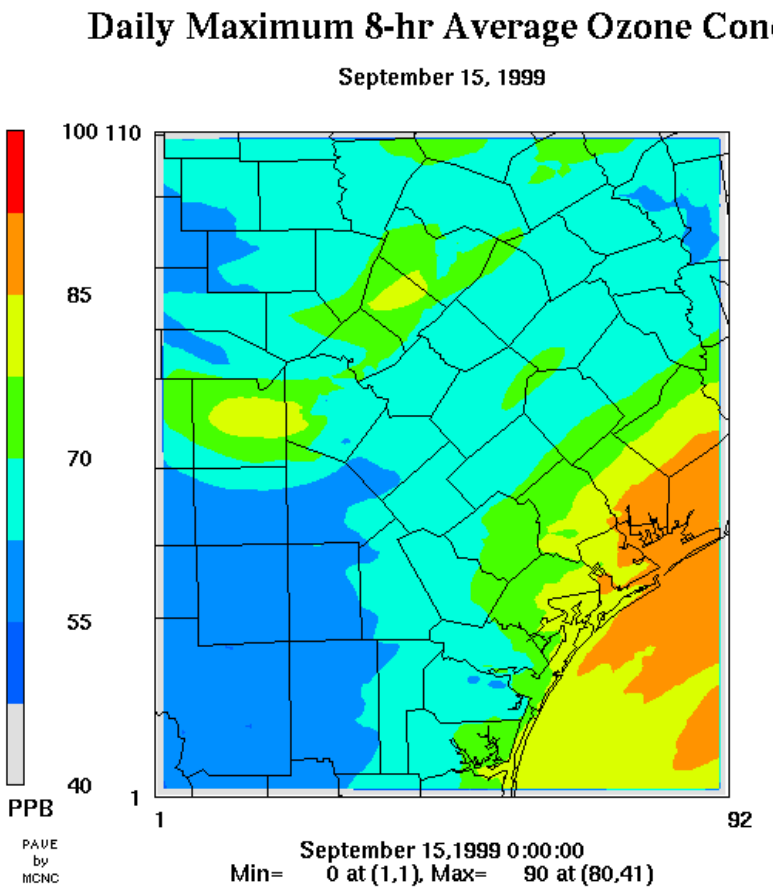
Figure G-7. Comparison of 1999 and 2007 Predicted Daily Maximum 8-hour Ozone Concentrations in the 4-km Subdomain on Wednesday, September 15th.

1999



2007

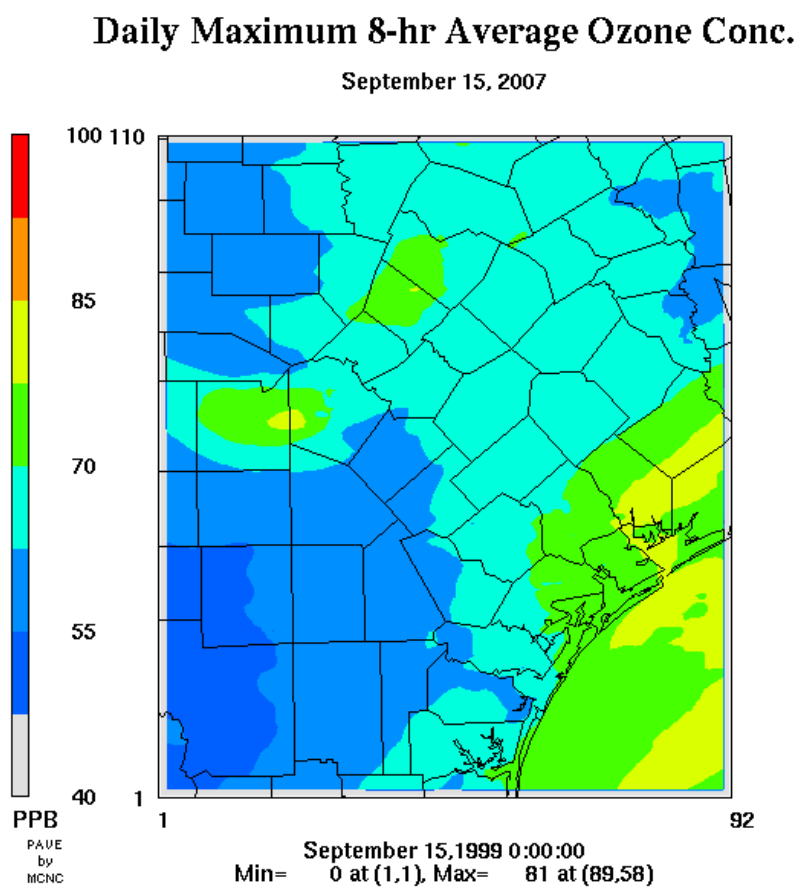


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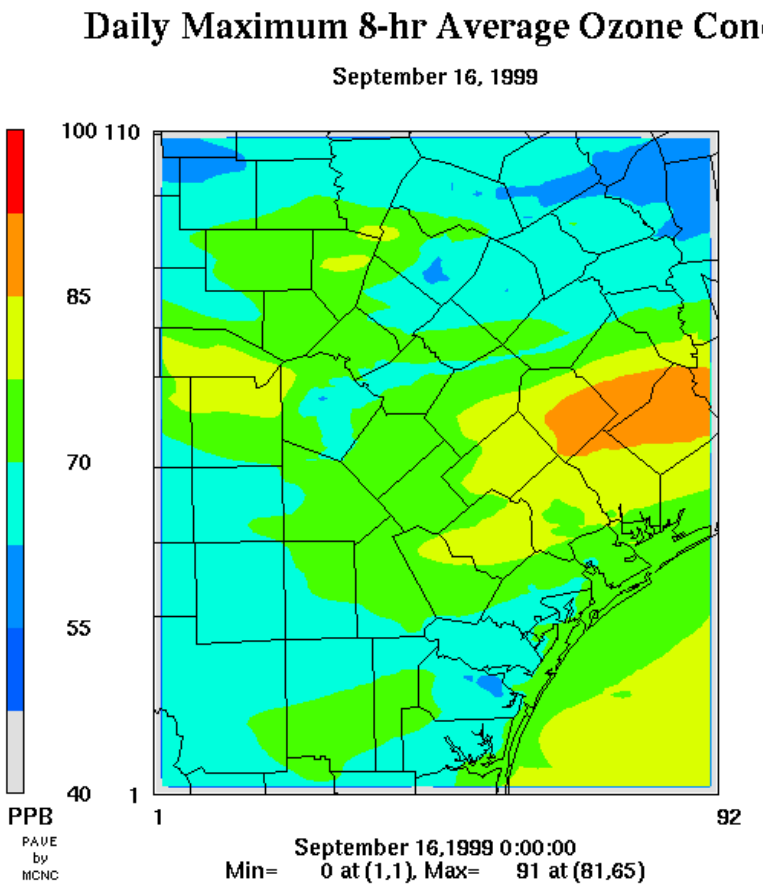
Figure G-8. Comparison of 1999 and 2007 Predicted Daily Maximum 8-hour Ozone Concentrations in the 4-km Subdomain on Thursday, September 16th.

1999



2007

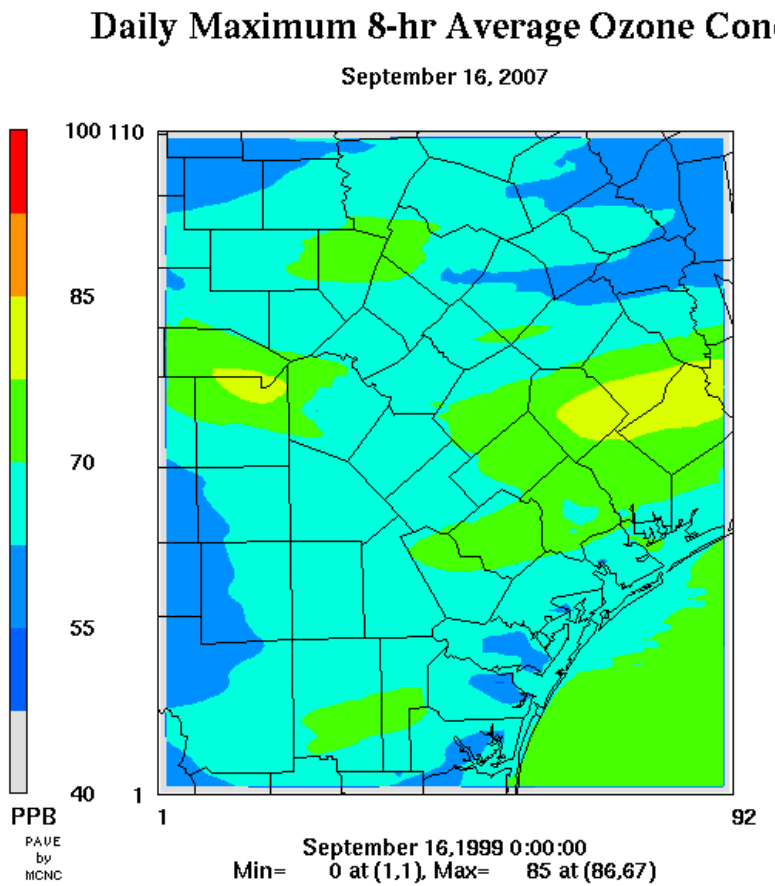


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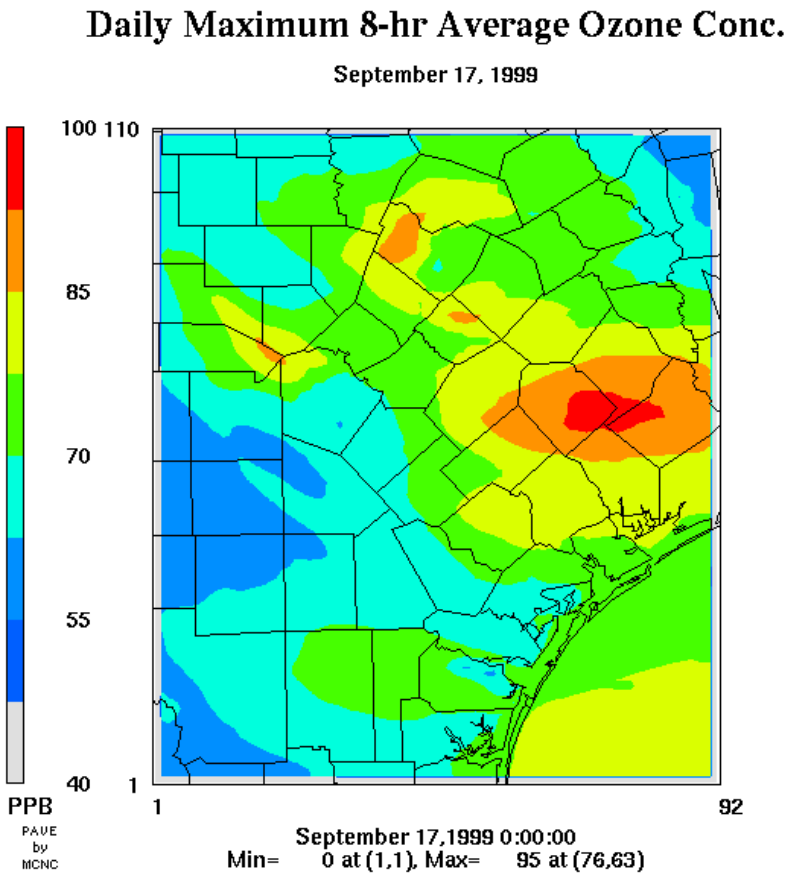
Figure G-9. Comparison of 1999 and 2007 Predicted Daily Maximum 8-hour Ozone Concentrations in the 4-km Subdomain on Friday, September 17th.

1999



2007

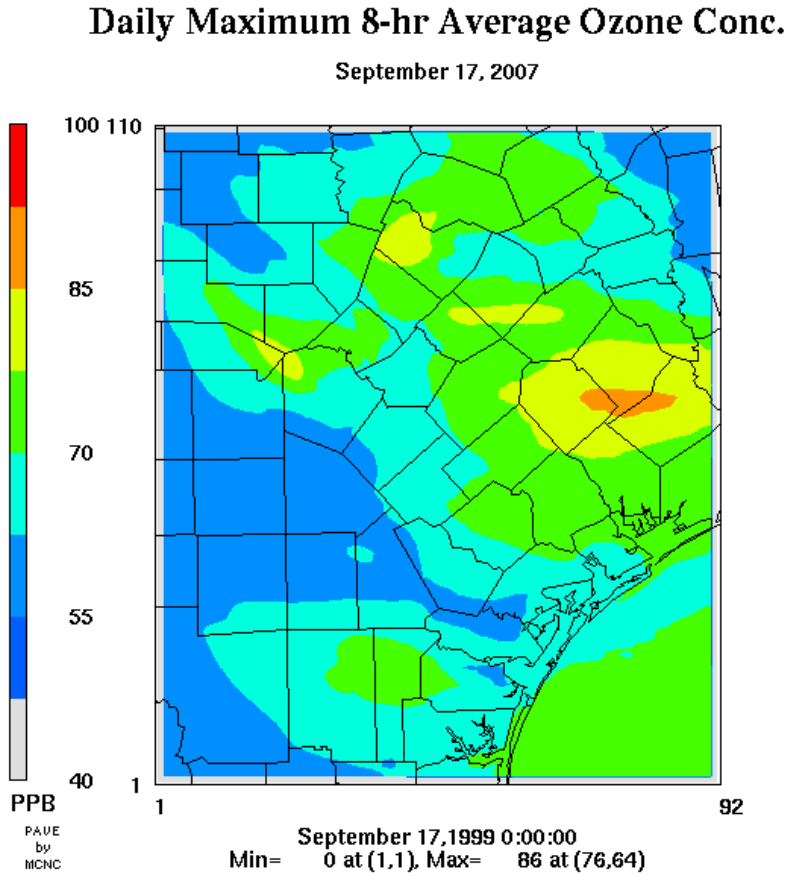


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Figure G-10. Comparison of 1999 and 2007 Predicted Daily Maximum 8-hour Ozone Concentrations in the 4-km Subdomain on Saturday, September 18th.

1999 **2007**

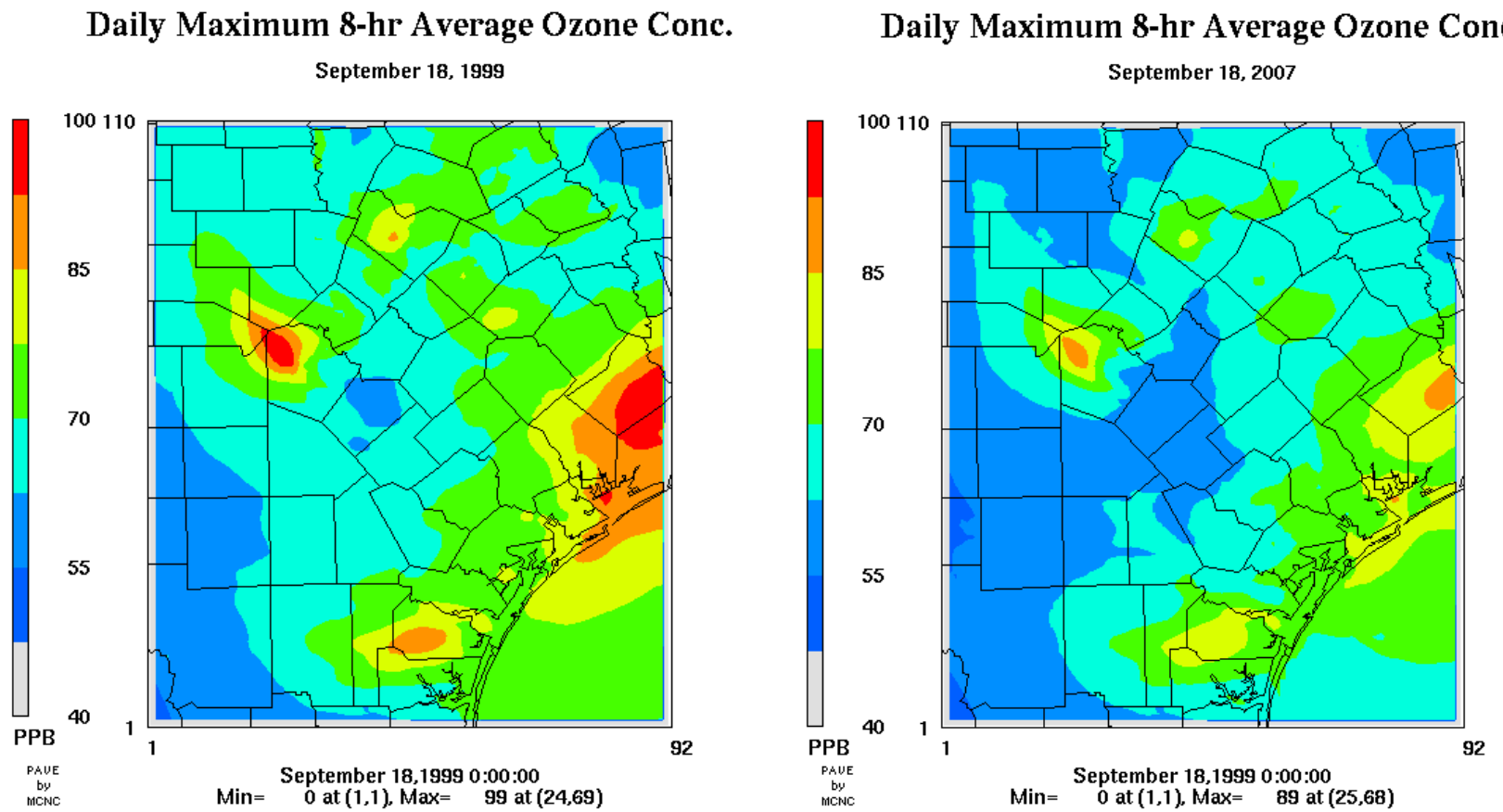

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Figure G-11. Comparison of 1999 and 2007 Predicted Daily Maximum 8-hour Ozone Concentrations in the 4-km Subdomain on Sunday, September 19th.

1999 **2007**

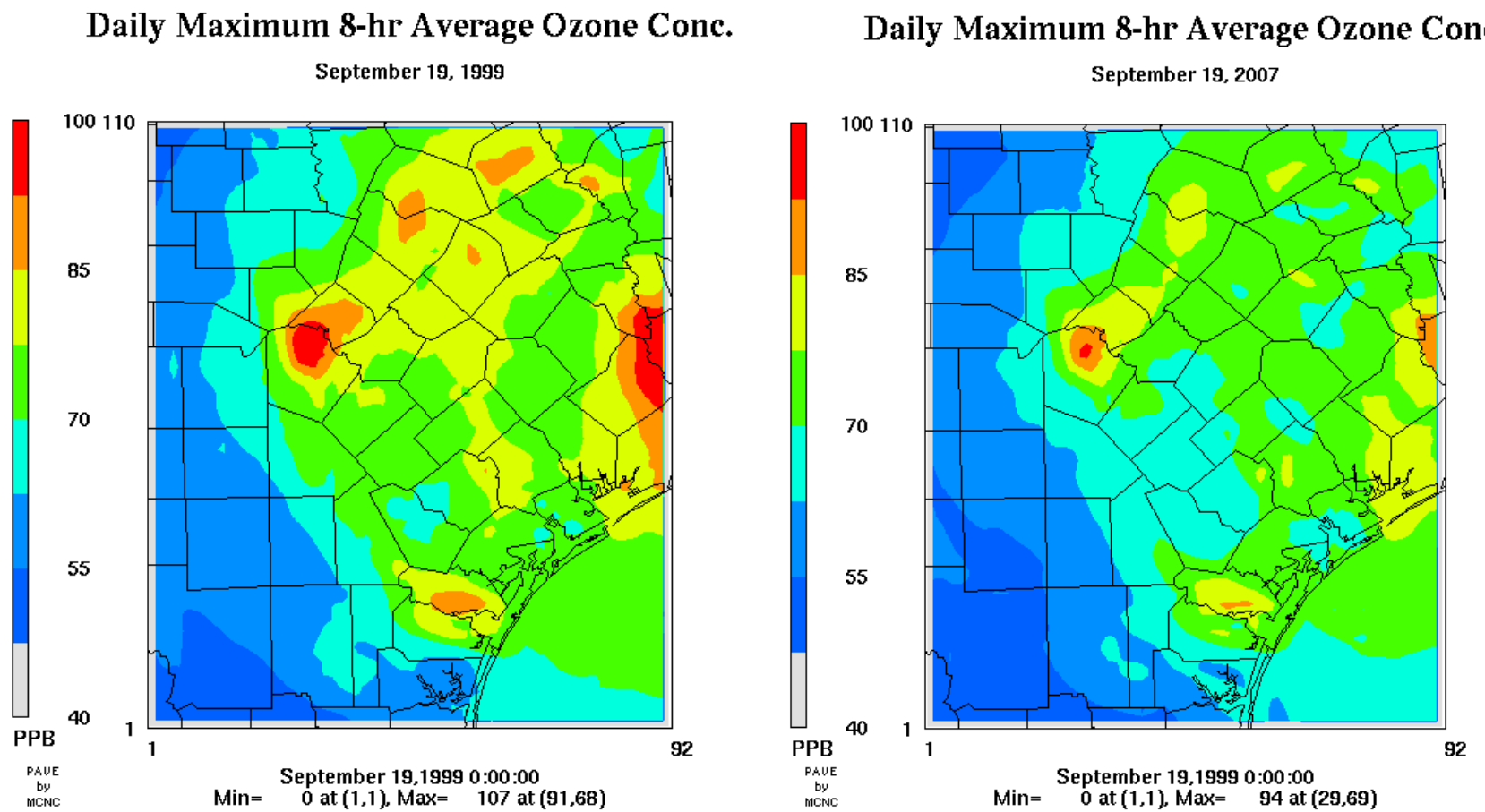

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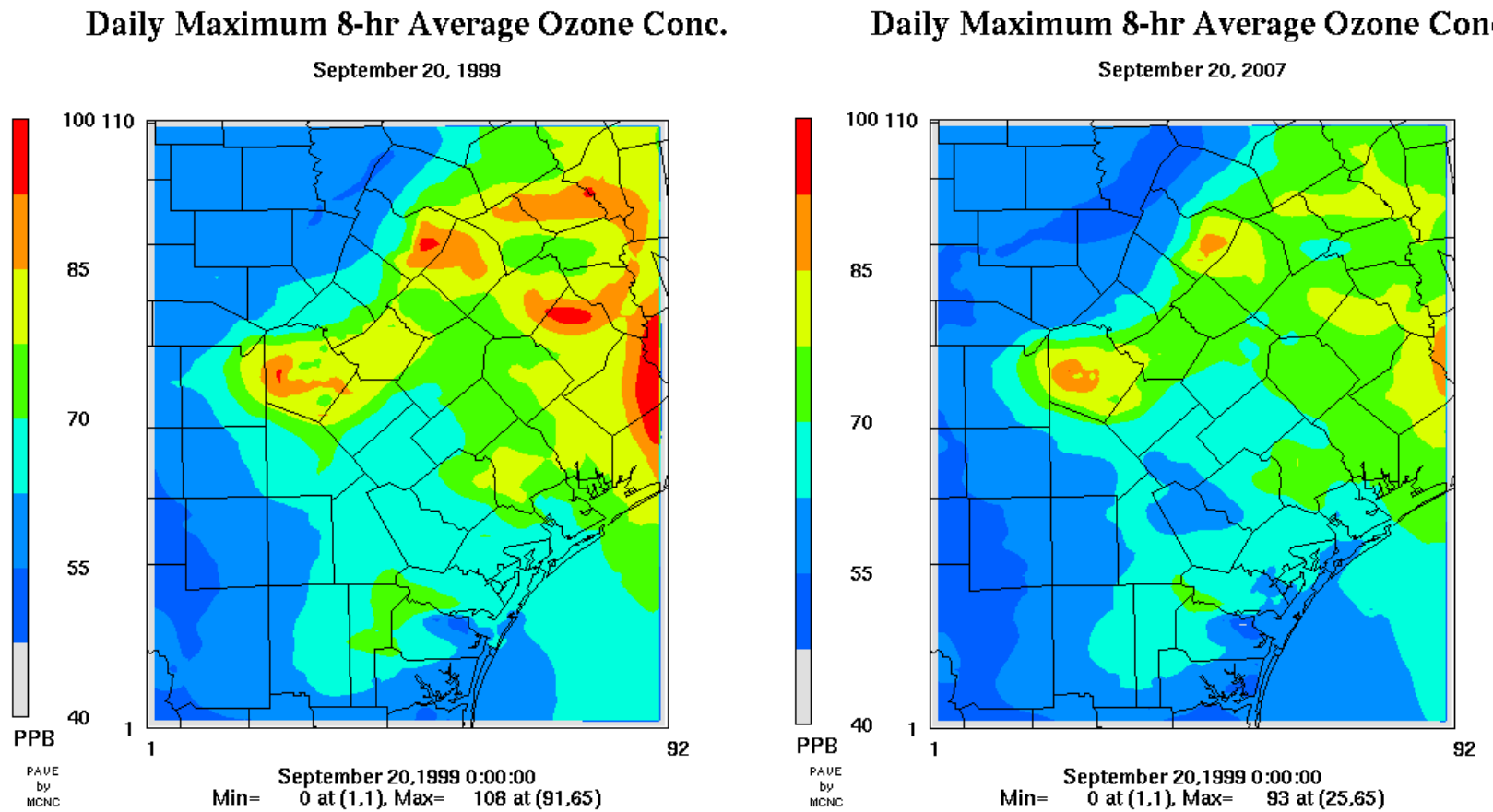
Figure G-12. Comparison of 1999 and 2007 Predicted Daily Maximum 8-hour Ozone Concentrations in the 4-km Subdomain on Monday, September 20th.

1999 **2007**



As demonstrated by these plots, urban plumes are replicated predictably, both in terms of intensity and spatial allocation. Peak ozone concentrations are predicted downwind of city centers and major point sources in these tile plots. In addition, the overall reduction in NOx, VOC, and CO emissions (local and regional) between 1999 and 2007 reduced the magnitude of the ozone plumes in each of the daily 1999-2007 comparisons.

Comparisons Between Model Refinements

As described in appendix E, the original September 1999 model was developed by ENVIRON and refined through a collaboration between ENVIRON, UT Austin[1], and AACOG (meteorological model and air quality input refinements). Subsequently, the model was provided to the Texas Near Nonattainment (NNA) partners[2], or their contractors, for further modifications. These modifications included refinement of the emissions inventory inputs, development of the future case, and clean air strategy analyses. Because the model was modified by more than one agency during this process, there was a concern that the various agencies' models would become dissimilar and provide different predictions for the base case, future case, and control strategy runs.

A great amount of effort was spent ensuring that the Austin and San Antonio base and future cases contained identical input. Often this involved discussions between the two agencies, as well as TCEQ, regarding the most appropriate EI data for local and regional areas. Discrepancies in emissions inputs were corrected prior to the final AACOG and UT runs.

An analysis was conducted by AACOG staff to determine any differences between the final 1999 base case refined by UT Austin and the final base case refined by AACOG, based on predicted concentrations at two Austin monitors. The 2007 future cases developed by UT and AACOG were similarly analyzed. The results of these analyses are provided in table G-4. The table provides daily peak 8-hour predictions within the 7x7 array of cells near the Murchison and Audubon monitors for the 1999 and 2007 base cases.

As shown, the differences between predictions by AACOG's final run (labeled 1999_sos.f) and UT's final run (labeled 1999_v3) are insignificant. With regards to the Murchison monitor, the average difference (six episode days) in ozone concentrations between the two 1999 base cases was 0.00 ppb, while the average difference at the Audubon monitor was 0.05 ppb. For the 2007 future cases, the average differences in peak ozone concentrations for the six-day episode was -0.06 ppb (Murchison) and –0.04 ppb (Audubon). These results provide additional, independent verification of the performance of the 1999 base case and 2007 future case.

[1] UT Austin acted on behalf of Austin modeling.

[2] Development of the September 1999 photochemical model simulation was a collaboration between TCEQ and four Texas NNAs: Austin, Corpus Christi, San Antonio, and Victoria.

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Table G-4. Comparison of Predicted Peak 8-hour Concentrations for Final UT and AACOG Base and Future Case Runs.

Monitor	UT **1999_v3**	AACOG **1999_sos.f**	Average Difference	UT **2007_v3**	AACOG **2007.f**	Average Difference	UT **RRF**	AACOG **RRF**	Average Difference	**Days**	Date
MURC	84.6	84.6	0.00	80.2	80.3	-0.06	0.948	0.949	-0.001	6	9/15 – 9/20
AUDU	81	80.9	0.05	76.7	76.7	-0.04	0.948	0.948	0.000	6	9/15 – 9/20
Monitor	UT **1999_v3**	AACOG **1999_sos.f**	Daily Difference	UT **2007_v3**	AACOG **2007.f**	Daily Difference	UT **RRF**	AACOG **RRF**	Daily Difference	**Days**	**Date**
MURC	77.8	77.8	0.0	75.1	75.1	0.0	0.964	0.965	-0.001	1	9/15
MURC	75.5	75.4	0.1	72.8	72.8	0.0	0.964	0.966	-0.002	1	9/16
MURC	86.8	86.7	0.1	82.2	82.2	0.0	0.947	0.948	-0.001	1	9/17
MURC	84.5	84.4	0.1	79.8	79.8	0.0	0.945	0.946	-0.001	1	9/18
MURC	89.6	89.7	-0.1	83.4	83.4	0.0	0.932	0.930	0.002	1	9/19
MURC	93.6	93.6	0.0	88.2	88.3	-0.1	0.942	0.942	0.000	1	9/20
AUDU	76.2	76.1	0.1	73.7	73.7	0.0	0.968	0.969	-0.001	1	9/15
AUDU	78.2	78.2	0.0	74.6	74.7	-0.1	0.954	0.955	-0.001	1	9/16
AUDU	87.4	87.4	0.0	82.2	82.2	0.0	0.94	0.941	-0.001	1	9/17
AUDU	84.5	84.4	0.1	78.8	78.8	0.0	0.933	0.934	-0.001	1	9/18
AUDU	89.4	89.5	-0.1	82.9	82.9	0.0	0.928	0.927	0.001	1	9/19
AUDU	70.1	70.2	-0.1	68.1	68.2	-0.1	0.972	0.971	0.001	1	9/20

Sensitivity Tests
Sensitivity tests are used throughout model development as diagnostic tools. These tests are conducted by perturbing model input. Results of sensitivity tests are analyzed in terms of whether the model responded to changes in input and, further, whether the model responded in a manner judged to be appropriate to input modifications.

In addition to providing an indication of model performance, sensitivity tests are useful for providing key information. For example, when applied to a projection year base case, sensitivity runs may be used to analyze the impact of emissions sources in the future. Furthermore, these evaluations may be used to predict the impact of control strategies and assist with determining what types of precursor reductions are likely to be the most effective for reducing ozone concentrations.

The 2007 future case sensitivity tests were conducted by modifying model input in one of two ways: 1) removing the precursor emissions for specific point sources/urban areas, or 2) reducing the local anthropogenic NOx and VOC emissions inventories in incremental amounts. The results of modifying model input to the 2007 future case are provided in the following sections.

Zero-Out Runs: Urban Areas
Appendix E describes sensitivity tests conducted on the 1999 base case in which the anthropogenic NOx and VOC EIs for Austin, Corpus Christi, and Houston were removed from, or "zeroed out" of, the model. These tests were also conducted on the 2007 future case, i.e., the 2007 NOx and VOC EIs for Austin, Corpus Christi, and Houston were removed from the future case in three separate tests. Figures G-13 and G-14 provide the predicted changes in ozone concentrations at CAMS 23 and CAMS 58, respectively, after removing the anthropogenic EIs for each of the three urban areas and compares those values to the 1999 sensitivity runs.

As shown by the graphs in figures G-13 and G-14, removing the anthropogenic EI for the 11-county Houston area had the greatest predicted impact on 2007 ozone concentrations in the San Antonio area, followed by the 2-county Corpus Christi area and 5-county Austin area. Moreover, this trend is the same whether referring to the 1999 base or 2007 future case sensitivity runs. During the 1999 episode, the predominate wind direction was such that Houston emissions were more likely to impact San Antonio than Austin or Corpus Christi. Since the meteorological inputs remain identical between base and future cases, it stands to reason that Houston emissions would continue to demonstrate the greatest influence on San Antonio ozone concentrations during the September episode.

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Figure G-13. Predicted Reductions in Ozone Concentrations at CAMS 23 after Zeroing Out Anthropogenic Precursor Emissions for the 11-county Houston Area, 2-county Corpus Christi Area, and 5-county Austin Area from the 1999 Base Case (orange) and 2007 Future Case (blue).

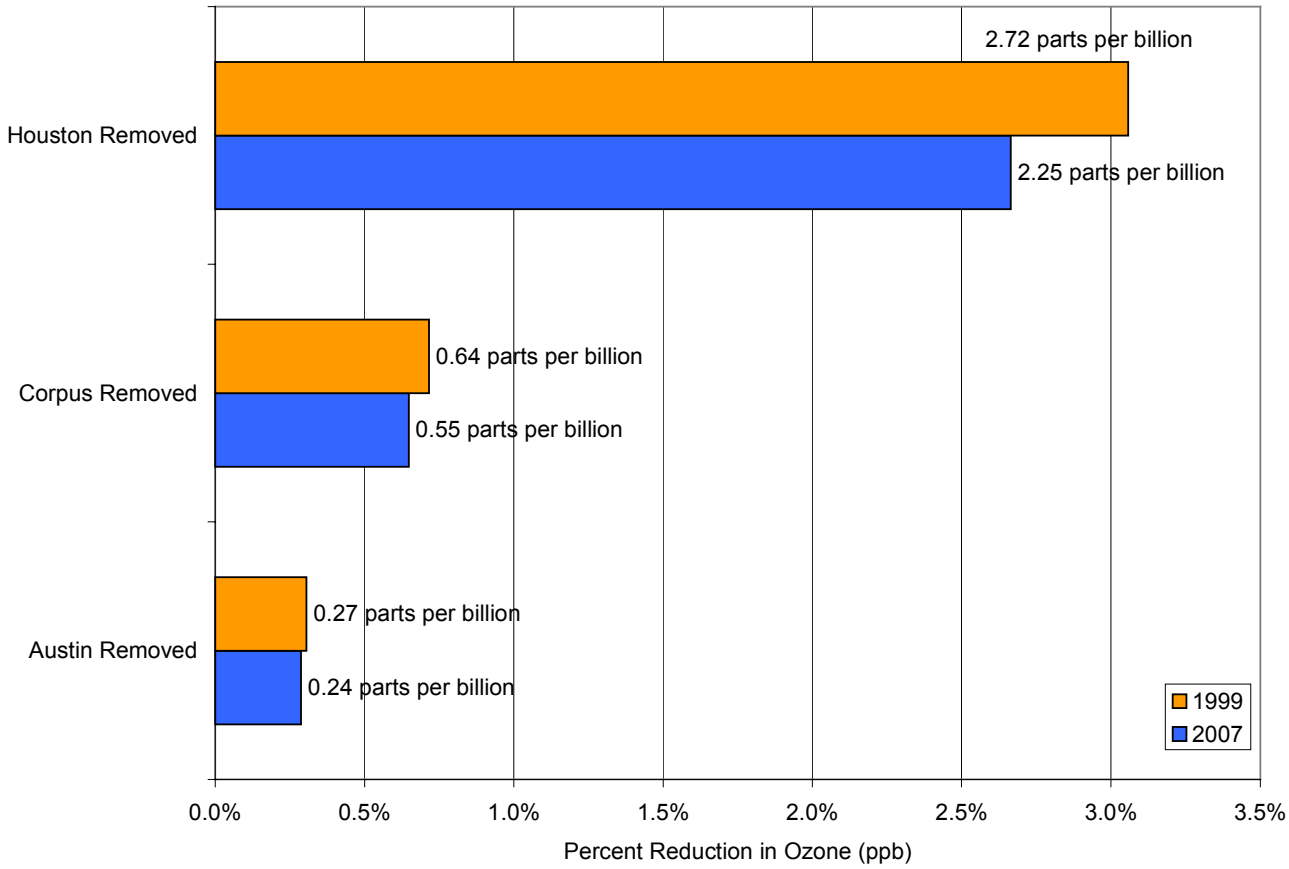

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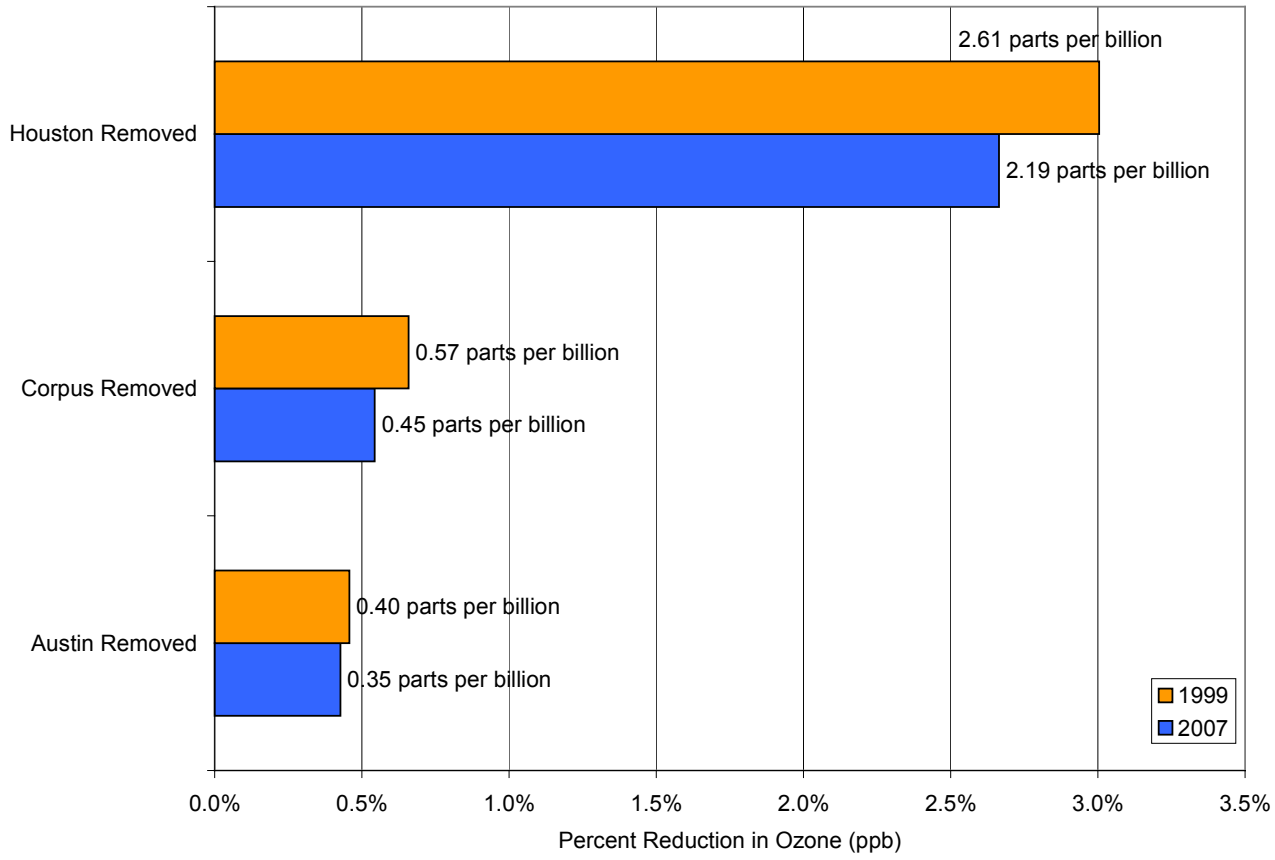
Figure G-14. Predicted Reductions in Ozone Concentrations at CAMS 58 after Zeroing Out Anthropogenic Precursor Emissions for the 11-county Houston Area, 2-county Corpus Christi Area, and 5-county Austin Area from the 1999 Base Case (orange) and 2007 Future Case (blue).



Zero-Out Runs: Point Sources

Analyses were also conducted in which specific point source emissions were removed from the model in separate sensitivity runs. These tests were run at the request of local elected officials and the TCEQ to identify likely strategies (VOC versus NOx) for ambient ozone reductions in the SAER.

Figures G-15 and G-16 provide the predicted changes in ozone concentrations at CAMS 23 and 58, as the result of conducting these zero out runs for 1999 and 2007. One run, labeled "CPS Spruce 1 Coal Plant Removed," simulates the impact of removing a currently-existing 750-megawatt power plant from the 2007 future case in the San Antonio area. A second run, "Remove All CPS Power Plants," simulates the impact of removing the nine power plants in the San Antonio region in 1999 from the 1999 base case and removing seven power plants (due to anticipated closures of two plants) from the 2007 future case. A third run "Remove Cement Plants" represents the removal of emissions from all cement kilns in the 4-county SAER. The last run, "Toyota Removed," simulates the impact of removing the EI for a major manufacturing plant from the 2007

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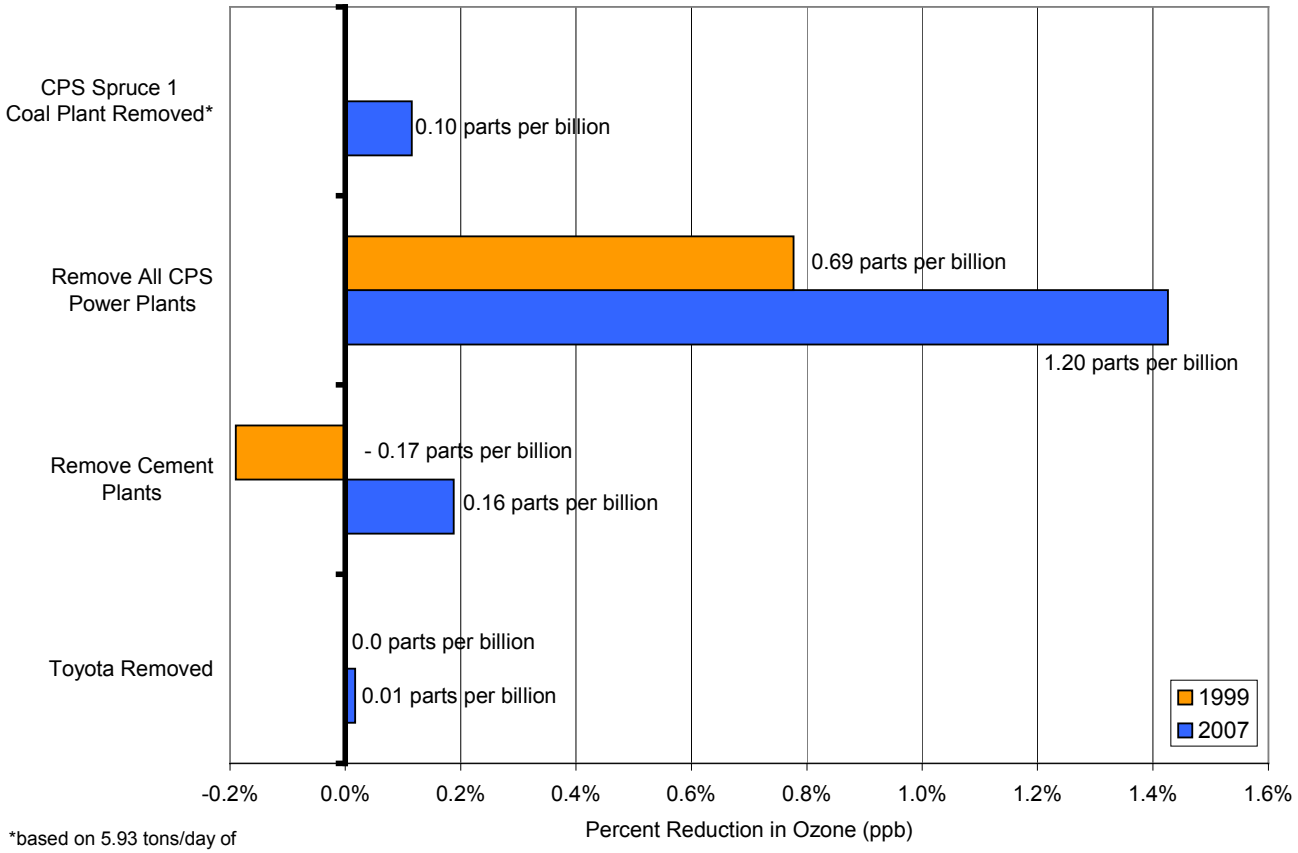
Figure G15. Predicted Reductions in Ozone Concentrations at CAMS 23 after Removing Various Point Source Emissions within the SAER– Comparison between 1999 (orange) and 2007 (blue).



*based on 5.93 tons/day of NOx in 2007 only

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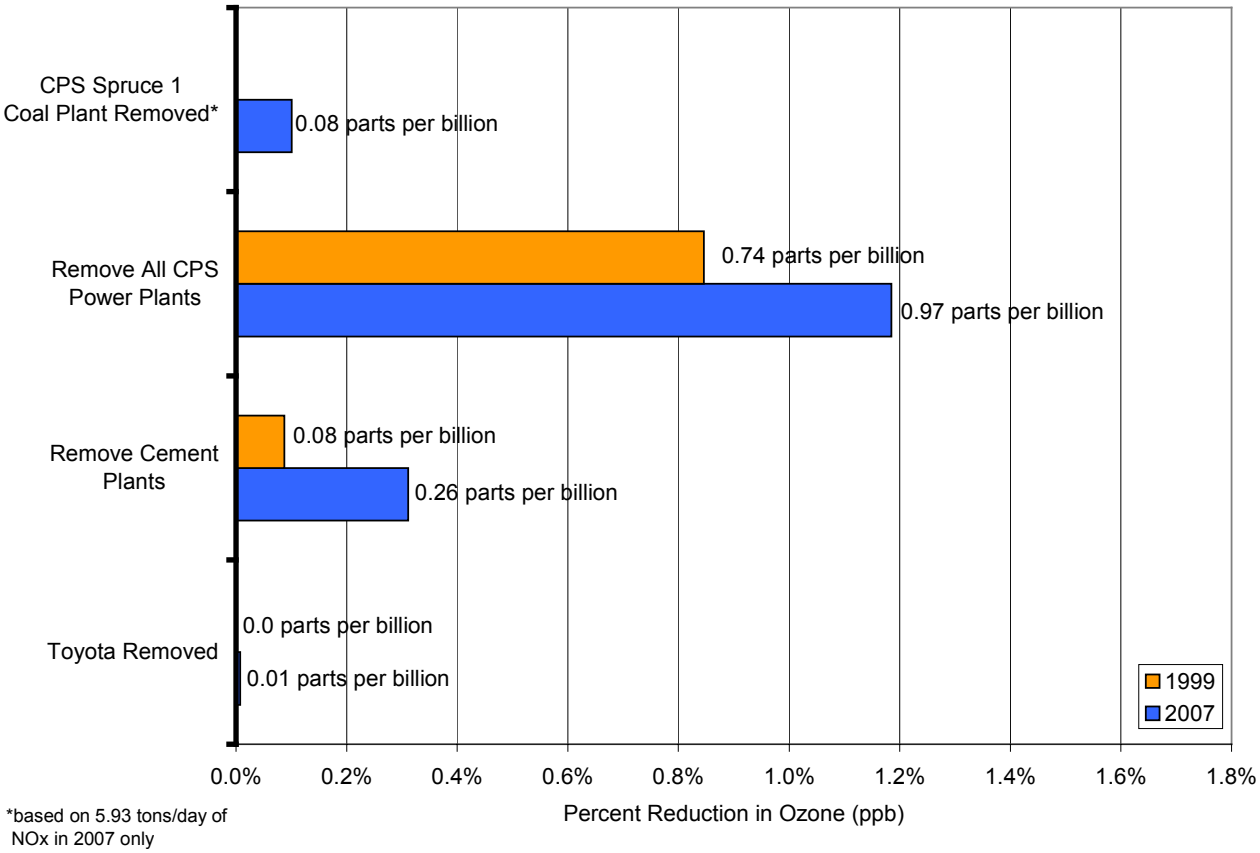
Figure G-16. Predicted Reductions in Ozone Concentrations at CAMS 58 after Removing Various Point Source Emissions within the SAER– Comparison between 1999 (orange) and 2007(blue).



future case. Since the plant is not scheduled to be in operation until 2006, removing these emissions have no impact on the 1999 base case.

As shown in these graphs, removing all power plant emissions had the greatest impact on both the 1999 and 2007 simulations. Since the combined power plants were the largest source of precursors (NOx) of all sources tested, this type of result is expected. Conversely, the Toyota plant, which has the lowest emission rates (primarily VOC), impacts San Antonio ozone concentrations the least.

With the exception of the results of removing the cement kiln emissions from the 1999 base case at CAMS 23, each sensitivity run demonstrates a decrease in predicted 1999 or 2007 ozone concentrations. The predicted increase in ozone concentration at CAMS 23 is most likely a reversal of the model's ozone scavenging process. During much of the 1999 episode, the model predicts conditions in which decreases in NOx cause ozone concentrations to increase (NOx reduction disbenefit). Thus, removing the NOx emissions from kilns near the monitor causes the model to predict increased ozone concentrations at that location in the 1999 base case.

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This NOx reduction disbenfit is much less evident in the 2007 future case. Consequently, removing the NOx emissions associated with the San Antonio area power plants causes larger ozone reductions in the 2007 future case than in the 1999 base case. Since there are no power plants in the vicinity of CAMS 23, removing the 1999 power plant emissions from the model did not cause an increase in predicted ozone levels in the 1999 base case, as was demonstrated by the cement kiln sensitivity run.

At the request of EPA Region 6, the output from each point source "zero out" simulation was run through a graphics program, PAVE, to obtain a visual depiction of the impact of removing these sources in the SAER. The plots for zeroing out point sources were created for all primary episode weekdays, when applicable,[3] as shown in figures G-17 through G-22. An advantage these plots have compared to the graphs for CAMS 23 and 58, shown previously, is that they provide an indication of the impact of modifying emissions in terms of spatial distribution.

As shown by these graphs, the impact of removing point source emissions was, to a large extent, influenced by the model's meteorological processes, particularly wind direction. The September 15th – 17th plots, for example, indicate that these emissions primarily affect counties to the west and northwest of Bexar County. In addition, the cement kiln zero out runs tended to show the widest area of influence. This is an expected outcome since the cement kiln emission sources are spread throughout the San Antonio area, whereas all seven CPS power plants are located in southeast Bexar County. Similarly, the Toyota manufacturing plant is represented by a single point in south Bexar County on the plots.

[3] Weekends were not included for the Toyota set of sensitivity runs because the plant is not scheduled to be operational on Saturday and Sunday.

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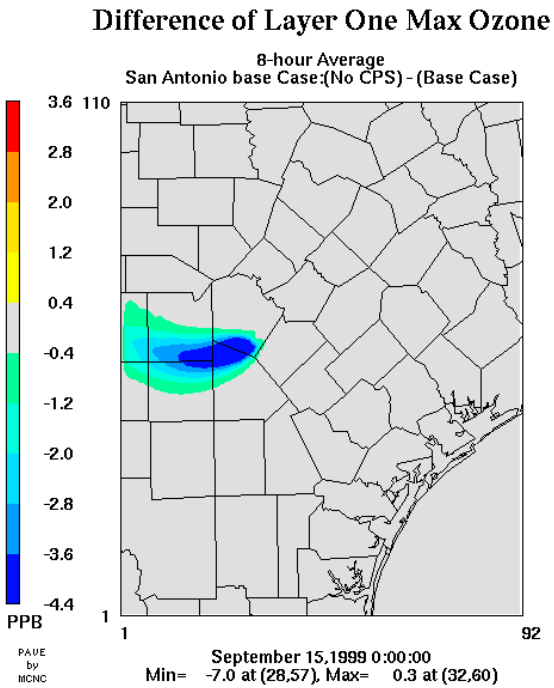
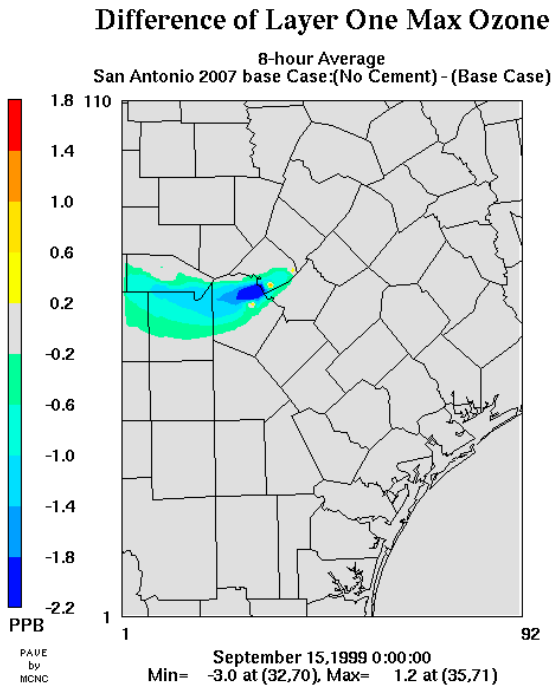
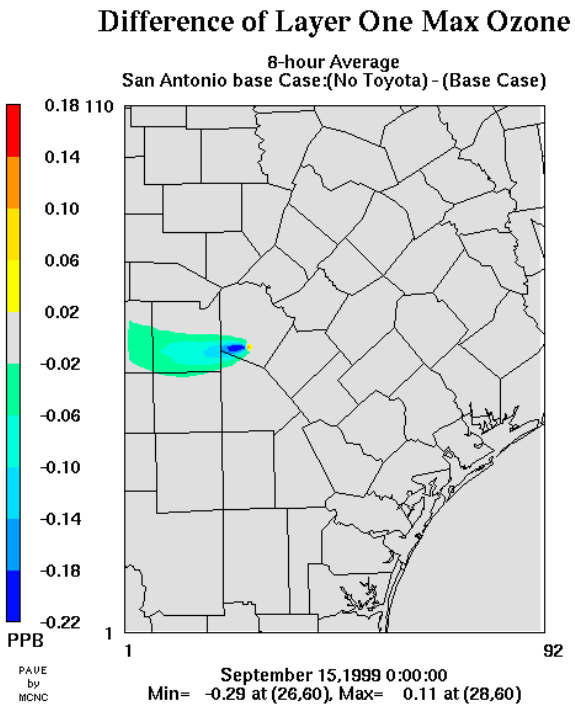
Figure G-17. Comparison of Zero Out Runs Conducted for CPS Power Plants, Cement Kilns, and Toyota Manufacturing Plant on the 2007 Future Case, Wednesday, September 15th.



Removal of CPS Power Plant Emissions



Removal of San Antonio area Cement Kiln Emissions



Removal of Toyota Manufacturing Plant Emissions

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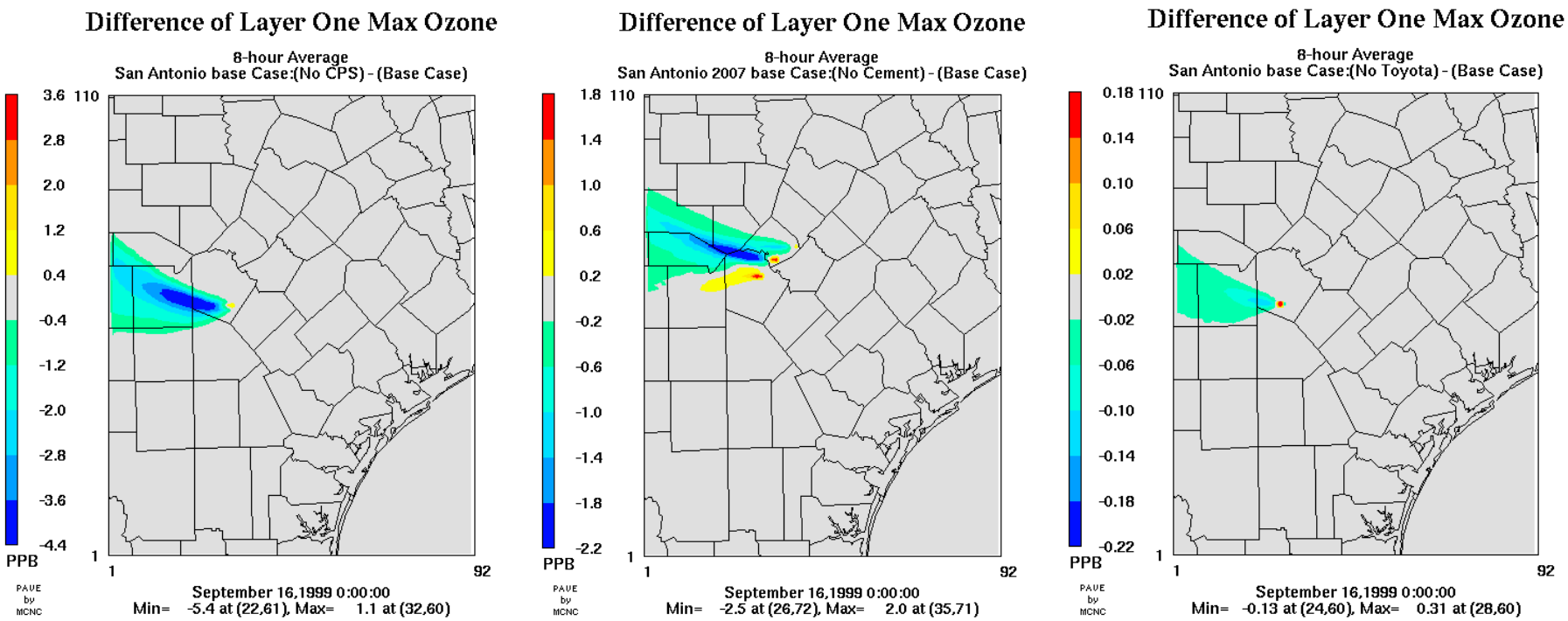
Figure G-18. Comparison of Zero Out Runs Conducted for CPS Power Plants, Cement Kilns, and Toyota Manufacturing Plant on the 2007 Future Case, Thursday, September 16th.



Removal of CPS Power Plant Emissions

Removal of San Antonio Area Cement Kiln Emissions

Removal of Toyota Manufacturing Plant Emissions

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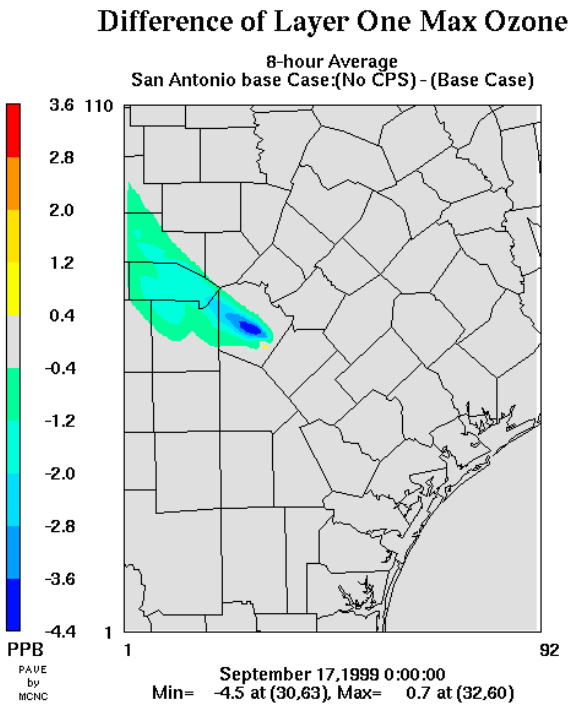
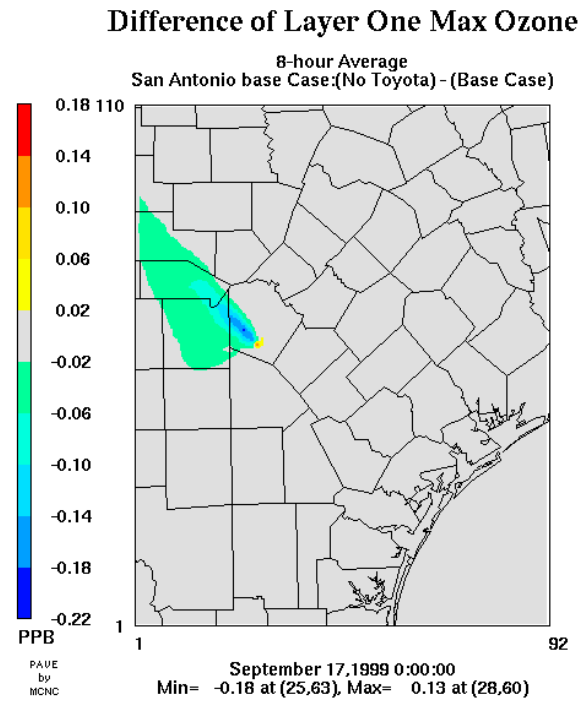
Figure G-19. Comparison of Zero Out Runs Conducted for CPS Power Plants, Cement Kilns, and Toyota Manufacturing Plant on the 2007 Future Case, Friday, September 17th.



Removal of CPS Power Plant Emissions

Problems with the graphics software prevented the completion of a tile plot for the September 17th cement kiln sensitivity run



Removal of Toyota Manufacturing Plant Emissions

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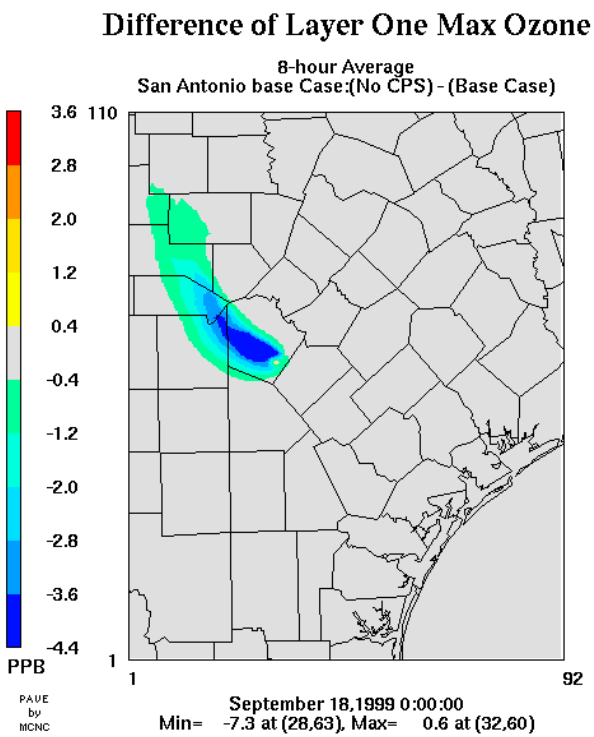
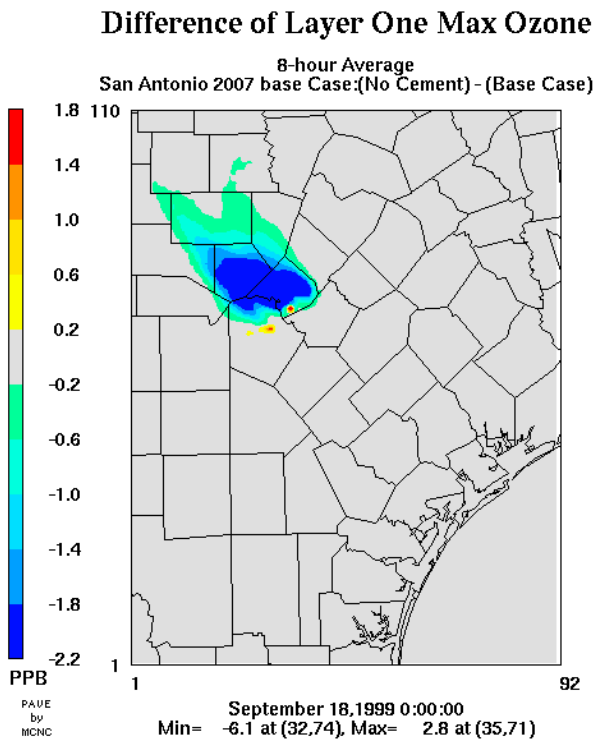
Figure G-20. Comparison of Zero Out Runs Conducted for CPS Power Plants, Cement Kilns, and Toyota Manufacturing Plant on the 2007 Future Case, Saturday, September 18th.



Removal of CPS Power Plant Emissions



Removal of San Antonio Area Cement Kiln Emissions

Not Applicable

Toyota Manufacturing Plant is not scheduled to be operational on Saturdays

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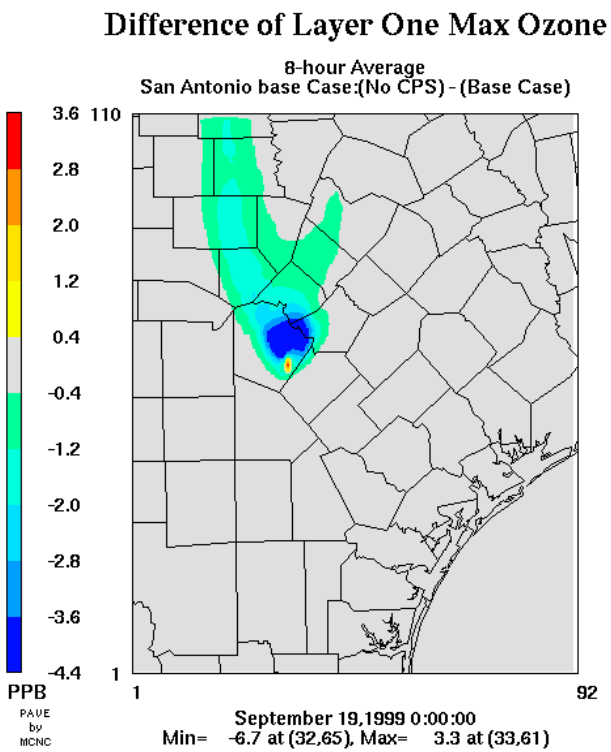
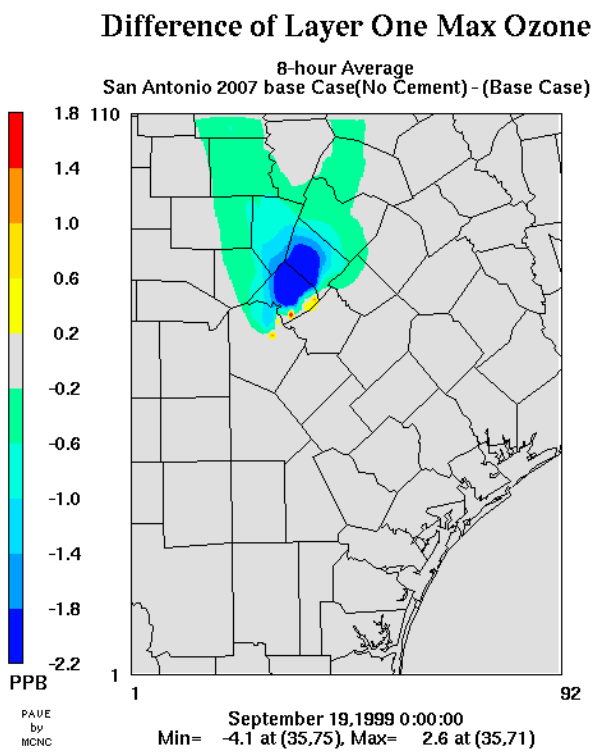
Figure G-21. Comparison of Zero Out Runs Conducted for CPS Power Plants, Cement Kilns, and Toyota Manufacturing Plant on the 2007 Future Case, Sunday, September 19th.



Removal of CPS Power Plant Emissions



Removal of San Antonio Area Cement Kiln Emissions

Not Applicable

Toyota Manufacturing Plant is not Scheduled to be Operational on Sundays

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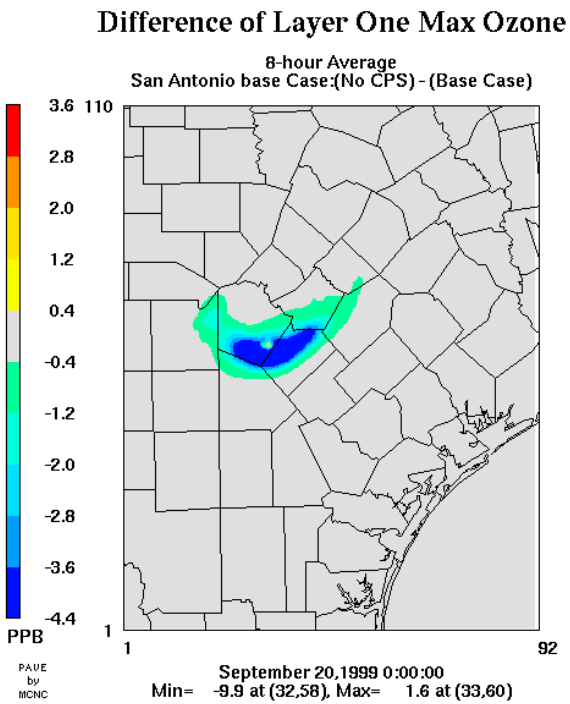
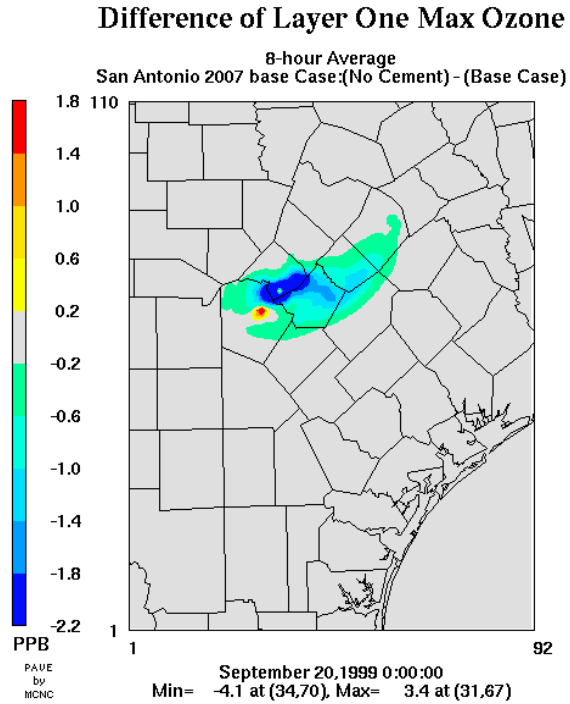
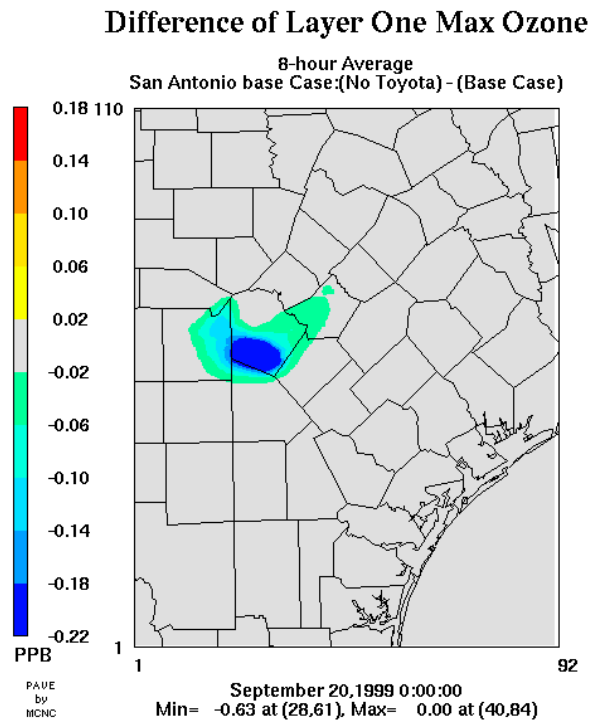
Figure G-22. Comparison of Zero Out Runs Conducted for CPS Power Plants, Cement Kilns, and Toyota Manufacturing Plant on the 2007 Future Case, Monday, September 20th.



Removal of CPS Power Plant Emissions



Removal of San Antonio Area Cement Kiln Emissions



Removal of Toyota Manufacturing Plant Emissions

For the most part, removing point source emissions caused the model to predict decreases in ozone concentrations along the area of impact. However, the model also predicts some areas of increased ozone concentrations, the most prominent of which is the Thursday, September 16th plot depicting the impact of zeroing out cement kiln emissions. Likewise some of the Toyota sensitivity runs exhibit small increases in ozone concentrations near the plant, despite the very low NOx emissions the plant represents (0.34 tons/day). This NOx reduction disbenefit is less pronounced in the power plant sensitivity runs. However, these tile plots depict ozone concentrations in the lowest atmospheric grid layer, whereas power plants pollutants are emitted, by computer simulation, into higher grid layers.

Incremental Removal of VOC and NOx Precursor Emissions

Across-the-board sensitivity runs were conducted by removing 25%, 50%, 75%, and 100% of the local (4-county SAER) NOx emissions, VOC emissions, and combinations of the two, from the 2007 future case. Figures G-23 and G-24 provide the results of the across-the-board reduction runs for CAMS 23 and CAMS 58 (San Antonio downwind monitors), averaged over the six day modeling period conducted on the 1999 base and 2007 future cases.

At the 25% reduction level (CAMS 23), VOC reductions were slightly more effective than NOx reductions at lowering ozone concentrations. At CAMS 58, 25% NOx and 25% VOC reductions are equally effective. These results are somewhat different than those predicted for the 1999 base case in that, at the 25% level, VOC reductions were more effective than NOx for reducing ozone concentrations in the SAER. These results tend to support the evaluation of both VOC and NOx control strategies as possible means of reducing ambient ozone concentrations in the San Antonio region.

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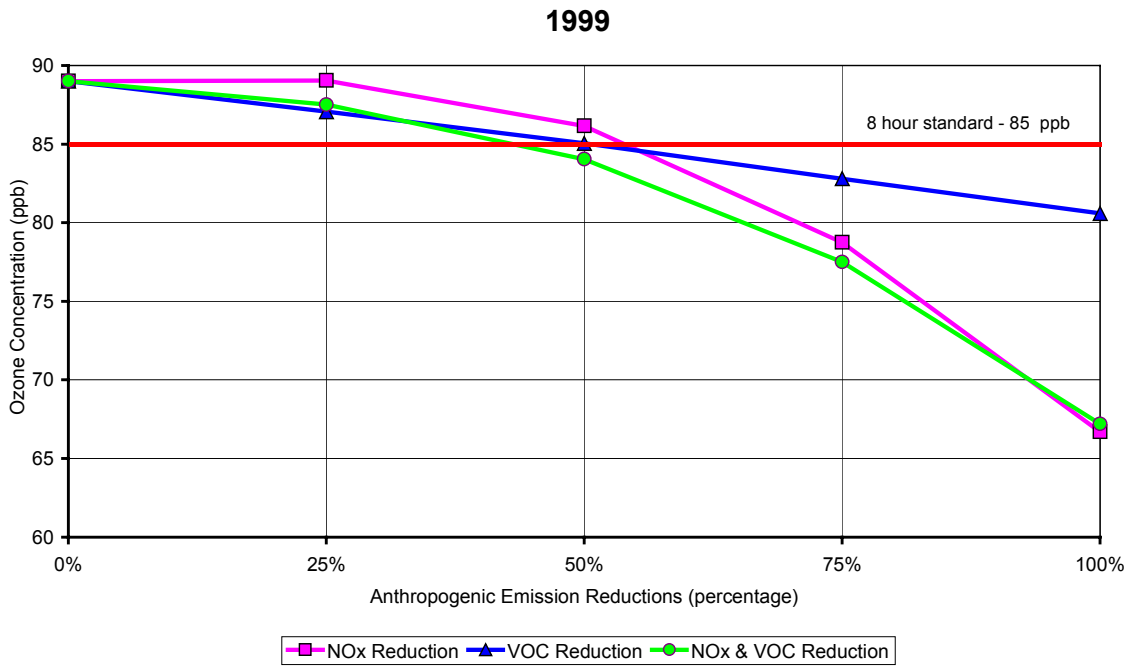
Figure G-23. Predicted Ozone Concentrations at CAMS 23 after Removing Local NOx and VOC Emissions from CAMx Run 18, Averages for September 15 -20, 1999 and 2007.



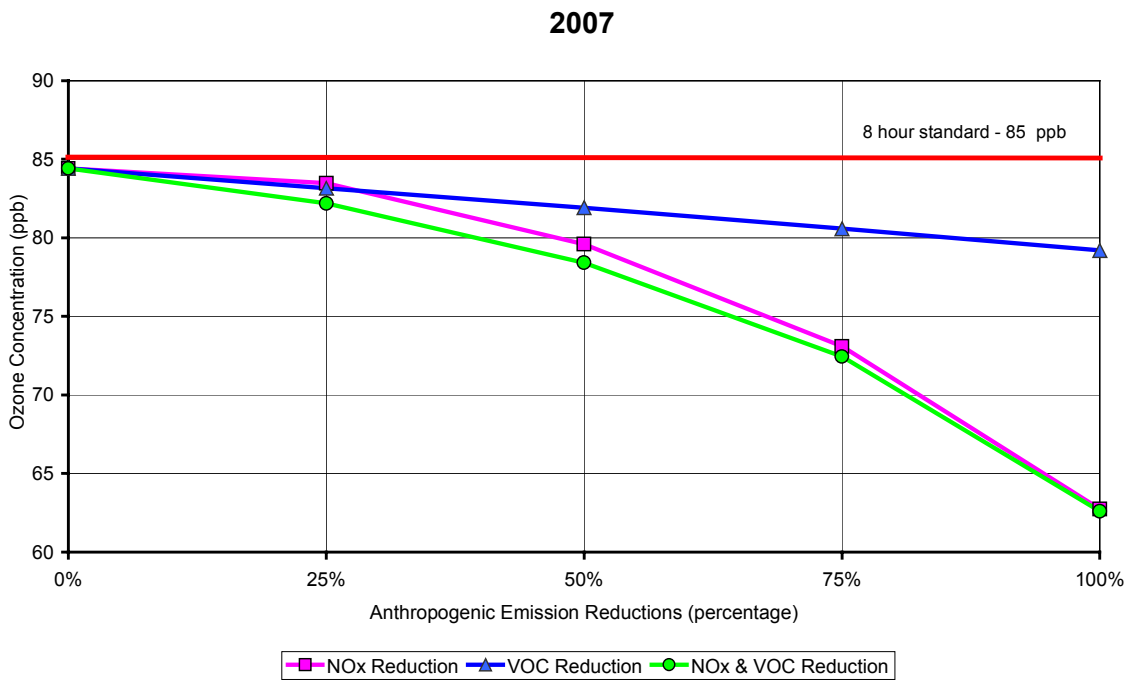


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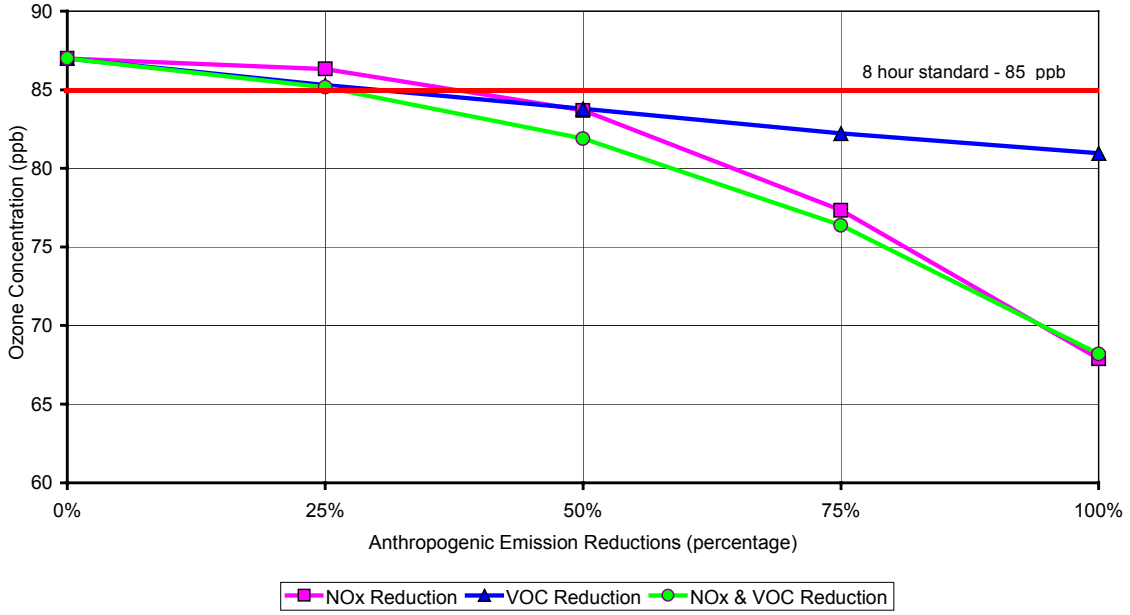
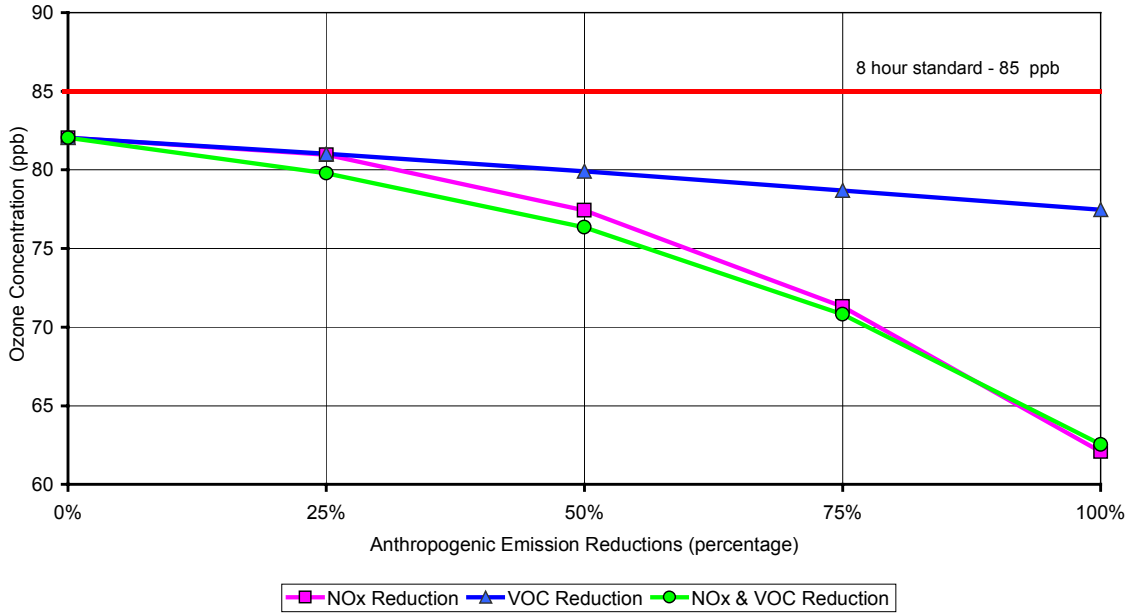
Figure G-24. Predicted Ozone Concentrations at CAMS 58 after Removing Local NOx and VOC Emissions from CAMx Run 18, Average for September 15 -20, 1999 and 2007.

1999



2007



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SUMMARY OF MODIFICATIONS TO THE 1999 BASE AND 2007 FUTURE CASES AND RESULTING DESIGN VALUES

As described previously, a great amount of time and effort were spent ensuring the 2007 future cases developed by UT Austin and AACOG were consistent. As part of that effort, UT and AACOG staff, in consultation with the TCEQ, evaluated local and regional 2007 EI files used as input to the two future cases. Whenever inconsistencies in emissions or procedures were identified, staff from UT, AACOG, and the TCEQ determined the most appropriate data to incorporate into the models. Both the UT and AACOG future cases were modified to reflect these decisions.

Tables G-5 through G-8 summarize the impact of making these modifications to AACOG's 2007 future case. The future case runs, labeled A through G, represent the first future case (A) developed by AACOG, projected from the 1999 base case labeled CAMx Run 18 (see appendix E for more information), through the final 2007 future case run (G). The far right column lists changes that were made to the model for each run.

Results of making the modifications to the future case model simulation are provided for each monitor in the San Antonio region (CAMS 23, 58, 59, and 678). Based on analyses between the AACOG and UT final future cases (see section on "Comparisons Between Model Refinements"), it is evident that the extra effort required to analyze all model inputs resulted in consistent, well-performing future case simulations on which to model control strategy effectiveness and base attainment demonstrations.

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Table G-5. Modifications to the1999 Base Case and 2007 Future Case as Part of the QA/QC Process and Resulting Peak 8-hour Predictions at CAMS 23 Associated with Each Run.

CAMS 23		Peak Predicted 8-hour Ozone Concentrations								
Run Label	Year	15th	16th	17th	18th	19th	20th	Average	Design Value	Modifications to Model
Base Case.A	1999	81.63	78.25	81.39	98.68	102.54	93.73	89.37	89.00	
Base Case.B	1999	81.62	78.25	81.36	98.67	102.46	93.68	89.34	89.00	▪ Updated quarry and construction equipment emissions
Base Case.D	1999	81.62	78.25	81.36	98.67	102.46	93.67	89.34	89.00	▪ Incorporated new wastewater estimates from San Antonio Water System
Base Case.E	1999	81.73	78.16	81.36	98.72	101.59	93.49	89.18	89.00	▪ Updated 1999 area and non-road source temporal profiles for regional Texas to match 2007 temporal profiles ▪ Updated point source cut off point from 20m to 50m for the 4km grid
Base Case F	1999	81.35	78.22	81.52	98.67	101.49	93.42	89.11	89.00	▪ Updated Victoria's mobile EI with latest data from UT ▪ Updated chemical and temporal profiles for Texas area and non-road emissions ▪ Updated Victoria's point sources ▪ Updated Texas NEGU and EGU sources outside of Houston ▪ Updated Louisiana point source emissions ▪ Updated Austin's area & non-road sources
Base Case G	1999	81.14	78.08	81.36	98.57	101.40	93.20	88.96	89.00	▪ Updated San Antonio asphalt emissions ▪ Updated tanker truck unloading emissions ▪ Updated tanker trucks in transit emissions ▪ Updated emissions for other gasoline distribution activities
Base Case.A	2007								84.56	
Base Case.B	2007	80.00	76.21	80.05	89.45	93.92	92.67	85.38	85.06	▪ Updated regional EI HDD non-road EI (provided by TCEQ) ▪ Updated Austin Point Source Control EI (Alcoa) ▪ Updated San Antonio construction and quarry equipment emissions

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CAMS 23 (continued) Base Case.D	2007	80.09	76.19	80.01	89.45	93.93	92.67	85.39	85.07	▪ Incorporated new wastewater estimates ▪ Revised Austin Point Source Control EI (Alcoa)
Base Case.E	2007	79.70	75.20	79.57	88.73	92.48	91.45	84.52	84.35	▪ Revised Austin Point Source Control EI ▪ Incorporated new regional temporal profile for point sources ▪ Added CO for Austin on-road EI (3 County) ▪ Included stage1 (125k) for the 4-county San Antonio MSA ▪ Removed tank truck unloading on Sunday to match EPA guidance ▪ Updated other area source temporal profiles to match EPA guidance ▪ Updated Texas regional area and non-road emissions ▪ Updated Texas point sources (besides CPS) ▪ Updated Lehigh cement Kiln controls ▪ Updated point source cut off point from 20m to 50m on the 4-km grid to match the 12-km grid cut off ▪ Updated Victoria's EI
Base Case F	2007	79.70	75.20	79.57	88.73	92.49	91.46	84.53	84.42	▪ Updated Victoria's mobile EI ▪ Updated chemical and temporal profiles for Texas area and non-road emissions
Base Case G	2007	79.57	75.07	79.50	88.69	92.50	91.57	84.48	84.52	▪ Updated San Antonio asphalt emissions ▪ Updated tanker truck unloading emissions ▪ Updated tanker trucks in transit emissions ▪ Updated emissions from other gasoline distribution activities ▪ Updated emissions for ROP controls

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Table G-6. Modifications to the1999 Base Case and 2007 Future Case as Part of the QA/QC Process and Resulting Peak 8-hour Predictions at CAMS 58 Associated with Each Run.

CAMS 58		Peak Predicted 8-hour Ozone Concentrations								
Run Label	Year	15th	16th	17th	18th	19th	20th	Average	Base Case Design Value	Modifications to Model
Base Case.A	1999	75.95	77.44	81.93	98.68	102.75	91.66	88.07	87.00	
Base Case.B	1999	75.95	77.44	81.93	98.67	102.68	91.64	88.05	87.00	▪ Updated quarry and construction equipment emissions
Base Case.D	1999	75.95	77.44	81.92	98.67	102.68	91.63	88.05	87.00	▪ Incorporated new wastewater estimates from San Antonio Water System
Base Case.E	1999	76.00	77.41	81.87	98.72	101.92	91.50	87.90	87.00	▪ Updated 1999 area and non-road source temporal profiles for regional Texas to match 2007 temporal profiles ▪ Updated point source cut off point from 20m to 50m for the 4km grid
Base Case F	1999	75.74	77.44	82.16	98.67	101.90	91.51	87.90	87.00	▪ Updated Victoria's mobile EI with latest data from UT ▪ Updated chemical and temporal profiles for Texas area and non-road emissions ▪ Updated Victoria's point sources ▪ Updated Texas NEGU and EGU sources outside of Houston ▪ Updated Louisiana point source emissions ▪ Updated Austin's area & non-road sources
Base Case G	1999	75.59	77.26	82.01	98.57	101.83	91.30	87.76	87.00	▪ Updated San Antonio asphalt emissions ▪ Updated tanker truck unloading emissions ▪ Updated tanker trucks in transit emissions ▪ Updated emissions for other gasoline distribution activities
Base Case.A	2007								82.19	
Base Case.B	2007	74.11	75.41	79.07	89.45	93.92	90.17	83.69	82.69	▪ Updated regional EI HDD non-road EI (provided by TCEQ) ▪ Updated Austin Point Source Control EI (Alcoa) ▪ Updated San Antonio construction and quarry equipment emissions

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CAMS 58 (continued)										
Base Case.D	2007	74.28	75.40	79.02	89.45	93.93	90.18	83.71	82.71	▪ Incorporated new wastewater estimates ▪ Revised Austin Point Source Control EI (Alcoa)
Base Case.E	2007	73.91	74.46	78.57	88.73	92.48	89.17	82.89	82.03	▪ Revised Austin Point Source Control EI ▪ Incorporated new regional temporal profile for point sources ▪ Added CO for Austin on-road EI (3 County) ▪ Included stage1 (125k) for the 4-county San Antonio MSA ▪ Removed tank truck unloading on Sunday to match EPA guidance ▪ Updated other area source temporal profiles to match EPA guidance ▪ Updated Texas regional area and non-road emissions ▪ Updated Texas point sources (besides CPS) ▪ Updated Lehigh cement Kiln controls ▪ Updated point source cut off point from 20m to 50m on the 4-km grid to match the 12-km grid cut off ▪ Updated Victoria EI
Base Case F	2007	73.90	74.46	78.57	88.73	92.49	89.18	82.89	82.04	▪ Updated Victoria's mobile EI ▪ Updated chemical and temporal profiles for Texas area and non-road emissions
Base Case G	2007	73.80	74.28	78.50	88.69	92.50	89.25	82.84	82.12	▪ Updated San Antonio asphalt emissions ▪ Updated tanker truck unloading emissions ▪ Updated tanker trucks in transit emissions ▪ Updated emissions from other gasoline distribution activities ▪ Updated emissions for ROP controls

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Table G-7. Modifications to the1999 Base Case and 2007 Future Case as Part of the QA/QC Process and Resulting Peak 8-hour Predictions at CAMS 59 Associated with Each Run.
Gray strike-through numbers are values that fall below the EPA requirement (EPA 1999, p. 41) of 70 ppb to be included in the RRF

CAMS 59		Peak Predicted 8-hour Ozone Concentrations								
Run Label	Year	15th	16th	17th	18th	19th	20th	Average	Base Case Design Value	Modifications to Model
Base Case.A	1999	~~66.95~~	72.04	~~69.83~~	72.53	83.04	86.65	76.82	79.00	
Base Case.B	1999	~~66.95~~	72.04	~~69.83~~	72.53	82.90	86.61	76.78	79.00	▪ Updated quarry and construction equipment emissions
Base Case.D	1999	~~66.95~~	72.04	~~69.83~~	72.53	82.90	86.60	76.78	79.00	▪ Incorporated new wastewater estimates from San Antonio Water System
Base Case.E	1999	~~67.33~~	72.30	~~69.86~~	72.58	82.24	86.25	76.65	79.00	▪ Updated 1999 area and non-road source temporal profiles for regional Texas to match 2007 temporal profiles ▪ Updated point source cut off point from 20m to 50m for the 4km grid
Base Case F	1999	~~67.12~~	72.33	70.09	72.38	81.90	86.46	76.63	79.00	▪ Updated Victoria's mobile EI with latest data from UT ▪ Updated chemical and temporal profiles for Texas area and non-road emissions ▪ Updated Victoria's point sources ▪ Updated Texas NEGU and EGU sources outside of Houston ▪ Updated Louisiana point source emissions ▪ Updated Austin's area & non-road sources
Base Case G	1999	~~66.89~~	72.38	~~69.90~~	72.12	81.75	86.26	78.13	79.00	▪ Updated San Antonio asphalt emissions ▪ Updated tanker truck unloading emissions ▪ Updated tanker trucks in transit emissions ▪ Updated emissions for other gasoline distribution activities
Base Case.A	2007								74.96	
Base Case.B	2007	~~64.65~~	67.40	~~67.68~~	68.97	78.73	84.15	73.38	75.51	▪ Updated regional EI HDD non-road EI (provided by TCEQ) ▪ Updated Austin Point Source Control EI (Alcoa)

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CAMS 59 (continued)										
Base Case.D	2007	~~64.70~~	67.40	~~67.66~~	68.97	78.73	84.15	73.38	75.51	▪ Updated San Antonio construction and quarry equipment emissions ▪ Incorporated new wastewater estimates ▪ Revised Austin Point Source Control EI (Alcoa)
Base Case.E	2007	~~64.25~~	65.90	~~68.05~~	69.21	76.99	83.03	72.64	74.87	▪ Revised Austin Point Source Control EI ▪ Incorporated new regional temporal profile for point sources ▪ Added CO for Austin on-road EI (3 County) ▪ Included stage1 (125k) for the 4-county San Antonio MSA ▪ Removed tank truck unloading on Sunday to match EPA guidance ▪ Updated other area source temporal profiles to match EPA guidance ▪ Updated Texas regional area and non-road emissions ▪ Updated Texas point sources (besides CPS) ▪ Updated Lehigh cement Kiln controls ▪ Updated point source cut off point from 20m to 50m on the 4-km grid to match the 12-km grid cut off ▪ Updated Victoria EI
Base Case F	2007	~~64.25~~	65.90	68.05	69.21	77.01	83.05	72.64	74.89	▪ Updated Victoria's mobile EI ▪ Updated chemical and temporal profiles for Texas area and non-road emissions
Base Case G	2007	~~63.98~~	65.93	~~67.82~~	68.92	76.84	82.96	73.66	74.48	▪ Updated San Antonio asphalt emissions ▪ Updated tanker truck unloading emissions ▪ Updated tanker trucks in transit emissions ▪ Updated emissions from other gasoline distribution activities ▪ Updated emissions for ROP controls

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Table G-8. Modifications to the1999 Base Case and 2007 Future Case as Part of the QA/QC Process and Resulting Peak 8-hour Predictions at CAMS 678 Associated with Each Run.
Gray strike-through numbers are values that fall below the EPA requirement (EPA 1999 , p. 41) of 70 ppb to be included in the RRF

CAMS 678		Peak Predicted 8-hour Ozone Concentrations								
Run Label	Year	15th	16th	17th	18th	19th	20th	Average	Base Case Design Value	Modifications to Model
Base Case A	1999	70.34	71.19	~~69.83~~	80.03	92.94	88.47	78.80	77.00	
Base Case B	1999	70.33	71.19	~~69.83~~	80.01	92.81	88.33	78.75	77.00	▪ Updated quarry and construction equipment emissions
Base Case D	1999	70.33	71.19	~~69.83~~	80.01	92.80	88.32	78.75	77.00	▪ Incorporated new wastewater estimates from San Antonio Water System
Base Case E	1999	70.57	71.45	~~69.86~~	80.06	91.99	87.92	78.64	77.00	▪ Updated 1999 area and non-road source temporal profiles for regional Texas to match 2007 temporal profiles ▪ Updated point source cut off point from 20m to 50m for the 4km grid
Base Case F	1999	70.39	71.50	70.09	79.81	91.60	87.84	78.54	77.00	▪ Updated Victoria's mobile EI with latest data from UT ▪ Updated chemical and temporal profiles for Texas area and non-road emissions ▪ Updated Victoria's point sources ▪ Updated Texas NEGU and EGU sources outside of Houston ▪ Updated Louisiana point source emissions ▪ Updated Austin's area & non-road sources
Base Case G	1999	70.16	71.51	~~69.90~~	79.63	91.49	87.65	80.09	77.00	▪ Updated San Antonio asphalt emissions ▪ Updated tanker truck unloading emissions ▪ Updated tanker trucks in transit emissions ▪ Updated emissions for other gasoline distribution activities
Base Case A	2007								74.71	
Base Case B	2007	70.43	69.14	~~68.99~~	76.78	87.03	89.14	76.92	75.21	▪ Updated regional EI HDD non-road EI (provided by TCEQ) ▪ Updated Austin Point Source Control EI (Alcoa)

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CAMS 678 (continued)										
Base Case D	2007	70.56	69.14	~~68.94~~	76.77	87.04	89.14	76.93	75.22	▪ Updated San Antonio construction and quarry equipment emissions ▪ Incorporated new wastewater estimates ▪ Revised Austin Point Source Control EI (Alcoa)
Base Case E	2007	70.08	68.00	~~68.89~~	76.26	85.53	87.83	76.10	74.51	▪ Revised Austin Point Source Control EI ▪ Incorporated new regional temporal profile for point sources ▪ Added CO for Austin on-road EI (3 County) ▪ Included stage1 (125k) for the 4-county San Antonio MSA ▪ Removed tank truck unloading on Sunday to match EPA guidance ▪ Updated other area source temporal profiles to match EPA guidance ▪ Updated Texas regional area and non-road emissions ▪ Updated Texas point sources (besides CPS) ▪ Updated Lehigh cement Kiln controls ▪ Updated point source cut off point from 20m to 50m on the 4-km grid to match the 12-km grid cut off ▪ Updated Victoria EI
Base Case F	2007	70.08	68.00	68.89	76.26	85.55	87.84	76.10	74.61	▪ Updated Victoria's mobile EI ▪ Updated chemical and temporal profiles for Texas area and non-road emissions
Base Case G	2007	69.89	67.86	~~68.75~~	76.11	85.50	87.87	77.45	74.46	▪ Updated San Antonio asphalt emissions ▪ Updated tanker truck unloading emissions ▪ Updated tanker trucks in transit emissions ▪ Updated emissions from other gasoline distribution activities ▪ Updated emissions for ROP controls

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U.S. Environmental Protection Agency (May 1999). Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS. Research Triangle Park, NC: Office of Air Quality Planning and Standards.

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APPENDIX H

MODELED ATTAINMENT TEST

SAN ANTONIO EAC REGION ATTAINMENT DEMONSTRATION

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MODELED ATTAINMENT TEST METHODOLOGY

The modeled attainment test for the SAER was conducted by completing a series of steps that are described in EPA's *Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS.* These steps require identifying the "current period" to use in the attainment test, calculating the current site-specific design value, calculating the relative reduction factor, and calculating the future site-specific design values. The 2007 modeled data listed in the following tables are the predicted averages from the base case. Therefore, these results represent a preliminary attainment test conducted prior to modeling local clean air strategies.

Current Period

To determine the current period to use in an attainment test, EPA guidance suggests reviewing monitored data for the three-year period straddling the year represented by the most recently available emissions inventory and the three-year period that is anticipated to be used to designate the area nonattainment. For the SAER, the most recently available emissions inventory is for the year 1999. Therefore, ozone measurements for the three-year period between 1998 – 2000 represented one data set used in the analysis. The three-year period anticipated for nonattainment designations is 2001 – 2003. The current monitored design values are selected based on the higher of the two estimates at each monitor.

Current Site-Specific Design Values

The current site-specific design value was calculated at each monitor by identifying the fourth highest concentration in each of three consecutive years and determining the mean (average) of the three year's data. The design values were computed for both three year periods, 1998-2000 and 2001-2003. Table H-1 provides the current design value by monitor for the 1998-2000 period. Likewise, table H-2 lists design values for the years 2001-2003. The highest design values, by monitor, when comparing the two tables are highlighted in yellow.

Table H-1. Design Values at Monitors during Three-year Period Straddling the Most Recent EI (1999).

Monitoring Site	4th High 8-hr Daily Max. 1998	4th High 8-hr Daily Max. 1999	4th High 8-hr Daily Max. 2000	Average 4th High 8-hr Daily Max.
CAMS 23 *	89 ppb	91 ppb	77 ppb	85.67 = 85 ppb
CAMS 58 **	87 ppb	87 ppb	80 ppb	84.67 = 84 ppb
CAMS 59 ***	76 ppb	81 ppb	82 ppb	79.67 = 79 ppb
CAMS 678 ****		84 ppb	70 ppb	77 ppb

*At San Antonio Northwest CAMS 23 (Marshall High School), the 1998 fourth-highest reading was 89 ppb (excusing May 7, 1998 as a smoke day, which had a value of 93 ppb).
**Camp Bullis CAMS 58 went online August 12, 1998
***Calaveras Lake CAMS 59 went online May 14, 1998
****CPS/Trinity Pecan Valley CAMS 678 went online March 11, 1999

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Table H-2. Design Values at Monitors during Three-year Period Anticipated for Nonattainment Designation (2001 – 2003).

Monitoring Site	4th High 8-hr Daily Max. 2001	4th High 8-hr Daily Max. 2002	4th High 8-hr Daily Max. 2003	Average 4th High 8-hr Daily Max.
CAMS 23	78 ppb	104 ppb	86 ppb	89.33 = 89 ppb
CAMS 58	81 ppb	95 ppb	85 ppb	87 ppb
CAMS 59	78 ppb	81 ppb	76 ppb	78.33 = 78 ppb
CAMS 678	72 ppb	80 ppb	76 ppb	76 ppb

76 ppb

Relative Reduction Factor

The modeled attainment test also requires the calculation of a relative reduction factor (RRF). The RRF is the ratio of the *future* 8-hour daily maximum concentration predicted near a monitor to the *curren*t 8-hour daily maximum concentration predicted near a monitor. Since the photochemical model uses a 4-km grid system, the area near a monitor was defined as the 7x7 array of grid cells surrounding the monitor. The predicted future and current 8-hour daily maximum concentrations are listed in table H-3.

Table H-3. Predicted Current and Future 8-hour Daily Maxima.

Monitoring Site	Predicted 8-hour daily maximum ozone (ppb) - 1999	Predicted 8-hour daily maximum ozone (ppb) - 2007
CAMS 23	88 ppb	84 ppb
CAMS 58	87 ppb	82 ppb
CAMS 59	78 ppb	73 ppb
CAMS 678	80 ppb	77 ppb

Using the results of the most recent model, Run 18 Base Case B, the relative reduction factors were calculated for each monitor using the formula shown below. Table H-4 lists the RRF for each SAER monitor.

$$\frac{\text{Future 8-hour daily maximum concentration near site I}}{\text{Current 8-hour daily maximum concentration near site I}} = \text{Relative Reduction Factor}$$

Table H-4. Relative Reduction Factor by Monitor.

Monitoring Site	Relative Reduction Factor
CAMS 23	.95
CAMS 58	.94
CAMS 59	.94
CAMS 678	.97

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Future Site-Specific Design Values
The future site-specific design values were calculated using the formula:

$$(DVF)_I = (RRF)_I(DVC)_I$$

where

$(DVC)_I$ = the current design value at monitoring site I
$(RRF)_I$ = the relative reduction calculated near site I
$(DVF)_I$ = the estimated future design value for the time attainment is required

Table H-5 lists the results of calculating a future design value for each monitoring site. The attainment test is passed when the future design value at each monitor is ≤ 84 ppb. As shown, the attainment test was passed for all SAER monitors.

Table H-5. Attainment Test Results at SAER Monitors.

Monitor	Modeled Average Daily Maximum Ozone Concentration - 1999	Modeled Average Daily Maximum Ozone Concentration - 2007	RRF	Current Design Value	Future Design Value	Pass / Fail Status
CAMS 23	88 ppb	84 ppb	0.95	89 ppb	84 ppb	Pass
CAMS 58	87 ppb	82 ppb	0.94	87 ppb	82 ppb	Pass
CAMS 59	78 ppb	73 ppb	0.94	79 ppb	74 ppb	Pass
CAMS 678	80 ppb	77 ppb	0.97	77 ppb	74 ppb	Pass

MODELED ATTAINMENT TEST RESULTS AFTER INCLUSION OF LOCAL CLEAN AIR STRATEGY IMPLEMENTATION
The future design value results listed in table H-5 show that the 2007 future case model attains the 8-hour ozone NAAQS without resort to local control strategy implementation. However, the local SAER air quality planners, elected officials, and citizens have chosen to implement local control strategies to assure this attainment result.

As described in appendix K, three strategies have been chosen. The single locally-implemented clean air strategy, Stage I vapor recovery, is creditable, enforceable, and permanent in the terms required for credit taken in the SIP.

- Stage I vapor recovery for service stations of 25,000 gallons throughput of gasoline or more per month will be implemented and operational no later than December 31, 2005.

The attainment test was recalculated based on results of modeling Stage I vapor recovery in the 4-county SAER. Table H-6 provides the future design values when the impact of the vapor recovery strategy is taken into account. Although EPA guidance allows for truncation of decimals when calculating future design values, these results are listed to two decimal places so that the effect of implementing Stage I is more readily apparent.[1]

[1] Of 11 clean air strategies modeled, including ASM with OBD II, each resulted in less than 0.5 ppb reduction in local ozone concentrations.

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As demonstrated by this table, the implementation of Stage I vapor recovery as a local clean air strategy is projected to decrease ozone concentrations at all SAER monitors. Therefore, implementation of this strategy will provide an additional margin of safety to ensure the SAER attains the 8-hour NAAQS by 2007.

Table H-6. Modeled Attainment Test Results that Account for Implementation of Stage I Vapor Recovery.

Monitor	Future Design Value (ppb)	RRF	Future Design Value with Stage I (ppb)	Pass/Fail Status
CAMS 23	84.52	0.949	84.40	Pass
CAMS 58	82.12	0.944	82.03	Pass
CAMS 59	74.48	0.943	74.44	Pass
CAMS 678	74.46	0.967	74.39	Pass

In addition, should lower Reid Vapor Pressure to 7.2 pounds per square inch be available during the coming ozone seasons through negotiations which are ongoing at the time of this document submission (late March 2004), SIP credit will be taken for this program also. See Appendix K, Analysis of Additional Evidence, for this discussion.

It is important to note that Transportation Emission Reduction Measures (TERMs) can be quantified as SIP creditable reductions as well. While the quantity of reductions available for existing, ongoing, and programmed TERMs have not been calculated and included in the attainment demonstration of San Antonio's proposed revisions to the State Implementation Plan, local air quality planners are now researching measures to make the TERMs enforceable. The region is intent on making them enforceable and calculating SIP credit for them in coordination with the state and the local San Antonio / Bexar County Metropolitan Planning Organization. Even if SIP credit is not taken here for the secured TERMs projects in the region, the benefits of the reductions accrue as Additional Evidence that the San Antonio region will reach attainment. See Appendix K, Analysis of Additional Evidence, for this discussion.

Adopted in December 2002, state Senate Bill 5 and Senate Bill 7 include requirements for implementing Energy Efficiency / Renewable Energy Projects and for calculating resultant reductions in ozone precursor emissions through energy savings. These requirements are ongoing in Texas and highly effective in the San Antonio region. Although credit is not taken here for the Energy Efficiency / Renewable Energy Projects in the region, the benefits of the reductions accrue as Additional Evidence that the San Antonio region will reach attainment. With the completion of the work accomplished through a partnership described in Appendix K, Analysis of Additional Evidence, the San Antonio regional air quality planners will include the SIP credit available.

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APPENDIX I

CLEAN AIR STRATEGY DEVELOPMENT

SAN ANTONIO EAC REGION ATTAINMENT DEMONSTRATION

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INTRODUCTION

Prior to the establishment of Early Action Compacts in 2002, areas that violated the NAAQS were subjected to state and federal law as dictated in the Clean Air Act. The Early Action Compact (EAC) has allowed areas that violated the new 8-hour NAAQS to develop plans that will solve their air quality problems based on local air quality analysis and planning. Local signatories of the EAC can select the clean air measures that will be implemented.

Investigation of emissions reducing strategies is a necessary component of the EAC. The Clean Air Plan and the Early Action Compact require the development and modeling of emission reduction control strategies using the most currently available tools. This is done in order to support the ongoing efforts by local authorities and citizens for maintaining, or attaining, federal air quality standards. The following sections describe multiple strategies that will assist in reaching attainment. Strategies noted below will be implemented by 2007 or are already implemented on the federal, state, or local level.

FEDERAL AND STATE RULES

The on-going efforts by EPA and TCEQ to protect and preserve natural resources and human health has led to the development of various regulations controlling emissions in future years. In some cases, enforcement began as early as the year 2000. These rules are to be fully implemented by 2007. The emission reductions as a result of the following strategies were accounted for in the photochemical model when the 2007 future base case projection was developed. The following sections describe the state and federal rules expected to influence the San Antonio EAC region's air quality.

National LEV Program

The National Low Emission Vehicle (LEV) program was initiated in 1998 as a voluntary program to make new cars significantly cleaner burning than previously mandated by federal regulations. Substantial pollution reductions would be achieved with this program while at the same time providing automotive industry flexibility to meet program standards.

When states and automotive manufacturers opted into the program, the standards were enforced as federal vehicle standards. In return for manufacturer participation, the EPA agreed to provide regulatory stability and provide emissions standards based on a combination of California and federal motor vehicle standards.

The program is projected to reduce NOx in 2007 by 496 tons per day on a national level and allows emission reductions without the need of a state-by-state adoption of California's motor vehicle regulations. (USEPA, 1997) The rule was placed into effect in the northeastern states for the 1999 vehicle model year and went into effect on a national level for 2001 vehicles. (USEPA, 1998a) Since the national LEV program became effective in Bexar County with model year 2001, this program is included in the 2007 photochemical model runs.

The Texas Transportation Institute (TTI) calculated credits for this program. The TTI created the on-road mobile source modeling emissions inventories for 1999, 2007 and 2012. Their technical report is available as Appendix C, On-Road Mobile Emissions Inventory Development (TTI Report), of this document set. Using MOBILE6 model, TTI modeled all federal motor vehicle control programs in its work.

On-board Refueling Vapor Recovery

Onboard refueling vapor recovery (ORVR) is an emission control system found on vehicles that inhibits the emission of fuel vapors from a vehicle's gas tank during refueling. Within the gas tank and fill pipe of a vehicle, an activated carbon-packed canister absorbs fuel vapors during refueling. When the engine is operating, the canister directs gasoline vapors into the engine intake manifold to be used as fuel.

It is projected that ORVR controls will allow a 300,000 to 400,000 ton per year reduction of volatile organic compounds (VOC) nationwide. ORVR systems are also projected to provide an annual fuel savings of $2 to $4 per vehicle for the consumer. (USEPA, 1998b)

The Schedule for implementation of ORVR is:

- Automobiles: 40% of 1998, 80% of 1999, and 100% of 2000 and beyond models will be equipped with ORVR.
- "Light Duty Trucks" and similar vehicles: 40% of 2001, 80% of 2002, and 100% of 2003 and beyond models will be equipped with ORVR.
- "Medium Duty Trucks" and similar vehicles: 40% of 2004, 80% of 2005, and 100% of 2006 and beyond models will be equipped with ORVR.
- Heavy Duty Trucks and other Vehicles: At this time, it is not required in these vehicles.

To estimate the effect of ORVR, the NO CLEAN AIR ACT command was used in MOBILE6 to model vehicle emissions as if the Federal Clean Air Act Amendments of 1990 had not been implemented. MOBILE6 assumes that the Clean Air Act (CAA) Amendments of 1990 did occur and includes a number of vehicle and fuel requirements mandated by the 1990 Clean Air Act Amendments in its forecasts and analyses of future year. These include Tier1, low emissions vehicle (LEV), and Tier2 tailpipe exhaust emission standards, and new evaporative emission test procedure requirements.

The following table indicates the exact reduction/adjustment values for VOC emissions for each county in San Antonio region.

Table I-1. ORVR Reductions for the SAER Counties, 2007; Percent Reductions and Tons Per Day (TPD) Reduced

Date	Bexar		Comal		Guadalupe		Wilson	
	Percent Reductions	TPD	Percent Reductions	TPD	Percent Reductions	TPD	Percent Reductions	TPD
Sept. 13	62.3%	7.26	62.7%	0.39	60.3%	0.41	59.7%	0.15
Sept. 14	62.3%	7.26	62.7%	0.39	60.3%	0.41	59.7%	0.15
Sept. 15	62.3%	7.26	62.7%	0.39	60.3%	0.41	59.7%	0.15
Sept. 16	62.3%	7.26	62.7%	0.39	60.3%	0.41	59.7%	0.15
Sept. 17	63.7%	7.42	63.5%	0.39	61.5%	0.42	60.7%	0.15
Sept. 18	64.3%	4.80	64.4%	0.26	62.0%	0.27	61.6%	0.10
Sept. 19	64.0%	2.43	63.7%	0.13	61.4%	0.14	61.1%	0.05
Sept. 20	62.3%	7.26	62.7%	0.39	60.3%	0.41	59.7%	0.15

For the study of the effects of absence of CAA, AACOG ran a 2007 base year with and without the effects of CAA and calculated the differences in the amounts of VOC for 4

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counties in the SAER and for each days of the week. The amounts of VOC in 2007 for each modeled day and for each county in our study area was higher by approximately 60% when the CAA requirements in MOBIE6 were disabled. This reduction percentage was reflected in the emission inventory for the photochemical model to account for the presence of the effects of CAA in the year 2007. The reductions were applied to the Vehicle refueling category (SCC 2501060100)

Low Sulfur Gasoline

In 2000, the EPA enacted a ruling supporting the production of a gasoline with a lower sulfur content. Such a strategy was developed because sulfur in the gasoline reduces the effectiveness of a vehicle's emission control system. Gasoline refiners would be required to produce gasoline with an average sulfur level of 30 ppm by 2004, down from the sulfur content average of 300 ppm. (USEPA, 1999) In 2006, refiners will be required to produce gasoline with a 30 ppm average sulfur level with a maximum cap of 80 ppm. Gasoline produced for sale in parts of the Western U.S. will be allowed to meet a 150 ppm refinery average and a 300 ppm cap through 2006 but will have to meet the 30 ppm average/80 ppm cap by 2007. (USEPA, 2000)

The Texas Transportation Institute (TTI) calculated credits for this program. The TTI created the on-road mobile source modeling emissions inventories for 1999, 2007 and 2012. Their technical report is available as Appendix C, On-Road Mobile Emissions Inventory Development (TTI Report), of this document set. Using MOBILE6 model, TTI modeled all federal motor vehicle control programs in its work.

New Heavy-Duty Diesel Vehicle Rates

In October 1997, the EPA promulgated a new combined emission standard for emissions of oxides of nitrogen (NOx) and non-methane hydrocarbons (NMHC) from model year 2004 and later heavy-duty diesel engines used in trucks and buses. This new standard will lead to a 50 percent reduction in NOx in the new engines appearing in 2004, as compared to the 1998-2003 model year engines meeting the current NOx standard. By 2020, it is projected that 1.1 million tons of ozone precursors will be reduced in one year nationally. (USEPA, 1997) Since these standards will apply to the 2007 fleet, the input files for the 2007 MOBILE runs included the appropriate emission rate changes in the Heavy-Duty Diesel Vehicle class. (USEPA, 1998c)

The Texas Transportation Institute (TTI) calculated credits for this program. The TTI created the on-road mobile source modeling emissions inventories for 1999, 2007 and 2012. Their technical report is available as Appendix C, On-Road Mobile Emissions Inventory Development (TTI Report), of this document set. Using MOBILE6 model, TTI modeled all federal motor vehicle control programs in its work.

Texas Administrative Code (TAC), Chapter 106 (T): Surface Preparation

Permits By Rule §106.1 identifies facilities or changes within facilities that have been determined not make a significant contribution of air pollution. Subchapter T of Chapter 106 addresses degreasing units that may be subject to permit by rule. Permits By Rule §106.454 states that degreasing units, regardless of the county in which it is located, shall meet the requirements of Control of Air Pollution from Volatile Organic Compounds § 115.412-415. Since this rule was promulgated in 1994, degreasing units built on or after 1994 are subject to adhering to Chapter 115 specifications.

Solvent degreasing is the physical process of using organic solvents to remove grease, fats, oils, wax or soil from various metal, glass, or plastic items. The types of equipment used in

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this method are categorized as cold cleaners, open top vapor degreasers, or conveyorized degreasers. Nonaqueous solvents such as petroleum distillates, chlorinated hydrocarbons, ketones, and alcohols are used. Solvent selection is based on the solubility of the substance to be removed and on the toxicity, flammability, flash point, evaporation rate, boiling point, cost, and several other properties of the solvent. The following bullets are examples of requirements for controlling degreasing equipment:

- *Cold Cleaning Machines*: A cover shall be provided for each cleaner which shall be kept close whenever parts are not being handled in the cleaner. The system shall be equipped with a freeboard that provides a ratio equal to or greater than 0.7, or a water cover (solvent must be insoluble in and heavier than water).

- *Open-top Vapor Degreasing*: A cover that can be opened and closed easily without disturbing the vapor zone. A freeboard provides a ratio equal to or greater than 0.75 and, if the degreaser opening is greater than 10 ft^2 ($1m^2$), a powered cover.

- *Conveyorized Degreasing*: A properly sized refrigerated chiller, a drying tunnel of other means, such as rotating (tumbling) basket to prevent solvent liquid or vapor carry-out; a condenser flow switch and thermostat which will shut off sump heat if the condenser coolant is not circulating or if the condenser coolant discharge temperature exceeds the solvent manufacturer's recommendation.

Chapter 106 affects degreasing units throughout Texas and subjects emission controls to the units as specified in Control of Air Pollution from Volatile Organic Compounds § 115.412-415, therefore, a reduction of 85% of VOC emissions between 1999 to 2007. Since Chapter 106 rules was promulgated in 1994, it allows for some degreasing equipment emission credit for time periods before 1999; however for the SAER, credits were calculated for the time period between 1999 and 2007. This calculation is described as following:

Unregulated 2007 Degreasing Emissions – Base 1999 Degreasing Emissions = Growth from 1999 to 2007
*Growth from 1999 to 2007 * 0.85 Reduction Factor = Emission Reductions due to Chapter 106 Regulation*
1999 Degreasing Emissions + Emission reductions = 2007 Regulated Degreasing Emissions

Table I-2 indicates the amount of reductions in the 2007 degreasing emissions resulted from the above calculations in the 4-county SAER.

Table I-2. VOC Emissions in the SAER due to Chapter 106 Degreasing Controls

County	2007 Unregulated Degreasing Emissions	1999 Unregulated Degreasing Emissions	Growth from 1999 to 2007	2007 Emission Reductions due to Chapter 106	2007 Regulated Degreasing Emissions
	Tons/Day	Tons/Day	Tons/Day	Tons/Day	Tons/Day
Bexar	14.03	8.99	5.04	4.28	9.74
Comal	0.85	0.54	0.30	0.26	0.59
Guadalupe	0.01	0.01	0.00	0.00	0.01
Wilson	0.20	0.13	0.07	0.06	0.14
Total	15.09	9.67	5.42	4.61	10.48

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TAC Chapter 115(C)(2): Filling of Gasoline Storage Vessels (Stage I) for Motor Vehicle Fuel Dispensing Facilities

Stage I vapor recovery systems are designed to control the escape of gasoline vapors from gasoline storage tanks. The vapors escape by being displaced by liquid gasoline unloaded from refueling trucks. Such systems have shown to reduce hydrocarbon emission by 98%. The vapors are captured by a vapor return hose, which is connected to the storage tank and the refueling truck.

As a tank of volatile fuel such as gasoline is gradually emptied, the empty space will be occupied by vapors of the fuel, or by a mixture of air and vapors, if an inlet air vent is provided. When a tanker truck delivers fuel to a gas station, the new fuel entering the underground tank would force accumulated gasoline vapors out of the tank into the air. With the Stage I vapor recovery system, vapors are forced out of the underground storage tank into the tanker truck through a vapor recovery line. The recovered vapors in the tanker truck can then be recycled.

Gasoline vapors are present in the air space of the storage tank. When the tank is refilled, the vapors are displaced by liquid gasoline and can enter the atmosphere, thus contributing to the formation of ozone. Stage I vapor recovery systems are designed to control the escape of these vapors, and can achieve a 98% reduction in hydrocarbon emissions once they are put into use. The vapors are captured by a vapor return hose, which is connected to the storage tank and the gasoline delivery truck. Once captured, the vapors are stored in a vapor cargo department in the gasoline delivery trucks and transported to the refinery for recovery or incineration

Currently, Stage I systems are required in the San Antonio EAC Region for facilities that dispense 125,000 or more gallons/month of gasoline, as stipulated in Control of Air Pollution From Volatile Organic Compounds, §115.221-229. The effectiveness of the Stage I vapor recovery system strategy was measured by calculating the current release of hydrocarbon emissions due to tank unloading for the San Antonio MSA. These emissions would be eliminated if all of the gasoline stations in the region were required to have Stage I vapor recovery system. The projected amount of VOC emission from unloading tankers within the San Antonio EAC Region for the year 2007 is 9.99 tons per a day as displayed in table I-3.

Table I-3. 2007 Emissions from Tanker Unloading in San Antonio EAC Region (AACOG, 2001)

County	VOC tons/day	VOC tons/year
Bexar	8.81	2750.89
Comal	0.47	145.81
Guadalupe	0.52	160.78
Wilson	0.19	58.51
Total SA MSA	9.99	3115.99

However, this projection does not take into account the use of Stage I vapor recovery systems for throughput greater than 125,000 gallons per month, which is already in place in the San Antonio EAC Region. In order to refine these projections with the results of the 125,000 gallons/month rule, the results of a previous analysis for the 95 counties east of I-35 were used. The results of this study are displayed in Table I-4.

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Table I-4. Emission Reduction due to Stage I Rule in the 95-county Region (AACOG, 1999)

Gasoline Throughput Gallons/Month	Number of Gas Stations	% of Total Stations	VOC Reductions Tons/Year	% of Total VOC Reductions
Less than 10,000	1,607	18.6%	0	0.0%
10,000 – 25,000	2,436	28.3%	1,210	11.8%
25,000 – 50,000	2,287	26.5%	2,480	24.1%
50,000 - 125,000	1,599	18.6%	3,510	34.1%
Greater than 125,000	691	8.0%	3,090	30.0%
Total	8,620	100%	10,290	100%

As displayed in Table I-4, facilities with 125,000 gallons per month throughput, which have their Stage I systems in place, can reduce the VOC emissions by 30%. Removing this amount of reduction from the total projected amount of VOC emissions in SA MSA from tanker truck unloading results in bringing the 2007 projected estimates down to 6.99 tons per day. This calculation is shown in the formula.

2007 SAER total VOC X Percentage of VOC Reduction = VOC Reduction, Tons/Year

9.99 *X* 0.30 = 6.99

The following table indicates the exact reduction/adjustment values for VOC emissions for each county in San Antonio region.

Table I-5. Emission Reductions in the SAER due to Stage I Rule at 125,000 gallons Throughput, 2007

County	Unregulated 2007 Emissions Tons/Day	Emission Reductions due to Stage I Rule Tons/Day	2007 Emission with Stage I Rule Tons/Day
Bexar	8.81	2.64	6.17
Comal	0.47	0.14	0.33
Guadalupe	0.52	0.15	0.37
Wilson	0.19	0.06	0.13
Total	9.99	2.99	7.00

Note that, as a locally preferred air quality control strategy, the Stage I at 25,000 gallons per month throughput has been discussed in the Local Clean Air Strategies section of this appendix.

Rate of Progress Control Factors

Rate of Progress (ROP) control factors were also used on several categories, as directed by TCEQ and ENVIRON. Table I-6 shows applicable ROP control factors for the AACOG 2007 emissions inventory (ENVIRON, 2001). These control factors account for the amount of emission reductions due to use of improved techniques and/or implementation of new regulations.

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Table I-6. Rate of Progress Control Factors

Category	SCC	Control Factor
Leaking Underground Tanks	2660000000	0.0
Architectural Coatings	2401001000	0.8
Traffic Markings	2401008000	0.8
High-Performance Maintenance	2401100000	0.8
Other Specific Purpose Coatings	2401200000	0.8
All Solvent Types	2465000000	0.8
Personal Care Solvents	2465100000	0.8
Household Solvents	2465200000	0.8
TSDF's	2640000000	0.07
Automotive Aftermarket Coatings	2465400000	0.8
Adhesives & Sealants	2465600000	0.8

To forecast the amount of emission for each area source category, the emission amount for each category in 1999 EI was reduced by the given 2007 and a 2012 projection factors. The results were then factored by the ROP factors to account for improvements in applications techniques and changes in regulations. To give a demonstration of this procedure, the following table, which is prepared for the 2007 Bexar County, is presented in this appendix. The last column in this table indicates the net amount of change between before and after application of ROP factors. The table includes the results of the following calculation.

Category Specific Base Year 1999 Emissions X ROP Factor = Emission Reductions due to ROP Controls
Category Specific Base Year 1999 Emissions - Emission Reductions due to ROP Controls = 2007 emissions

Table I-7. 2007 SAER County Area Source Emissions Using ROP Factoring

County	Base Year 1999 Emissions	Percentage Reductions due to ROP Controls	Emission Reductions due to ROP Controls	2007 Emissions with Controls
	Tons/Day		Tons/Day	Tons/Day
Architectural Coatings	11.10	20%	2.22	8.88
Traffic Markings	0.03	20%	0.01	0.02
High-Performance Maintenance	3.41	20%	0.68	2.73
Other Spec. Purpose Coatings	2.62	20%	0.52	2.10
Personal Care Solvents	4.21	20%	0.84	3.37
Household Solvents	2.79	20%	0.56	2.23
Automotive Solvents	1.80	20%	0.36	1.44
Leaking Tanks	0.71	100%	0.71	0.00

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TAC Chapter 117 (B)(4): Cement Kilns
Chapter 117 addresses various regulations on the control of air pollution from NOx. Subchapter B, Division 4 addresses emission regulations of various cement kilns. Regulations stipulated by Control of Air Pollution From Nitrogen Compounds §§117.260, 117.261, 117.265, 117.273, 117.279, and 117.283, which affect the cement industry in Texas were accounted for in the attainment demonstration.

REGIONAL RULES
Many of the rules applied to the Houston/Galveston and Beaumont/Port Arthur and other non-attainment areas have regional implications. The emission control strategies implemented in these areas would affect the ambient air quality in the San Antonio region. Photochemical models have indicated that emissions from eastern parts of Texas affect emission levels in other downwind parts of Texas. Information about these rules and regulations were collected from various regulating agencies and organized into electronic files and used as input data for the photochemical model runs to better reflect emission reductions due to the implementation of these regional emission control policies. The followings are descriptions, provided by TCEQ, of these files.

HGA's NOx cap packet: This packet provides a revision to the cap on HGA's NOx emissions. It is to be applied to year 2000 emissions. This packet also includes 3.8 tpd of reductions due to the Emission Reduction Credit (ERC) and Discrete Emission Reduction Credit (DERC) programs for the HGA as of October 14, 2002.

BPA's bank packet: This control packet applies the banked ERC and DERC VOC total of 3.3 tpd and NOx total of 29.2 to all of the 2000 Aug. 29 base4a Non Electric Generating Units (NEGU) totaling 60.3 tpd VOC and 92.7 tpd NOx in BPA, except for Special Inventory sources and those with *Science Coordinating Committee,* beginning with TAC Chapter 101 and Chapter 201.

HGA bank packet: This control packet applies the banked ERC and DERC VOC total of 17.9 tpd to all of the 2000 Aug. 29 base4a scenario for NEGUs in HGA totaling 176.5 tpd VOC. Except for special inventory sources and those with the Science Coordinating Committee, beginning with TAC Chapter 101 and Chapter 201.

Tier3 Emission Specifications for Attainment Demonstration: This packet takes the HGA's EGUs from the ~90 revised ESAD level to the ~80% of Business Coalition for Clean Air alternate ESAD level. Hence, this packet is meant to be applied, in addition to the revised (~90%) ESAD level. And the revised packet was to be applied to the HGA 30 day highest heat input packet. The "auxiliary boilers" are located at the top section of this file.

Revised ESAD: This packet is to be applied after the control "HGegu30day" packet. It corrects areas whose ESAD rates went from .01 to .02 and from .03 to .04. This packet represents the future base EGU controls for the entire domain.

SB7 NOx Rule: This packet represents the future base EGU controls for the entire domain. It includes 50% reduction for 95 county area – attainment counties East of I-35 and I-37. The file also addresses controls for various states affected by the NOx SIP rule, including Indiana, Kentucky, Ohio, Tennessee, Alabama, Georgia, and Missouri.

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Tier1for BPA: Developed on 10/15/02, this control packet for BPA EGUs ESAD includes 0.10 lbNOx/mmBtu. The calculation is based on the percentage reductions in the 1997 annual Acid Rain Scorecard.

Tier 2 for DFW: Developed on 0/15/02, in this control packet Handley utility plant's unit 5 was changed to match the 1997 EGUs. This packet accounts for the new control on EGU boilers with limit of 0.033 lb/MMBTU for TXU, and 0.06 lb/MMBtu for plants in Garland and Denton. The small boilers at Denton and Garland get controlled based on their AP-42 emission rate 0.28 controlled to 0.06 lb/MMBt. This gives 79% control. TXU gets 89% control, Garland gets 72%, and Denton gets 86% control for an overall control of 88%. On 4/19/2000 the stack and point numbers for HANDLEY 5 had been changed so that it would work in "cntlem" file. On 4/19/2000 a second boiler was added to the Mountain Creek 3B unit.

Milan County CO Emission: Control factors set to provide 28.50 TCEQ tpd to 26.66 tpd. for NEGU point sources in Milan County, 48331. This control package was provided by CAPCO.

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LOCAL STRATEGY DEVELOPMENT

Development of Potential Clean Air Measures

Control strategies aimed at reducing emissions from transportation sources, area sources, and point sources were considered and analyzed based on their emission reducing capacity and cost of implementation. The list of emission reducing strategies was compiled by gathering information on control measures currently employed in the Dallas-Ft. Worth and Houston/Galveston nonattainment areas and studying measures that are recommended by the TCEQ, or are employed in other states. The control measure description, emission reduction associated with the measure, and the cost for the measure to be implemented were used in developing the list of potential clean air measures.

Throughout the duration of selection process, AACOG's technical staff continuously updated emission reductions and cost analysis for relevancy to the region's air quality. Updates to the emission reduction estimates and cost estimates were performed by various means and methods. Emission factors were often updated through the use of EPA approved models, such as MOBILE6 or the NONROAD model. Frequent revisions were necessary due to the updated data provided by TCEQ or other near nonattainment areas that would improve model performance thus providing realistic outputs.

The list of potential clean air strategies was provided to the AIR Technical Committee for review and additional input, as agencies may/may not be affected by the suggested control measures.

Selection of Potential Clean Air Measures

The AIR Technical Committee reviewed approximately 100 strategies aimed at reducing emissions and assisting the SAER in reaching attainment of the 8-hour ozone standard. The strategies were assessed based on the criteria of creditability (quantifiable, enforceable, and permanent) and effectiveness at reducing ozone precursors while being cost efficient.

The AIR Technical Committee met twice a month to discuss various technical issues and review the list of control strategies. The committee considered several factors when analyzing various control strategies. These factors included whether the strategies were currently implemented in the area, the emission reducing capacity in the San Antonio MSA, and possible costs associated with strategy implementation.
The AIR Technical Committee provided draft copies and reports of the progress of control strategy selection to the AIR Executive Committee during the selection process. Whenever necessary, the AIR Executive Committee would then provide comments to the AIR Technical Committee in regards to their selections. Table I-8 lists the strategies that fulfilled the prescribed criteria and were feasible for the San Antonio area. Also, selected control strategies were combined to enhance the potential emission reductions.

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Table I-8. Potential Control Measures Selected for Modeling

Control Measure	Ton per Day (NOx+VOC) Reduction	Cost per Ton
Acceleration Simulation Mode Test with On Board Diagnostics Systems Test (OBD-II)	13.33	$10,620
Two Speed Idle Test (TSI) together with OBD-II	10.42	$9,425
OBD-II	8.52	$8,419
Lower 7.0 RVP for all counties east of I35 and I37 corridor	3.13 for the SAER only	Not Calculated
Lower 7.0 RVP	3.13	$11,402
Lower 7.2 RVP	2.15	$7,717
Stage I vapor recovery at 25,000 for all counties east of I35 and I37 corridor	5.81 for the SAER only	$4,471
Stage I vapor recovery at 50,000	3.41	$2,894
Stage I vapor recovery at 25,000	5.81	$4,471
Degreasing solvents*	14.34	$1,400
Degreasing equipment*	12.83	$0
Wood spray technique	0.131	$0
Removal of 5.93 tons of NOx from Spruce 1 power plant**	5.93	Not Calculated***

* Calculated based on the assumption that Chapter 106 was not implemented in the SAER
** Was used to simulate the ozone levels with the shutting down of a power plant in this location
*** Rough estimates indicate that shutting down a coal power plant would be many factors more expensive then any other control strategy considered on this list

EVALUATION OF POTENTIAL CLEAN AIR STRATEGIES

The elimination of inadequate control measures resulted in a list of feasible and applicable control measures that were to be evaluated through performance of the photochemical model. The strategies that were to be evaluated in this manner were thought to be most effective in reducing emissions in the San Antonio area. At the request of the Air Improvement Resources (AIR) Committee, the strategies previously listed in table I-8 were evaluated in the photochemical model 2007 demonstration. Tables I-9 and I-10 detail the sequence of modeling runs when the strategies were evaluated.

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This evaluation of the strategies allowed local officials and technical staff to understand the effectiveness of each individual strategy. Understanding the effects of the control measures in this manner would allow officials to formulate possible combinations of control measures that would best affect San Antonio's air quality.

Screen Cell Design Value Scaling

Since the modeled attainment test provides no indication of future ozone concentrations at locations without monitors, the EPA recommends a supplementary screening analysis to support an attainment demonstration. The predicted 8-hour daily maximum for the SA region exceeded the highest predicted 8-hour daily maximum near a monitor by more than 5% on only two day of the episode (15th & 16th). Since the 5% threshold was not exceeded on "50% or more modeled days," a screening test is unnecessary for demonstration purposes.

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Table I-9. Modeling Sequence Employed in Evaluating Potential Clean Air Strategies on an Individual Basis

Emission Control Options		Base Case	Control Strategy											
			SA1	SA2	SA3	SA4	SA5	SA6	SA7	SA8	SA9	SA10	SA11	SA12
On Road Sources	ASM with OBDII		4											
	TSI with OBDII			4										
	OBDII				4									
	RVP 7.0 (Regional)					95								
	RVP 7.0						4							
	RVP 7.2							4						
Area Sources	Stage I (50K)								4					
	Stage I (25K)									4				
	Stage I (25K Regional)										95			
	Degreasing Solvent*											4		
	Degreasing Equipment*												4	
	Wood Spray Technique													
Point Sources	Removal of 5.93 tons of NOx from Spruce 1 Power Plant													1
CAMS 23 adjusted 2007 Design Value**		84.52	84.14	84.22	84.30	84.42	84.44	84.46	84.44	84.40	84.33	84.22	84.26	84.42

* Does not include Chapter 106 controls in future case

** Adjusted to final Base Case model (numbers are not truncated to show differences)

Key: "4" – 4-county San Antonio EAC region
"95" – 95-county area east of I-35 and I-37 (not including Houston, BPA or Dallas)
"1" – Bexar County only

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Table I-10. Modeling Sequence Employed in Evaluating Potential Clean Air Strategies in Various Combinations

Emission Control Options		Base Case	Control Strategy									
			SA13	SA14	SA15	SA16	SA17	SA18	SA19	SA20	SA21	SA22
On Road Sources	ASM with OBDII							4				
	TSI with OBDII					4						
	OBDII		4						4			
	RVP 7.0 (Regional)											
	RVP 7.0			4		4	4	4	4	4	4	
	RVP 7.2		4		4							4
Area Sources	Stage I (50K)		4	4	4	4	4					
	Stage I (25K)							4	4	4	4	4
	Stage I (25K Regional)											
	Degreasing Solvent*							4				
	Degreasing Equipment*			4	4	4	4		4	4	4	4
	Wood Spray Technique						4	4		4		
Point Sources	Removal of 5.93 tons of NOx from Spruce 1 Power Plant											
CAMS 23 adjusted 2007 Design Value**		84.52	84.17	84.07	84.10	83.70	84.07	83.62	83.83	84.01	84.01	84.04

* Does not include Chapter 106 controls in future case
** Adjusted to final Base Case model (numbers are not truncated to show differences)

Key: "4" – 4-county San Antonio EAC region
"95" – 95-county area east of I-35 and I-37 (not including Houston, BPA or Dallas)
"1" – Bexar County only

Based on the technical analysis of the various clean air strategies and the performance of the 1999 photochemical model for the 2007 projections, several strategies were recommended by technical staff to the AIR Technical Committee. The 2007 projection of the 1999 episode was demonstrating an 8-hour ozone slightly below the 8-hour NAAQS of 85 ppb. Therefore, the strategies of low RVP gasoline of either 7.0 or 7.2, the implementation of Stage I vapor recovery on area service stations that dispense at least 25,000 gallons or 50,000 gallons, and degreasing controls were recommended for inclusion to the Clean Air Plan. The following table lists the recommended clean air strategies by the AIR Technical Committee. The list was subsequently recommended to the AIR Executive/Advisory Committee and received full endorsement by its body.

Table I-11. List of Clean Air Strategies Recommended for SIP

Clean Air Strategy	AIR Tech Recommends		AIR Committee Recommends		Cost Per Ton	VOC + NOx Reductions (ton/day)
	Yes	No	Yes	No		
Degreasing Equipment Operation Controls	X		X		0	12.83*
Reid Vapor Pressure (7.2)	X		X		$7,717	2.15
Stage I (50,000)		X		X	$2,894	3.41
Reid Vapor Pressure (7.0)		X		X	$11,402	3.13
Stage I (25,000)	X		X		$4,471	5.81

* Assuming no controls/reductions due to Chapter 106 rules

LOCAL CLEAN AIR STRATEGIES

The AIR Committee recommended three Clean Air Strategies for inclusion in the Clean Air Plan to local Early Action Compact signatory governments for their final approval. The strategies were:

- Reid vapor pressure lowered to 7.2 pounds per square inch during the ozone season for the San Antonio region;
- Degreasing Equipment Operation Controls, described in TAC, Title 30, Ch. 115; and
- Stage I vapor recovery required of service stations of 25,000 gallons throughput of gasoline or more per month.

The eight local governments which are signatories to the Early Action Compact for the San Antonio region deliberated these strategies during regularly scheduled meetings of their representatives (i.e., during City Council meetings or during Commissioners' Court sessions). These meetings are open to the public and have meeting schedules published according to the Texas Open Meetings Act. All eight governments approved each of the three strategies specified above. Copies of their signed resolutions to this effect are attached to this Clean Air Plan document set.

The San Antonio EAC Region, acting through the AIR Committee, has incorporated these three strategies into the Clean Air Plan and requests that the Texas Commission on Environmental Quality take the necessary actions, including development of enforcement provisions, to implement these Clean Air Strategies.

The following sections describe the clean air measures that were selected by local officials to clean the SAER's ambient air. Along with strategy descriptions, the emission reductions are provided.

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Lower Reid Vapor Pressure (RVP)
The use of lower Reid vapor pressure fuel will reduce the emission of volatile organic compounds (VOC) into the atmosphere. The requirement for gasoline refineries to provide such gasoline will only be during the months of March through October, which is traditionally the time of the year ozone levels exceed the national standard. Fuel with a lower volatility achieves emissions reductions in ozone precursors by reducing aromatic hydrocarbon emissions from gasoline thereby reducing its ability to evaporate as quickly. Currently, state law caps the RVP levels sold in Texas at 7.8 during the ozone season.

Reducing the RVP to 7.2 will provide a reduction of 2.1 tons/day of VOC and 0.05 tons/day of NOx. The cost benefit of such reductions is estimated to be $7,717 per ton of reduced VOC and NOx. The per ton costs of RVP 7.2 and 7.0 were calculated based on the information that Valero, a local refinery, had submitted to AACOG.

Challenges Facing the Lower RVP Strategy
This Clean Air Strategy was originally envisioned as SIP creditable. Information received by AACOG has challenged the SIP creditability. On January 27, 2004, communication from EPA's Region 6 office was received regarding Section 211 of the Clean Air Act and its possible implications to SAER's request for state implementation of requirements for gasoline with an RVP of 7.2 in the region. Further clarification was necessary for the CAA's interpretation on whether such a provision is applicable to Early Action Compact areas. This possible challenge, however, did not deter the AIR Committee's consideration of the strategy, and on January 28, 2004 lower RVP received formal endorsement by the committee. The strategy, along with the other approved strategies, were then presented to the local EAC signatory governments for ratification. Endorsement was given to lower RVP by the EAC signatory governments, first by the City of Seguin on February 3, 2004. The final government to endorse lower RVP was the Guadalupe Commissioner's Court on February 24, 2004. Thus, all eight local governments approved resolutions requesting the three strategies during that February 3-24 period.

On February 13, 2004, Candy Garret[1] (personal communication, February 13, 2004) from the TCEQ provided AACOG some clarification regarding the circumstances allowing such a measure to be implemented in the local EAC SIP. According to the EPA's and TCEQ's preliminary investigations, Section 211(c)(4)(A) of the federal CAA prohibits state and federal governments from enforcing RVP as it was being requested. Such a measure can only be implemented in an EAC SIP if there are special circumstances. Detailed descriptions regarding Section 211 and its effect on the promulgation of lower RVP rules are provided in Appendix K. On February 17, 2004, an EPA working group confirmed their earlier interpretation of this provision, supporting TCEQ's opinion.

Resolution of Challenges Facing Lower RVP
- Given the formal approval of the EAC signatory governments, the San Antonio EAC region is committed to requesting that the state implement a 4-county EAC regional rule requiring gasoline stations to dispense gasoline with an RVP 7.2 during the months of March to October.

[1] Ms. Candy Garrett is a Director, Environmental Planning and Implementation, for TCEQ.

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- Given also the apparent enforcement prohibitions described above, the emissions reduction credits which would be expected through such a rule are not being placed in the SIP-creditable section of this document.
- Specifically, the credits which would be available due to seasonal 7.2 RVP and the technical details of such credit estimation methodology are relegated to the section entitled "Analysis of Additional Evidence", Appendix K.

Stage I Vapor Recovery
Currently, Stage I systems are required in the SAER for facilities that dispense 125,000 or more gallons/month of gasoline. The local Early Action Compact signatory governments in their final approval have requested to lower this threshold to 25,000 gallons/month. There is a general consensus among the air quality planners in the region that implementation of this strategy would face the least difficulties, due to the existing wide spread use of Stage I technology in manufacturing of the underground gasoline tanks and anticipation of such a rule by the gas station owners.

As described in Table I-5, the projected amount of VOC emissions for 2007 "Tanker Truck Unloading" in SAER is approximately 7 tons per day. Lowering the threshold for Stage I to 25,000 gallons per day would reduce the 2007 "Tanker Truck Unloading" VOC emissions by 5.81 tons per day allowing for a total VOC emissions of 1.18 tpd for the "Tanker Truck Unloading" category. The methodology for the above calculation could be described as followings:

In the absence of emissions from gas stations with 125,000 gallon per day throughput, the share (percentage) of the other throughput categories indicated in Table I-4 could be rearranged as shown below.

10,000 to 25,000	gallon/day	16.86%
25,000 to 50,000	gallon/day	34.43%
50,000 to 125,000	gallon/day	48.71%

If these reduction percentages are applied to the total "Tanker Truck Unloading" VOC emissions, then we will arrive at the followings:

10,000 to 25,000	16.86% X 6.99 = 1.178	ton/day VOC reduction
25,000 to 50,000	34.43% X 6.99 = 2.406	ton/day VOC reduction
50,000 to 125,000	48.71% X 6.99 = 3.405	ton/day VOC reduction

The 25,000 gallons per day throughput control strategy results in 5.81 ton/day of VOC reduction if we simply aggregate 2.406 and 3.405. Stage I Vapor Recovery for service stations of 25,000 gallons throughput of gasoline or more per month will be implemented and operational no later than December 31, 2005. Implementation of this control strategy comes as a formal request of the eight local governments who are signatories to the Early Action Compact. Their support for Stage I Vapor Recovery as a local clean air strategy, and their approval of this proposed local State Implementation Plan Revision, are attached as appendix N.

Degreasing Controls
The Clean Air Strategy endorsed by the San Antonio EAC Region involves the application of Chapter 115 of the TAC to degreasing units in its four-county region. Chapter 115 addresses emission controls on degreasing processes particularly in

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nonattainment areas and it was believed that such controls could be applied to the SAER. Degreasing Equipment controls, as prescribed in Chapter 115, were projected to provide VOC emission reductions of 12.83 tons per day in the San Antonio region. This reduction total assumes no existing state degreasing controls of this type. This reduction total was presented to the elected officials and technical staff as the reductions available through local enactment of a Chapter 115 Degreasing Controls rule as identified in the ERG report.

The eight local Early Action Compact signatory governments took up the formal endorsement of Degreasing Controls as one of three Clean Air Strategies for their approval. The first government to consider this Clean Air Strategy set was the City of Seguin on February 3, 2004. The final government to consider them was Guadalupe Commissioners' Court on February 24, 2004. All eight local governments approved resolutions requesting the three strategies during that February 3 - 24 period.

Challenges

In early February 2004, TCEQ staff from the Region 13 office informed AACOG staff that Chapter 106 of the TAC contained a requirement to implement Chapter 115-compliant degreasing controls statewide. Subsequent investigations revealed that subchapter T of Chapter 106 addresses degreasing units that may be subject to permit by rule and require the units, regardless of the county in which they are located, to meet the requirements of §115.412 and §115.415. (TAC, 2004b) Following the realization that much of the credit previously calculated for degreasing controls as a voluntary Clean Air Strategy might no longer be available due to Chapter 106, AACOG staff proceeded to analyze Chapter 106 and Chapter 115 and assess how emission reductions should be properly determined and allocated.

Eddie Mack (personal communication, February 13, 2004) of EPA's Region 6 office explained that the Chapter 115 degreaser requirements have been in place since early in the 1980's for certain other regions of the state. Permit by rule (PBR) stipulations in Chapter 106 (§106.454) require compliance with the Chapter 115 degreaser requirements, regardless of location. Such compliance with Chapter 115 through 106 regardless of location has only been in place since May 1994.

Hence, the initial 2007 degreasing emission reductions estimated through local Chapter 115 promulgation, which assumed that no such state rule was in place, were clearly overestimated. On the other hand, since promulgation of Chapter 106 predates 1999, then both the 1999 and 2007 "uncontrolled" degreasing emissions inventories, which heretofore had also assumed no effective degreasing controls of this type, were also likely to be too large.

Note that Chapters 106/115 as existing state rules guarantee that reduction credits are available, not as voluntary credits available to the region as Local Clean Air Strategy enactment, but in both the 1999 and 2007 base case as was the case for other existing state and federal rules.

Reductions in degreasing emissions due to both local implementation of Chapter 115 in the Clean Air Plan and due to Chapter 106 are described in two categories.

1. Reductions in emissions based on the growth of degreasing emission between 1999 and 2007, and
2. Reductions in degreasing emissions in the 1999 (and hence, in the 2007) base case.

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As reported in Appendix F, area source emission projections were generally calculated for 2007 using the Economic Growth Analysis System (I-GAS) model. The EGAS model supplied growth factors for projecting of all area source emissions[2]. Thus growth in degreasing emissions to 2007 was calculated based on the 1999 emissions inventory for this category.

Because Chapter 106 was in effect from 1999 to 2007, the *growth* in degreasing emissions during that period was in fact limited by the same factor as promulgation of the effective rule limited *emissions* in the degreasing operations themselves. That is, reduction credits due to the effective state rule can be taken on earlier calculations for growth in the degreasing emissions category from 1999-2007. This is both a first approximation correction to the 2007 base case degreasing emissions inventory and a source of modeling credit identified under applicable state and federal rules. As mentioned earlier, these reductions are not categorized as voluntary credits available to the region as Local Clean Air Strategy enactment.

Correcting the 1999 EI to account for the promulgation of Chapter 106, which was effective in 1994 and hence prior to 1999, is challenging. The 1999 EI should be corrected to account for the effects of Chapter 106, just as the 1999-2007 growth has been corrected. The preferred approach in taking credit for Chapter 106/115 emission reductions for 1999 involves using available information and data regarding compliance to the rules in 1999. Information regarding Safety-Kleen, a Texas based company that provides various environmental services throughout the nation, was utilized in this approach.

Documentation provided by TCEQ shows that Safety-Kleen 1) provides degreasing equipment and solvents for approximately 50% of the San Antonio market; 2) Safety-Kleen products are Chapter 115 compliant; 3) Safety-Kleen provided these products to their customers in the San Antonio region consistent with the promulgation of Chapter 106. Hence, the 85% reduction effective through Chapter 106/115 should act as a first approximation correction to 50% of the degreasing emissions in the 1999 EI. Since these emission reductions are not reflected in the 1999 base case, these emission reductions and potential credit are further documented in Appendix K, Additional Evidence.

Note that the 2007 degreasing EI is simply equal to the sum of the 1999 degreasing EI plus the 1999-2007 growth in degreasing emissions. Hence, lowering the 1999 degreasing EI due to the presence of Safety-Kleen in the market is necessarily reflected also as an adjustment to the 2007 degreasing EI.

Resolution of Challenges: Degreasing Equipment Controls

- Given the formal approval of the EAC signatory governments, the San Antonio EAC region is committed to requesting that the state implement a 4-county EAC regional rule requiring compliance with Degreasing Equipment Operation Controls, described in TAC, Title 30, Ch. 115.
- Given Chapter 106, reductions in emissions based on the growth of degreasing emission between 1999 and 2007 have been approximated and are treated uniquely as additional reductions due to current State rule.

[2] With the exception of Architectural Surface Coatings and Consumer/Commercial Solvents

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- Reductions in the 1999 (and 2007) base case degreasing emissions inventories have been calculated based on Safety-Kleen's participation in the regional market. These reductions are treated as tentative and unconfirmed reductions and are discussed in the Additional Evidence section, Appendix K.
- Chapter 106 of the TAC was adopted in 1994, thus applying to degreasing facilities that were constructed or scheduled to be constructed on and after 1994. This leaves degreasing facilities that were in existence prior to 1994 exempt from Chapter 106 rule. These uncontrolled facilities would be subjected to the regulations of Chapter 115 due to the passage of the rule by local governments, therefore be a source of additional emission reductions, as described in Appendix K, Additional Evidence.

Local signatory governments were presented the three clean air strategies recommended by the AIR Committee between the dates of February 3 and February 24, 2004. The EAC signatory governments passed resolutions requesting the clean air measures in table 5.4 be implemented in the SAER.

Design Values

Once the strategies were incorporated into the photochemical model's 2007 projection, a design value was analyzed to ensure the strategies had a positive impact on the predicted ozone values. These control strategy design values are the result of analyzing Stage I Vapor Recovery implementation on area gasoline stations that dispense at least 25,000 gallons a month and are listed in table I-8.

Table I-12. Design Values for the CAMS Stations after Clean Air Strategy Analysis

Monitoring Station	2007 Design Value	2007 Design Value with Control Strategies
CAMS 23	84.52	84.40
CAMS 58	82.12	82.03
CAMS 59	74.48	74.44
CAMS 678	74.46	74.39
CAMS 3[3]	82.57	82.57
CAMS 38[3]	84.41	84.41

The calculations for the development of the design values are described in greater detail in Appendix H, Modeled Attainment Test.

CONCLUSION

The San Antonio EAC Region has committed to pursue various clean air measures as requested by the local governments. These commitments involve requesting lower RVP gasoline implementation, Stage I Vapor recovery systems, and Degreasing Equipment Controls. Details regarding emission reductions due to gasoline having an RVP of 7.2

[3] CAMS 3 and CAMS 38 are located in the Austin MSA. Ozone readings from these monitors are included in the modeling analysis since guidance recommends analysis of monitoring stations within the 4-km grid of the modeling episode. Due to Austin's close proximity to the SAER, reflecting attainment of the 8-hour NAAQS in this region strengthens SAER's 2007 demonstration.

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can be found in Appendix K, Additional Evidence. Stage I vapor recovery system for retailers that dispense no less than 25,000 gallons per month is SIP creditable was discussed in a previous section of this appendix. Degreasing controls, through consideration of Chapter 106 and Chapter 115, have various degrees of creditability. Emission reductions achieved by Chapter 106 on growth in degreasing emission between 1999 and 2007 are accounted for as emission reductions due to state rule and were discussed in this appendix. Reductions in the 1999 base case due to Chapter 106 are treated as additional evidence and discussed in Appendix K. Additional reductions are possible through local implementation of Chapter 115 to degreasing units that were in existence prior to 1999, described in Appendix K.

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APPENDIX J

MODELING PROTOCOL

SAN ANTONIO EAC REGION ATTAINMENT DEMONSTRATION

MARCH 2004

AACOG
Alamo Area Council
Of Governments

Appendix J

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MODELING/ANALYSIS PROTOCOL

The modeling/analysis protocol serves numerous functions including: (1) identifying the local (lead) air quality agency assisting the State with attainment analyses, (2) identifying methods and procedures used to support the demonstration, and (3) describing the review process applied to steps in the demonstration process (EPA, 1999). Although the protocol serves other functions, one of the most important is providing a means of planning and communicating the procedures to be used for demonstrating attainment.

Appendix J is divided into two parts. The first, Protocol Overview, lists key issues that are addressed in the local modeling/analysis protocol and describes the means used to fulfill protocol requirements. Part two of this appendix consists of the Modeling Protocol document provided to AACOG by ENVIRON International Corporation for development of the 1999 photochemical model.

PART 1: PROTOCOL OVERVIEW

Lead Agency

The local (or lead), agency assists the State with evaluating the analyses needed to support a defensible demonstration. For purposes of the SAER attainment demonstration, the lead agency is the Alamo Area Council of Governments (AACOG). Although AACOG is the local agency charged with emissions inventory development, photochemical model development, and other major components of the SAER attainment demonstration, the agency works closely with the state (Texas Commission on Environmental Quality) and federal (US Environmental Protection Agency) governments to ensure compliance with applicable guidance and regulations.

Stakeholders Participating in the Process

Local stakeholders participating in the protocol process include the Air Improvement Resources (AIR) Committee of the Alamo Area Council of Governments. Formed in April 1999, the mission of the AIR Committee is twofold: (1) facilitate the completion of the air quality studies and necessary planning activities for attainment under the new 8-hour average ozone NAAQS, and (2) develop a comprehensive emission reduction plan that will guide the region's actions to attain the 8-hour NAAQS. Furthermore, much of the technical and educational air quality activities conducted by AACOG are directed, reviewed, and approved by the AIR Committee. The Air Improvement Resources Committee is composed of five subcommittees as described below:

<u>AIR Executive Committee</u>

The AIR Executive Committee is comprised of members representing the major government organizations within the San Antonio Metropolitan Statistical Area defined according to data from the 1999 U.S. Census.[1] The following municipal and county

[1] At the time the Early Action Compact was signed, the MSA consisted of four counties: Bexar, Comal, Guadalupe, and Wilson. The bylaws of the AIR Committee state that "membership shall be extended to similar local governments brought into the San Antonio Metropolitan Statistical Area through US Census redesignations of the SA/MSA boundary." As recently as December 2003, EPA Region 6 Administrator Richard Greene affirmed that only this four-county region is recommended as the nonattainment area for the San Antonio region. Richard Greene's letter to Texas Governor Rick Perry, dated December 3, 2003, available online as: <http://www.epa.gov/air/oaqps/glo/designations/documents/03Recommendations/6/s/Texas_R.pdf>.

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governments appoint one representative to serve on the AIR Executive Committee. The county government representative is an elected official serving as judge or commissioner. The municipal government representative is an elected official serving as mayor or city councilperson.

- Bexar County
- Comal County
- City of Floresville
- Guadalupe County
- City of New Braunfels
- City of San Antonio
- City of Seguin
- Wilson County

In addition, the following entities appoint one representative to serve on the AIR Executive Committee:

- Alamo Area Council of Governments Board of Directors
- Greater Bexar County Council of Cities
- San Antonio / Bexar County Metropolitan Planning Organization

During its five-year history, membership of the AIR Executive Committee has varied. Table J-1 provides a list of the AIR Executive members as of March 2004.

Table J-1. Executive (voting) Members of AIR Committee.

Agency	Representative
Bexar County	Nelson Wolff, Bexar County Judge
City of San Antonio	Ed Garza, San Antonio Mayor / Chip Haas, City of San Antonio Councilman
Comal County	Jay Millikin, Comal County Commissioner
City of New Braunfels	Adam Cork, New Braunfels Mayor
Guadalupe County	Donald Schraub, Guadalupe County Judge
City of Seguin	Ernest Hernandez, City of Seguin Councilman
Wilson County	Marvin Quinney, Wilson County Judge
City of Floresville	Raymond Ramirez, Floresville Mayor
Alamo Area Council of Governments Board of Directors	Patrick Heath, AACOG Chairman
Greater Bexar County Council of Cities	Marcy Meffert, Leon Valley Mayor
Bexar County-San Antonio Metropolitan Planning Organization	Julian Castro, City of San Antonio Councilman

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AIR Advisory Committee

The AIR Advisory Committee acts as liaison between the AIR Executive Committee and the greater citizen sectors, both public and private. The membership of the AIR Advisory Committee includes the AIR Executive Committee membership. AIR Advisory Committee membership invitations are extended among the following groups and individuals, and others as determined by the Executive Committee, with all membership nominations made by members of the AIR Executive Committee and final approval for membership by vote of the AIR Executive Committee:

- Business representatives
- Environmental groups
- Education agencies
- Transportation organizers
- Utilities
- Industry representatives
- Chambers of Commerce
- Health organizations
- Neighborhood organizations
- Other elected officials
- Minority organizations

AIR Technical Committee

The AIR Technical Committee is composed of technical staff representing local governments knowledgeable of air quality issues. The committee provides recommendations and technical assistance on air quality technical issues to the AIR Executive Committee for planning meetings held by the AIR Executive Committee. The following local planning agencies are represented on the Technical Committee.

- AACOG
- Bexar County
- City Public Service (Utility provider)
- Comal County
- City of Floresville
- Guadalupe County
- Metropolitan Health District
- Metropolitan Planning Organization
- City of New Braunfels
- City of San Antonio
- City of Seguin
- Texas Commission on Environmental Quality (ex-officio)
- Texas Department of Transportation (TxDOT) District Office
- United States Environmental Protection Agency (ex-officio)
- Via Metropolitan Transit
- Wilson County

AIR Public Education Committee

The AIR Public Education Committee is charged with disseminating information about the ozone challenge through news media and public events. Its mission is to educate the public about local air quality problems and issues. The Public Education Committee makes recommendations to the AIR Executive / Advisory Committee on ways to increase media coverage of air quality issues and provide air quality information to the

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general public. Membership of the AIR Public Education Committee includes representatives of local governments, utilities, and transportation organizations.

Off-Road Equipment Subcommittee

The AIR Off-road Equipment Subcommittee works with local industry to promote voluntary implementation of ozone control strategies and studies the impact of legislation and other legal issues on the off-road community. The Off-Road Subcommittee membership includes owners/operators of off-road equipment in the public and private sectors.

Alamo Area Clean Cities Coalition

Although the Alamo Area Clean Cities Coalition is not a subcommittee of the AIR Committee, the coalition encourages local governments and organizations to form public/private partnerships to develop markets for alternative fuel vehicles (AFVs). Clean Cities is a voluntary federal program funded by the U.S. Department of Energy to accelerate and expand the use of alternative fuels in communities throughout the country and to develop the necessary infrastructure for their operation.

Since 1996, the AACOG has supported the Alamo Area Clean Cities Coalition by hosting meetings, organizing awareness events, and developing project subcommittees that are chaired by members of the local community. As a regional planning organization, the coalition works to improve the quality of life in South-central Texas including the 12-county area surrounding the City of San Antonio.

Public Participation

Each meeting of each of the subcommittees of the Air Improvement Resources Committee system is open to the public. Although the AIR Technical Committee is a technical working group and is not a forum for policy development and action, the agendas of the regular meetings of this committee have always included a “Citizens to be Heard” item. In addition to a “Citizens to be Heard” item, the bylaws of the AIR Committee system allow citizens to address every action item on the AIR Executive/Advisory Committee agendas, guaranteeing the right of the citizens to voice their opinion prior to any vote by the policy development and action committee.

Management / Communication Procedures

Many of the technical decisions required by the modeling/analysis protocol – such as episode selection, choice of photochemical models, and others – were first discussed and evaluated by representatives of the Texas Near Non-attainment Areas (NNAs), the Texas Commission on Environmental Quality, the Environmental Protection Agency, and other technical advisors during regularly-scheduled meetings of the Texas NNA Working Group. A list of participants and stakeholders involved in the process is provided in part 2 of this appendix.

For instances where technical decisions affecting the San Antonio EAC Region (SAER) were first evaluated and approved by the NNA Working Group, approval was subsequently sought at the local level. Technical decisions reviewed/approved at the local level included such issues as episode selection and performance of the photochemical model. A typical process involving local participation would start with review and approval by the Texas NNA Working Group (including input from TCEQ and EPA) followed by review and approval by the AIR Technical Committee. Upon approval by the Technical Committee, the group would provide recommendations to the AIR

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Executive/Advisory Committee. Final decisions were made by vote of the Executive members during public meetings of the AIR Executive/Advisory Committee. Whenever the protocol decisions involved matters of policy, the AIR Executive Committee made recommendations for action to the local governments represented by the AIR Executive Committee membership. Figure J-1 provides a flowchart of the communication process at the local level.

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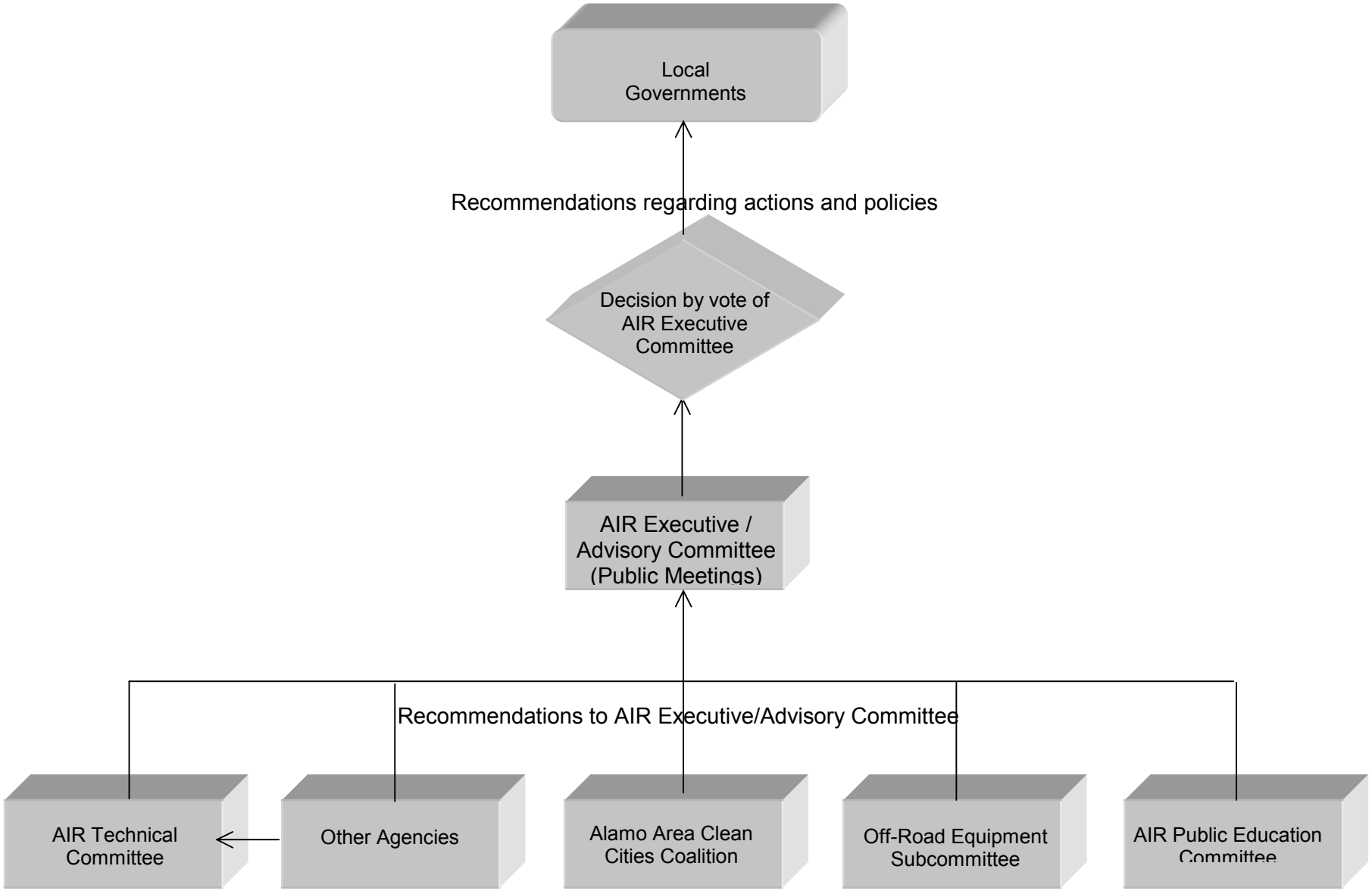
Figure J-1. Flowchart of Communication Process of the Air Improvement Resources (AIR) Committees.



For decisions such as modeling of potential clean air strategies and selection of clean air strategies for adoption in the SIP, evaluation and approval were primarily local issues. Input regarding potential clean air strategies was sought from as many local stakeholders as possible including members of the AIR Technical Committee, the Alamo Area Clean Cities Coalition, and the Off-road Equipment Subcommittee. Additionally, public input was encouraged through a series of meetings conducted by AACOG that addressed such topics as the Clean Air Plan, regional air quality, and clean air strategies as shown in table J-2.

AACOG staff provided news briefs to the media regarding public meetings to encourage participation as shown in exhibit A. The public meetings were held at various locations and in all four SAER counties to provide access to as many regional citizens as possible. In addition to citizen's comments made during public meetings, AACOG encouraged feedback by accepting public comments via mail, fax, and email. Public comments were compiled and provided to the AIR Executive Committee (voting) members on a regular basis.

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Table J-2. Public Meetings Conducted in the SAER Counties.

Date	Location	Topic(s) of Discussion	Purpose(s)
August 20, 2002	AACOG Boardroom 8626 Tesoro Drive Suite 100 San Antonio, TX 78217 Bexar County	Regional Air Quality Clean Air Plan Non-attainment designations Vehicle emissions testing	To educate the public on the current air quality situation and the structure, purpose, and function of the Clean Air Plan. To answer questions and gather comments regarding the Clean Air Plan, potential designation of “non-attainment” by the EPA, and vehicle emissions testing programs.
January 22, 2003	AACOG Boardroom 8700 Tesoro Drive Suite 100 San Antonio, TX 78217 Bexar County	Early Action Compact and Clean Air Plan Pollution control strategies	To educate the public on the structure, purpose, and function of the Early Action Compact. To answer questions and gather comments regarding the Early Action Compact, the Clean Air Plan, and air pollution control strategies to be considered.
February 22, 2003	AACOG Boardroom 8700 Tesoro Drive Suite 100 San Antonio, TX Bexar County	Regional air quality Air pollution strategies under consideration Control strategy evaluation Early Action Compact and Clean Air Plan	To update the public on our air quality situation and the process of evaluating potential air pollution control strategies for our Clean Air Plan. To answer questions and gather comments regarding the Early Action Compact, the Clean Air Plan, and air pollution control strategies to be considered.

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March 19, 2003	Landa Haus 360 Aquatic Circle New Braunfels, TX 78130 Comal County	Regional air quality Air pollution strategies under consideration Control strategy evaluation Early Action Compact and Clean Air Plan	To update the public on our air quality situation and the process of evaluating potential air pollution control strategies for our Clean Air Plan. To answer questions and gather comments regarding the Early Action Compact, the Clean Air Plan, and air pollution control strategies to be considered.
April 12, 2003	Seguin City Council Chambers 210 E. Gonzales Seguin, TX Guadalupe County	Regional air quality Air pollution strategies under consideration Control strategy evaluation Early Action Compact and Clean Air Plan	To update the public on our air quality situation and the process of evaluating potential air pollution control strategies for our Clean Air Plan. To answer questions and gather comments regarding the Early Action Compact, the Clean Air Plan, and air pollution control strategies to be considered.
May 20, 2003	Criminal Justice Center 800 10th Street Floresville, TX Wilson County	Regional air quality Air pollution strategies under consideration Control strategy evaluation Early Action Compact and Clean Air Plan	To update the public on our air quality situation and the process of evaluating potential air pollution control strategies for our Clean Air Plan. To gather comments regarding the Early Action Compact, the Clean Air Plan, and air pollution control strategies to be considered.
June 14, 2003	AACOG Boardroom 8700 Tesoro Drive Suite 100 San Antonio, TX 78217 Bexar County	Regional air quality Control strategy evaluation	To answer questions and update the public on our air quality situation and the process of evaluating potential air pollution control strategies for our Clean Air Plan.

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July 16, 2003	AACOG Boardroom 8700 Tesoro Drive Suite 100 San Antonio, TX 78217 Bexar County	Regional air quality Control strategy evaluation	To answer questions and update the public on our air quality situation and the process of evaluating potential air pollution control strategies for our Clean Air Plan.
November 5, 2003	AACOG Boardroom 8700 Tesoro Drive Suite 100 San Antonio, TX 78217 Bexar County	Clean air strategies under consideration	To provide information on the Clean Air Strategies being considered as a part of the region's Clean Air Plan. To answer questions posed at previous Clean Air Plan workshops.
November 18, 2003	AACOG Boardroom 8700 Tesoro Drive Suite 100 San Antonio, TX 78217 Bexar County	Air quality Clean Air Plan Clean air strategies	To receive public comments on air quality, the Clean Air Plan, and Clean Air Strategies.
February 3, 2004	AACOG Boardroom 8700 Tesoro Drive Suite 100 San Antonio, TX 78217 Bexar County	Draft Revision to the State Implementation Plan Clean air strategies under consideration	To provide information on the Clean Air Strategies being considered as a part of the region's revision to the State Implementation Plan for air quality, and to gather public comment on those strategies.

Choice of Air Quality Simulation Model and how it Meets Requirements in 40CFR51, Appendix W for using "Alternative" Models

The September 1999 episode was modeled by ENVIRON International Corporation using the Comprehensive Air Quality Model with Extensions (CAMx). In 2003, the federal guidance listing alternative models (appendix B of 40 CFR Part 51, appendix W) was removed from appendix W (Federal Register, 2003) and placed on EPA's Support Center for Regulatory Air Models (SCRAM) web site. This web site lists CAMx as an alternative dispersion model (EPA web page, no date).

Rationale for Choice of Air Quality and Emissions Model and Choice of Method for Generating Meteorological Inputs

According to EPA's Summary Descriptions of Alternative Air Quality Models (EPA web page, no date), "CAMx is appropriate for simulating hourly ozone, CO, and PM concentrations from the urban-scale to regional-scale." Furthermore, the Texas Commission on Environmental Quality supports the use of CAMx for regional-scale modeling. The Attainment Demonstration for the Dallas/Fort Worth Ozone Nonattainment Area (TNRCC, 1999) states that models recommended by the EPA in past years had been replaced with updated counterparts such as CAMx that demonstrate "improved model chemistry, better treatment of vertical diffusion, and more realistic treatment of plumes." Because of these and other advantages, the TCEQ recommends the use of CAMx for ozone attainment demonstration modeling in Texas.

Emissions inputs to the photochemical model were developed by a variety of agencies. State and regional emissions for the base year (1999) and projection year (2007) were provided to AACOG from the Commission; therefore the state and regional EI data have undergone review and approval at the state level. For some categories of inputs, such as regional 2007 EI, the data were also federally approved. Local area and off-road sources were developed by AACOG staff using EPA recommended / alternative methodologies or using EPA software models (e.g., NONROAD). Local biogenic and point source data were provided by the Commission. With few exceptions, the Commission-provided point emissions were used as model input. Examples where the Commission's data were not used included data developed from measurements recorded at or studies conducted for specific emission point sources (e.g. a wastewater treatment plant and power plants) and provided to staff by representatives of those point sources. Appendices D and F provide additional information regarding methodologies/models used to develop the modeling emission inventories.

The Fifth Generation Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Model (MM5) was utilized by ENVIRON to develop hourly, three-dimensional meteorological input fields for CAMx. The original 1999 episode was developed using MM5v3.4 (version 3, release 4). During the model refinement process, modelers were able to take advantage of the expanded capabilities of the recently released MM5v3.5. The fifth-generation Penn State/NCAR Mesoscale Model is the primary tool for providing meteorological input for EPA's Models-3/Community Multiscale Air Quality (CMAQ) modeling system. EPA recognizes that MM5 is widely used for providing meteorological characterizations throughout the air quality modeling community (EPA web page, no date). Development of the meteorological inputs is explained in more detail in appendix B.

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Identification of Specific Deliverables and Schedule for Delivery to the Appropriate U.S. EPA Regional Office

The Early Action Compact for the San Antonio region lists milestones that must be completed in accordance with a specified timeline. Most milestones include products for delivery to the TCEQ and U.S. EPA Region 6 Office. The sections of the milestone list that contain deliverables are reproduced in table J-3 below. Table J-3 also references the sections of the EAC where the milestones are described.

Table J-3. Schedule of Deliverables to U.S. EPA Region 6.

Milestone	Delivery Date	Reference in the Early Action Compact
Emissions Inventory Milestones		
Development of a 1999 or later episode emissions inventory according to requirements in Chapter IV, b)	March 31, 2004	Chapter IV, b)
Incorporate MOBILE6 data with Link-Based Travel Demand Model data in urban areas	March 31, 2004	Chapter IV, b)
Further emission inventory episode development based on local Conceptual Model update. Other episode inventories, if required, made in concert with EPA, TCEQ, and local entities.	April 30, 2003 and April 30, 2005	Chapter IV, b)
NONROAD model data adjusted for local equipment populations and usage rates; Area source data is based when possible on local survey data.	March 31, 2004	Chapter IV, b), c)
Modeling Milestones		
Develop SIP quality modeling episodes that perform within the EPA's accepted margin of accuracy, including a base case and future case on or before December 31, 2007. Documented & reviewed by TCEQ & EPA. Quantifiable emission reduction measures in the future case to produce one or more control cases. Control strategies determined against control case model.	September 30, 2003	Chapter IV, c)
Develop other episodes as necessary to fully represent the variety of situations that typically contribute to local ozone production	Updates delivered by April 30, 2003 and April 30, 2005	Chapter IV, c)
Control Strategy Development Milestones		
Identify additional local controls, as necessary, to demonstrate 2007attainment of the 8-hour standard. Controls implemented by Dec. 31, 2005, with full local stakeholder participation.	Future case analysis, control cases and control case showing achievement of the 8-hour ozone standard on or before Dec. 31, 2007 will be delivered as a report by March 31, 2004 from AACOG	Chapter IV, d)
All control measures will be incorporated by the state into the State Implementation Plan.	March 31, 2004	Chapter IV, d)
Maintenance for Growth Milestones		
Component to address emissions growth at least 5 years beyond December 31, 2007, ensuring that the area will remain in attainment of the 8-hour standard during that period.	March 31, 2004.	Chapter IV, e)

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Milestone **Maintenance for Growth Milestones (continued)**	Delivery Date	Reference in the Early Action Compact
If the review of growth demonstrates that adopted control measures are inadequate to address growth in emissions, additional measures will be added to the plan	After December 31, 2004. See conclusion to Appendix L for details.	Chapter IV, e)

Data Access
Input files for and output files generated from the photochemical model have been archived by the Alamo Area Council of Governments, the Texas Commission on Environmental Quality, and the University of Texas at Austin. Other data access issues are described in the table below (J-4).

Table J-4. Data Access Protocol.

Computer on which files were generated and can be read	Red Hat Linux 9.0, Pacific Group Fortran Compiler 1 gigabyte (gb) of DDR Ram 4-200 gb IDE hard drives, 1-80 gb SCSI hard drive
Software necessary to process model outputs	EPS2, CAMx version 3.10b, camxpost, camxtract, avgcat, PAVE, Perl
Contact person	Steven Smeltzer, Environmental Manager, AACOG 210/362-5266 ssmeltzer@aacog.com
Means for downloading files	Hard drive or off-site ftp server
Administrative procedures which need to be satisfied to access files	Written request to: Steven Smeltzer Environmental Manager Alamo Area Council of Governments 8700 Tesoro Drive, Suite 700 San Antonio, TX 78217

Other Protocol Topics
The EPA lists other modeling/analysis protocol steps in their draft guidance that were performed during development of the 1999 model, but are discussed in other areas of this attainment demonstration SIP. Table J-5 provides a list of these other protocol topics and the location of their descriptions in the SAER SIP and/or SIP appendices.

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Table J-5. Modeling/analysis Protocol Steps Described elsewhere in SIP

Modeling/Analysis Protocol Topic	Location in SIP
Scientific peer review of modeling procedures and outputs	Chapter 3 of Executive Summary – Section 3.3.
Analyses included in the weight of evidence ("WOE") determination	A “weight of evidence” study as defined by EPA’s draft 8-hour guidance was not required or appropriate, given definition of WOE; however, similar "additional evidence" analyses are provided in Chapter 5 of the Executive Summary (Section 5.5) and appendix K
Database used to support air quality modeling and other types of analyses	Chapter 3 of Executive Summary – Sections 3.4 and 3.5 and appendices B, C, D, E, and F
Methods used to quality assure emissions inputs	Chapter 3 of Executive Summary – Section 3.5.3
Domain size and spatial resolution to be used	Chapter 3 of Executive Summary – Section 3.3
Criteria/goals in selecting periods to model and process to be used in selecting episodes	Chapter 3 of Executive Summary – Section 3.2 and appendix A
Performance evaluation procedures and additional diagnostic tests planned	Chapter 3 of Executive Summary – Sections 3.6 and 3.8 and appendices E and G
Outcomes in the modeled attainment and screening tests as well as results of analyses to be used in a broader weight of evidence determination	Chapters 3 and 5 of Executive Summary – 3.9, 5.4, and 5.5 and appendices H and K

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References

Federal Register (April 15, 2003). 40 CFR Part 51Revision to the Guideline on Air Quality Models: Adoption of a Preferred Long Range Transport Model and Other Revisions; Final Rule. RIN 2060-AF01

Texas Natural Resource Conservation Commission (February 24, 1999). Revisions to the State Implementation Plan for the Control of Ozone Air Pollution: Attainment Demonstration for the Dallas/Fort Worth Ozone Nonattainment Area Rule Log No. 98046-SIP-AI. Austin, TX.

US Environmental Protection Agency (May 1999). Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAQQS EPA-454/R-99-004.

US Environmental Protection Agency (no date). Atmospheric Modeling Models [On-line], Available: http://www.epa.gov/asmdnerl/mm4.html

US Environmental Protection Agency (no date). Dispersion Models – Alternative Models [On-line], Available: http://www.epa.gov/scram001/tt22.htm#camx.

US Environmental Protection Agency (no date). Summary Descriptions of Alternative Air Quality Models [On-line], Available: http://www.epa.gov/scram001/models/other/altmodel.pdf

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AACOG
Alamo Area Council Of Governments

News Brief

Clean Air Plan Workshop to Discuss Draft State Implementation Plan, Clean Air Strategies

What: Clean Air Plan Workshop

When: Tuesday, February 3, 2004

6:00 p.m. – 8:00 p.m.

Where: Alamo Area Council of Governments Board Room
8700 Tesoro Drive, Suite 100, San Antonio, TX 78217

Why: To provide information on the Clean Air Strategies being considered as a part of the region's revision to the State Implementation Plan for air quality, and to gather public comment on those strategies.

Who: Open to the Public

Cost: FREE

Contact: Dorothy Birch
(210) 362-5213
dbirch@aacog.com

More Info: To view the draft State Implementation Plan, visit www.aacog.com/sip .
To learn about air quality and ozone pollution, visit www.aacog.com/air.

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PART 2: MODELING PROTOCOL PREPARED BY ENVIRON INTERNATIONAL CORPORATION

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APPENDIX K

ADDITIONAL EVIDENCE

SAN ANTONIO EAC REGION ATTAINMENT DEMONSTRATION

MARCH 2004

Appendix K

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Alternative Fuel Survey

Introduction

A local alternative fuel survey has been conducted in 2001by staff of AACOG, which inventoried the AFV fleet in the SA MSA. The survey provided information on the number of AFVs, specific fuel type, the percentage of time that they operate on alternative fuel, the number of days per week they typically operate, and an estimate on how many vehicle miles traveled (VMT) were accumulated by each vehicle for 2001.

The results indicated that there were 2,050 AFVs in the San Antonio region, and this number is expected to increase to 2,442 AFVs by 2006. The survey results were used to assess the effectiveness of both the current AFV fleet, and the 2007 AFV fleet, at reducing ozone precursor emissions. AFVs reporting a 0% usage rate of alternative fuels taken out, there were 1,755 vehicles modeled for the September 2001 fleet, and 2,147 vehicles modeled for the September 2007 fleet that use alternative fuel.

Analysis of operation of the 2001 AFV fleet indicates that this fleet is generating emissions reductions of 62 lbs./day of VOC, 45 lbs./day of CO, and 689 lbs./day of NOx, and it is projected that this fleet could contribute emissions reductions of 72 lbs./day of VOCs, 45 lbs./day of CO, and 858 lbs./day of NOx for the year 2007.

While these estimated reductions are not overly sizeable, they do illustrate that a switch to alternative fuel vehicles will result in the reduction of ozone precursors in addition to reducing our nation's dependence on foreign oil. As alternative fuel technology advances, refueling infrastructure expands, and the use of alternative fuels becomes more acceptable, the emissions reductions resulting from the utilization of an AFV fleet in the SA MSA should become more significant.

The following pages reproduce the survey materials distributed in 2001.
The survey information is followed by the results.

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2001 Alternative Fuel Survey

Alternative Fuel Work Schedule Survey

COMPANY or ORGANIZATION

FUEL - How much of each alternative fuel, in gasoline gallon equivalents (gge), did your fleet consume in 2001?

Natural Gas	0
Propane	0
Ethanol	0
Methanol	0
Biodiesel	0
Electricity	0

Fuel Stations

Please update the number of vehicle alternative fuel refueling stations you operate on the following page. Please make sure that your station numbers add up (that the number of stations for 2001 equals the number of 2000 stations, plus the number added in 2001, minus stations closed in 2001.) In addition, please forecast the number you plan to have in operation in the year 2006.

Public - A public refueling site is available for use by the general public, either by accepting cash/credit payment, by prior arrangement, or by use of a refueling card.

Private - A private refueling site is not available for use by the general public.

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Alternative Fuel Refueling Stations

Customer Availability (Public or Private)		Fuel Type	2000 Total	Added in 2001	Closed in 2001	2001 Total	Planned for 2006
Public	Private						
0	0	CNG	0	0	0	0	0
0	0	LNG	0	0	0	0	0
0	0	Propane	0	0	0	0	0
0	0	Ethanol	0	0	0	0	0
0	0	Electric	0	0	0	0	0
0	0	Biodiesel	0	0	0	0	0
0	0	Methanol	0	0	0	0	0
0	0	Other: _____	0	0	0	0	0
Total			0	0	0	0	0

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VEHICLES – Please update the number of alternative fuel vehicles in your fleet on the following page. Please make sure that your vehicle numbers add up (that the number of vehicles for 2001 equals the number of 2000 vehicles, plus the number added in 2001, minus vehicles retired in 2001).
Alternative Fueled Vehicles

Vehicle Class	Vehicle Type (Car, Truck, Bus, etc.)	Fuel Type	2000 Vehicle Total	Vehicles Added in 2001	AFVs Retired in 2001	2001 Reported Total	Planned For 2006	Estimated Vehicle Miles Traveled Per Year for each Vehicle
LIGHT DUTY		CNG	0	0	0	0	0	0
		LNG	0	0	0	0	0	0
		Propane	0	0	0	0	0	0
		Ethanol	0	0	0	0	0	0
		Electric	0	0	0	0	0	0
		Biodiesel	0	0	0	0	0	0
		Methanol	0	0	0	0	0	0
		Other: _____	0	0	0	0	0	0
		Light-duty Subtotal	0	0	0	0	0	0

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Alternative Fueled Vehicles (Cont.)

Vehicle Class	Vehicle Type (Car, Truck, Bus, etc.)	Fuel Type	2000 Vehicle Total	Vehicles Added in 2001	AFVs Retired in 2001	2001 Reported Total	Planned For 2006	Estimated Vehicle Miles Traveled Per Year for each Vehicle
Heavy Duty		CNG	0	0	0	0	0	0
		LNG	0	0	0	0	0	0
		Propane	0	0	0	0	0	0
		Ethanol	0	0	0	0	0	0
		Electric	0	0	0	0	0	0
		Biodiesel	0	0	0	0	0	0
		Methanol	0	0	0	0	0	0
		Other: _____	0	0	0	0	0	0
		Heavy-Duty Subtotal	0	0	0	0	0	0
Grand Total			0	0	0	0	0	0

2001 Alternative Fuel Survey Results

The results of the 2001 Alternative Fuel Survey can be found in the following tables. Averages and defaults used in the modeling are denoted in bold.

Table K-1. Light Duty Vehicles Operating on CNG

Vehicle Class	Organization	2001 Total	% as AFV	Days/ Week	VMT	2006 Projected Increase
LDT	12 TS Randolph	50	0%	0	5562	
LDT	37 TS Lackland	118	0%	0	10,000	
LDT	BexarMet Water	34	90%	5	10,000	
LDT	CPS	2	100%	4	5 to 10,000	
LDT	SA Parks	22	100%	7	10,000	
LDT	TxDOT	46	90%	5	10,000	
LDT	USPS	4	0%	0	10,000	
LDT	UTSA	15	45%	5	5,486	
LDT	Yanaguana Cruise	40	100%	7	10,000	
	Total LDT CNG	331				

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Table K-2. Light Duty Vehicles Operating on Propane

Vehicle Class	Organization	2001 Total	% as AFV	Days/ Week	VMT	2006 Projected Increase
LDT	AmeriGas	7	100%	5	10,000	
LDT	Beldon Roofing	74	86%	5	10,000	
LDT	Bell Hydrogas	16	100%	5	10,000	
LDT	Bexar County	60	50%	5	3795	25
LDT	BexarMET Water	6	86%	5	10,000	
LDT	City of San Antonio	37	50%	5	13,514	
LDT	City of San Antonio	198	100%	5	13,514	55
LDT	Mission Gas	14	100%	5	10,000	
LDT	Northside ISD	8	100%	5	10,000	
LDT	SA Inter. Airport	20	100%	5	10,000	
LDT	San Antonio Water System	43	14%	5	10,000	
LDT	SA Trans	18	100%	7	10,000	
LDT	Schwan's Enterprise	25	100%	5	10,000	
LDT	Texas State Hospital	52	86%	5	10,000	
LDT	Thad Ziegler Glass	37	86%	5	10,000	23
LDT	TxDOT	188	86%	5	10,000	172
LDT	US Park Service	1	86%	5	10,000	
LDT	UTSA	2	50%	5	16,602	
LDT	VIA Transit	184	100%	6	32,019	
	Total LDV Propane	990				

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Table K-3. Light Duty Vehicles Operating on Ethanol

Vehicle Class	Organization	2001 Total	% as AFV	Days/ Week	VMT	2006 Projected Increase
LDT	12 TS Randolph	1	0%	0	5,562	
LDT	CPS	21	0%	0	14,000	
LDT	USAA	100	0%	0	10,000	
LDT	USPS	1	0%	0	10,000	
	Total Ethanol	123				

Table K-4. Light Duty Vehicles Operating on Electricity

Vehicle Class	Organization	2001 Total	% as AFV	Days/ Week	VMT	2006 Projected Increase
LDT	37th TS Lackland	2	100	5	10,000	
LDT	USAA	21	100	5	10,000	
LDT	UTSA	26	100	5	2,080	
	Total Electric	49				

Table K-5. Heavy Duty Vehicles Operating on LNG

Vehicle Class	Organization	2001 Total	% as AFV	Days/ Week	VMT	2006 Projected Increase
	Total LNG	0				

Table K-6: Heavy Duty Vehicles Operating on Propane

Vehicle Class	Organization	2001 Total	% as AFV	Days/ Week	VMT	2006 Projected Increase
HDT	VIA Transit	66	100%	7	34,295	37
HDT	City of San Antonio	51	100%	5	9,551	
	Total HDV Propane	117				

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Table K-7. Heavy Duty School Buses Operating on Propane

Vehicle Class	Organization	2001 Total	% as AFV	Days/ Week	VMT	2006 Projected Increase
HDT	NISD	440	100%	5	14,000	80
	Total	440				

Additional respondents to the survey included the Schertz-Cibolo-Universal City Independent School District and the City of Floresville. Both reported that they did not currently operate any AFVs.

These survey responses were analyzed through the use of the AirCRED model. Prior to the use of the AirCRED model, the survey results were first grouped together based on the percentage of time the vehicle operated on alternative fuels, and the number of days per week the vehicle typically operated. This was a necessary component of the modeling process since not all of the vehicles operated the same percentage of time on alternative fuels, or the same number of days per week, and these two fleet characteristics are required model inputs. For these reasons, the survey responses were categorized into nine groups as illustrated in the following pages.

Table K-8. Group 1 – 100%, 7 Days Per Week

Group 1	Vehicles that operate 100% of the time on AFs, 7 days per week								
Vehicle Class	Fuel	Organization	Total	VMT	% as AFV	Days/Week	Total VMT	Avg. VMT/ Yr	Avg. Daily VMT
LDT	CNG	SA Parks	22	10000	100	7	220000		
LDT	CNG	Yanaguana	40	10000	100	7	400000		
			62				620000	10000	27
LDT	Propane	Satrans	18	10000	100	7	180000	10000	27
HDT	Propane	VIA Transit	66	34295	100	7	2263470	34295	94

Table K-9. Group 2 – 100%, 6 Days Per Week

Group 2	Vehicles that operate 100% of the time on AFs, 6 days per week								
Vehicle Class	Fuel	Organization	Total	VMT	% as AFV	Days/Week	Total VMT	Avg. VMT/ Yr	Avg. Daily VMT
LDT	Propane	VIA Transit	184	32,019	100	6	5891496	32019	103

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Table K-10. Group 3 – 100%, 5 Days Per Week

Group 3	Vehicles that operate 100% of the time on AFs, 5 days per week								
Vehicle Class	Fuel	Organization	Total	VMT	% as AFV	Days/Week	Total VMT	Avg. VMT/ Yr	Avg. Daily VMT
LDT	Propane	AmeriGas	7	10000	100	5	70000		
LDT	Propane	Bell Hydrogas	16	10000	100	5	160000		
LDT	Propane	COSA	198	13514	100	5	2675772		
LDT	Propane	Mission Gas	14	10000	100	5	140000		
LDT	Propane	NISD	8	10000	100	5	80000		
LDT	Propane	SA Int. Airport	20	10000	100	5	200000		
LDT	Propane	Schwan's Ent.	25	10000	100	5	250000		
			280				3575772	12415.9	48
LDT	Electric	37 TS Lackland	2	10000	100	5	20000		
LDT	Electric	USAA	21	10000	100	5	210000		
LDT	Electric	UTSA	26	80	100	5	2080		
			49				232080	4736.33	18
HDT	Propane	COSA	51	9551	100	5	487101	9551	37
School Bus	Propane	NISD	440	14000	100	5	6160000	14000	54

Table K-11. Group 4 – 100%, 4 Days Per Week

Group 4	Vehicles that operate 100% of the time on AFs, 4 days per week								
Vehicle Class	Fuel	Organization	Total	VMT	% as AFV	Days/Week	Total VMT	Avg. VMT/ Yr	Avg. Daily VMT
LDT	CNG	CPS	2	5000	100	4	10000	5000	24

Table K-12. Group 5 – 90%, 5 Days Per Week

Group 5	Vehicles that operate 90% of the time on AFs, 5 days per week								
Vehicle Class	Fuel	Organization	Total	VMT	% as AFV	Days/Week	Total VMT	Avg. VMT/ Yr	Avg. Daily VMT
LDT	CNG	BexarMet Water	34	10000	90	5	340000		
LDT	CNG	TxDOT	46	10000	90	5	460000		
		Total	80				800000	10000	38

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Table K-13. Group 6 – 86%, 5 Days Per Week

Group 6	Vehicles that operate 86% of the time on AFs, 5 days per week								
Vehicle Class	Fuel	Organization	Total	VMT	% as AFV	Days/Week	Total VMT	Avg. VMT/ Yr	Avg. Daily VMT
LDT	Propane	Beldon Roofing	74	10000	86	5	740000		
LDT	Propane	BexarMet Water	6	10000	86	5	60000		
LDT	Propane	Texas State Hosp.	52	10000	86	5	520000		
LDT	Propane	Thad Ziegler Glass	37	10000	86	5	370000		
LDT	Propane	TxDOT	188	10000	86	5	1880000		
LDT	Propane	US Park Service	1	10000	86	5	10000		
Total			358				3580000	10000	38

Table K-14. Group 7 – 50%, 5 Days Per Week

Group 7	Vehicles that operate 50% of the time on AFs, 5 days per week								
Vehicle Class	Fuel	Organization	Total	VMT	% as AFV	Days/Week	Total VMT	Avg. VMT/ Yr	Avg. Daily VMT
LDT	Propane	Bexar County	60	3795	50	5	227700		
LDT	Propane	COSA	37	13,514	50	5	500018		
LDT	Propane	UTSA	2	16,602	50	5	33204		
Total			99				760922	7686.08	30

Table K-15. Group 8 – 45%, 5 Days Per Week

Group 8	Vehicles that operate 45% of the time on AFs, 5 days per week								
Vehicle Class	Fuel	Organization	Total	VMT	% as AFV	Days/Week	Total VMT	Avg. VMT/ Yr	Avg. Daily VMT
LDT	CNG	UTSA	15	5486	45	5	82290	5486	21

Table K-16: Group 9 – 14%, 5 Days Per Week

Group 9	Vehicles that operate 14% of the time on AFs, 5 days per week								
Vehicle Class	Fuel	Organization	Total	VMT	% as AFV	Days/Week	Total VMT	Avg. VMT/ Yr	Avg. Daily VMT
LDT	Propane	SAWS	43	10,000	14	5	430000	10000	38

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Table K-17. 1999 AFV Participation and 2007 AFV Participation Projections for the San Antonio Metropolitan Area

Summer	1999 Total Participation	2007 Total Participation
LDT CNG	159	159
LDT Propane	982	1257
LDT Ethanol	0	0
LDT Electric	49	49
HDT LNG	0	0
HDT Propane	117	154
School Buses	0	0
Total	1307	1619
Fall	1999 Total Participation	2007 Total Participation
LDT CNG	159	159
LDT Propane	990	1265
LDT Ethanol	0	0
LDT Electric	49	49
HDT LNG	0	0
HDT Propane	117	154
School Buses	440	520
Total	1755	2147

Table K-18. Anticipated 2007 VOC & NOx Emission Reduction Estimates (lbs/Day)

Category	All AFVs 1999		All AFVs 2007	
	VOC	NOx	VOC	NOx
Summer Peak Hour Reduction	62.37	165.61	72.04	240.75
Fall Peak Hour Reduction	62.75	689.4	72.09	859.80

AFV Emission Reduction Methodology

The alternative fuels considered in this study were liquefied petroleum gas (LPG), compressed natural gas (CNG), liquefied natural gas (LNG), biodiesel, methanol, ethanol, and electricity.

The first step in the analysis process was to determine what alternative fuel types are being used in the San Antonio region. A questionnaire was distributed to both public and private entities seeking information on how many AFVs are in operation, what types of fuel they are using, and how many vehicle miles traveled (VMT) were accumulated by using each vehicle throughout the year. In addition, a separate telephone survey was conducted to gather information on the percentage of time the vehicles were operating on alternative fuels, and the number of days per week these vehicles were in use. The results were supplemented by information gathered from the 2000 Alternative Fuel Survey and the 2001 Clean Cities Report for organizations that did not respond to the 2001 Alternative Fuel Survey.

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The combined results indicated that there are currently 2,050 AFVs in the San Antonio region, and this number is expected to increase to 2,442 AFVs by 2006. The AFVs operating solely on conventional gasoline were not included in the subsequent analysis, bringing the total number of vehicles modeled in the 2001 analysis down to 1,755 vehicles, and the vehicles modeled in the 2007 analysis down to 2,147 vehicles. In addition, the 448 current, and 528 proposed propane vehicles operated by the Northside Independent School District were included in the September analysis based on the September 1999 photochemical modeling episode.

Once the results of the alternative fuel survey were compiled, the estimated emission reductions resulting from the utilization of these vehicles were calculated. Since there were no reported uses of biodiesel, methanol, or ethanol, the AirCRED model was utilized to calculate the estimated emission reductions for the entire AFV fleet. This model, developed by Argonne National Laboratory to assist the Department of Energy's (DOE's) Clean Cities coalitions, estimates the ozone precursor emissions reduction credits earned through the use of alternative fueled vehicles. The version of AirCRED that was used in this study is version 3.15, which was updated on August 1, 2001. The model is written in VisualBASIC for Microsoft Windows and consists of a series of screens, or forms, allowing for the input of data in a user-friendly manner.

The required inputs for the AirCRED model include the Clean City to be modeled, the number of AFVs, the daily VMT by the AFVs, the weekly days of operation of the AFVs, and the percentage of time the vehicles operate as an AFV. These inputs were obtained from the survey results. In the absence of survey data related to vehicle miles traveled (VMT), default VMT taken from the Dallas Fort Worth State Implementation Plan (SIP) were used. These VMT defaults are 36,000 miles/year for buses, and 10,000 miles/year for other vehicles. (TCEQ, 2000) A weighted average was calculated for the percentage of operation as an AFV, and a default of five days per week for the days per week of operation were used in the event that a response did not provide these values for a particular organization. An example of the weighted average calculation for light-duty CNG fueled vehicles is provided below.

The survey results indicated that 64 of the reported CNG vehicles were operating 100% of the time on CNG, and 15 CNG vehicles were operating 45% of the time on CNG. The weighted average was calculated to be 90% for CNG vehicles through the use of the following formula and subsequent calculation:

$$\frac{(\text{\# of AFVs x \% of operation as AFV}) + (\text{\# of AFVs x \% of operation as AFV})}{\text{Total number of vehicles}}$$

(64 x 100%) + (15 x 45%) / (64+15) = a weighted average of 89.6 or 90%

Once the required inputs were obtained or calculated, the last step in the process prior to actually running the model was to allocate the survey results, or the AFVs, into groups based on the percentage of time the vehicles operated on alternative fuels, and the number of days per week the vehicles typically operated. This was a necessary component of the modeling process since not all of the vehicles operated the same percentage of time on alternative fuels, or the same number of days per week, and these

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two fleet characteristics are required model inputs. For these reasons, the survey responses were categorized into 9 groups shown in the previous pages.

Having obtained the necessary inputs and broken the survey responses into similar categories, the AirCRED model was utilized to estimate the emission reductions resulting from the San Antonio MSA AFV fleet. The resulting emission reductions from each of the 9 groups were summed to obtain an emission reduction estimate for the entire fleet.

For the projected 2007 fleet it was assumed that the current fleet sizes were maintained at the current level unless otherwise noted. In addition, any projected increases in fleet sizes for 2006, were assumed to carry over into 2007. There were 2,147 vehicles modeled in the Sept. 2007 analysis. This represents a 22 percent increase in the AFV fleet size from 2001. The 2007 results are very similar to the 2001 results. In fact, the expected reduction in CO emissions is the same for both fleets. This is primarily due to the fact that all of the 392 additional AF vehicles are fueled by propane. The increase in the expected NOx reductions is a result of the 117 additional heavy-duty propane vehicles. Again, the projected 2007 AFV fleet size makes up only a very small percentage of all of the on-road vehicles within the region. If the AFV fleet size were to increase significantly, sizeable emission reductions should result.

The survey results were utilized in this section to assess the effectiveness of both the current AFV fleet, and the projected AFV fleet for 2007, at reducing ozone precursor emissions. With the AFVs reporting a 0% usage rate of alternative fuels taken out, there were 1,755 vehicles modeled for the September 2001 fleet, and 2,147 vehicles modeled for the September 2007 fleet that use alternative fuel.

The analysis of the SA MSA 2001 AFV fleet indicates that operation of this fleet help to reduce emission of VOC by a 62 lbs/day and a 689 lbs/day reduction in NOx emissions. The projected 2007 AFV fleet for the SA MSA indicates a 72 lbs/day reduction in VOC emissions and an 858 lbs/day reduction in NOx emissions.

While these estimated reductions are not overly sizeable, they do illustrate that a switch to alternative fuel vehicles will result in the reduction of ozone precursors in addition to reducing our nation's dependence on foreign oil. As alternative fuel technology advances, refueling infrastructure expands, and the use of alternative fuels becomes more acceptable, the emissions reductions resulting from the utilization of an AFV fleet in the SA MSA should become more significant.

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Transportation Demand Management

Introduction

TDMs are transportation projects and related activities that are designed to achieve on-road mobile source emission reductions and are included as control measures in the SIP. These measures target the users (demand) of transportation facilities (supply) rather than the facilities.

Successful implementation of TDMs can contribute to the reduction in frequency of traffic congestion, and by smoothing the traffic flow they can particularly reduce emission of VOCs, which occur at lower traveling speed.

The following pages contain materials that AACOG staff has used for conducting a local survey on use of TDMs, and at the end the overall impacts of TDMs on reduction of ozone precursors are discussed.

Cover Letter & Alternative Work Schedule Survey Questionnaire

December x, 2001

Dear <<Name>>:

The Alamo Area Council of Governments (AACOG) requests your assistance in our air quality work. AACOG is currently examining the effectiveness of reducing air pollution by allowing alternate work schedules, and we'd like to include information about your organization in our study.

AACOG will calculate the effectiveness of such initiatives by using information gathered from the entire San Antonio area. The purpose of this survey is to provide better information and services to the region, as well as to help minimize additional regulations on the community.

Your input is vital to this process and will allow AACOG to estimate the reduction of air pollution based on recent changes in business practices within office personnel. Please provide your responses on the attached survey and return it to us in the self-addressed envelope by the date indicated.

Thank you for your time and participation. If you have any questions or comments please feel free to contact Chris Langston at (210) 362-5270.

Regionally yours,

Al J. Notzon III
Executive Director
Enclosures (2)

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AACOG
Alamo Area Council Of Governments

Alternative Work Schedule Survey

Organization:_____
Contact:_____
Contact Phone Number:_____

The purpose of this survey is to collect information on the use of alternative work schedules by office personnel in organizations in the San Antonio Metropolitan Statistical Area. The following lines inquire on alternate work programs your company may/may not participate in. Please respond by January 30, 2002.

Alternate Work Schedule Programs

1) Does your organization participate in any type of alternate work schedule program?

Yes ☐ No ☐

2) If so, identify the type of alternate work schedule program your organization participates in and how many employees are involved in such programs.

☐ Compressed Week - 9 work days for a two work weeks # of Employees _____

☐ Compressed Week – 4 work days for one work week # of Employees _____

☐ Staggered Hours – vary start and end time (ex. 9-6, 12-8) # of Employees _____

☐ Flex-Time # of Employees _____

☐ Telecommuting – performs work at home # of Employees _____

If so, estimate average number of days worked at home. _____

3) Does your organization plan to expand any current alternate work schedule plans in the future?

Yes ☐ No ☐

4) How many more employees do you anticipate to participate in the future and in which program?

_____
_____
_____

Thank you.

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2001 TDM Statistics on Survey Respondents

Table K-19. Current Employee Participation Per Program

Company	Cww9	Cww4	Staggered Hrs	Flex Time	Telecommuting
Big Red / 7-Up Bottling Co.	17.5		65		
City of Hill Country Village		10			
City of Leon Valley **	19		15		
Dean Word Co. Ltd.			90		
Goodwill Industries			5		
Health South RIOSA *	4				
Mission Road Development Center			72	5	2
Oberthur Gaming Tech.			12		
Randolph-Brooks Federal Credit Union			25		
San Antonio - Bexar County MPO			7		
San Antonio Express-News		25			12
San Antonio Federal Credit Union**	13				
Science Applications International Corp (SAIC)			25		6
State Bank & Trust of Seguin, Texas			10		
Town of Hollywood Park			1		
WellMed at Greenway Park	7		5		1
City of China Grove				2	
Marion ISD		25			
City of Castle Hills		2			
LeadingEdge Personnel			5		
VIA Metropolitan Transit Authority		48	1416	258	
John B. Sanfilippo & Son			285		
YMCA of San Antonio & the Hill Country			650		
Comal ISD (Summer Only)		800			
Northside ISD			9500		
Texas Department of Human Services	300	200	100		
Southwest Texas State University				7	7.5
Education Service Center, Region 20			75		
Harlandale ISD				20	
Southside ISD (Summer Only)		60			
Focus Direct, Inc.		32	52	7	
Wallace L. Boldt, General Construction, Inc.			20		
Southwest Mental Health Center				10	
Our Lady of the Lake University (Summer Only)		350			
VNA & Hospice			7.5		1
Sterling Metal Products			6		
Harlandale ISD (Maintenance Department)			200	200	
LaVernia ISD (Summer Only)		23	0	0	
Schertz-Cibolo-Universal City ISD		10	10		
Tobin International Ltd.	94	20		24	2
San Antonio Housing Authority		1	21	13	1

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Company	Cww9	Cww4	Staggered Hrs	Flex Time	Telecommuting
Valero Energy Corporation	1127				
Bexar County	42	42	210	210	42
San Antonio Missions National Historical Park		2	52		
37 SPTG, Lackland Air Force Base			4000	2500	
City of Alamo Heights				4.5	
Guadalupe Valley Hospital		10		2	6
Randolph Air Force Base	219	5		406	
Southwest Independent School District			829		
Audie L. Murphy Veterans Administration	117	50	885		1
San Antonio Police Department		225			
U.S.A.A.		6940			727
Dee Howard Aircraft Maintenance, L.P.			298		
San Antonio Independent School District		8	74		
U.S. Army Garrison, FSH, TX.	1250	275		600	
Standard Aero (San Antonio), Inc			476		
Zachry Construction Corporation		20		20	15
Morningside Ministries					3.5
Texas Department of Transportation		21		248	
311 Human Systems Wing-Brooks AFB, TX	1				
Total Employee Participation per Program	3210.5	9204.0	19503.5	4536.5	827.0
Total EmployeeParticipation	37281.5				
Total Companies not Participating in a Program	61				
Total Companies Participating in a Program	60				
*Compressed Work Week 12					
**Compressed Work Week 4 ½					

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Table K-20. Future Increase in Employee Participation Per Program

Company	Cww9	Cww4	Staggered Hrs.	Flex-Time	Telecommuting
Big Red / 7-Up Bottling Co.					
City of Hill Country Village					
City of Leon Valley					
Dean Word Co. Ltd.					
Goodwill Industries					
Health South RIOSA					
Mission Road Development Center			7		
Oberthur Gaming Tech.					
Randolph-Brooks Federal Credit Union					
San Antonio - Bexar County MPO			1		
San Antonio Express-News					
San Antonio Federal Credit Union					
Science Applications International Corp (SAIC)					
State Bank & Trust of Seguin, Texas					
Town of Hollywood Park					
WellMed at Greenway Park					
City of China Grove					
Marion ISD					
City of Castle Hills					
LeadingEdge Personnel			20		
VIA Metropolitan Transit Authority					
John B. Sanfilippo & Son					
YMCA of San Antonio & the Hill Country					
Comal ISD					
Northside ISD					
Texas Department of Human Services					35
Southwest Texas State University					
Education Service Center, Region 20					
Harlandale ISD					
Southside ISD					
Focus Direct, Inc.					
Wallace L. Boldt, General Construction, Inc.					
Southwest Mental Health Center				15	
Our Lady of the Lake University					
VNA & Hospice					
Sterling Metal Products					
Harlandale ISD (Maintenance Department)					
LaVernia ISD					
Schertz-Cibolo-Universal City ISD					
Tobin International Ltd.					
San Antonio Housing Authority					
Valero Energy Corporation					
Bexar County					
San Antonio Missions National Historical Park					

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37 SPTG, Lackland Air Force Base					
City of Alamo Heights					
Guadalupe Valley Hospital					
Randolph Air Force Base					
Southwest Independent School District					
Audie L. Murphy Veterans Administration					12
San Antonio Police Department					
U.S.A.A.					
Dee Howard Aircraft Maintenance, L.P.					
San Antonio Independent School District					
U.S. Army Garrison, FSH, TX.					
Standard Aero (San Antonio), Inc					
Zachry Construction Corporation					
Morningside Ministries					
311 Human Systems Wing – Brooks AFB, TX					
Texas Department of Transportation					
Total Future Employee Participation per Program	0	0	28	15	47
Total Future Employee Participation	90				
Total Future Company Participation	18				
Total Not Partipating in Future A.W.S.	42				
Companies will expand, gave no details	12				
Companies will expand, gave details	6				

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Table K-21. 1999 TDM Participation Rates and 2007 TDM Forecasted Participation in the San Antonio Metropolitan Area

Participation	1999 Total	2007 Total Participation
Summer		
All Programs	37,282	40,357
Flex Time	4,537	4,552
Compressed WW 4/40	9,204	9,680
Compressed WW 9/80	3,211	3,211
Staggered Hours	19,504	22,041
Telecommuting	827	874
Fall		
All Programs	38,514	41,590
Flex Time	4,537	4,552
Compressed WW 4/40	10,437	10,913
Compressed WW 9/80	3,211	3,211
Staggered Hours	19,504	22,041
Telecommuting	827	874
1999 & Anticipated 2007 VOC Emission Reduction Estimates (lbs/day)		
Category	All TDMs 1999	All TDMs 2007
Summer Peak Hour Reduction	470	386
Fall Peak Hour Reduction	430	388
1999 & Anticipated 2007 NOx Emission Reduction Estimates (lbs/day)		
Category	All TDMs 1999	All TDMs 2007
Summer Peak Hour Reduction	436	422
Fall Peak Hour Reduction	426	420

TDM Emission Reduction Methodologies

The transportation demand management (TDMs) discussed in this summary are programs implemented within the San Antonio metropolitan area to reduce vehicle miles traveled (VMT) and shift remaining traffic to off-peak hours. The data reflect the current TDM participation rates and future TDM commitments of companies in the San Antonio metropolitan area with employment population greater than 100 and government

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agencies. The TDMs used in this plan are broken down into several categories including: Rideshare, Telecommuting, Flex Time, Compressed Workweek, and Staggered Hours. All of these programs are voluntary and are offered at either the employer or employee level.

The first step in conducting the study involved an extensive survey, which was mailed out to 361 organizations in the AACOG region. 120 responses were received and the data from those surveys were tabulated for further analysis using the Commuter Model. The results were then entered into the Commuter Model, which calculated the emission and VMT reductions based on pertinent data such as: work trip length, vehicle occupancy, length of peak period, etc. Using the output from the Commuter Model and the anticipated TDM participation rates for 2007, the projected emission and VMT reductions were determined.

There was a significant difference in the participation rate for the September and July episodes, specifically, in level of participation in the Compressed Workweek 4/40 plan. Because of seasonal participation by educational institutions (teachers, administrators, maintenance and custodial employees, bus drivers, etc.), approximately 1200 employees who participate in the plan during the academic year do not participate during the summer season. Therefore based on the July rate of participation for the 4/40 plan, no increase in participation for this plan for the year 2007 is projected; whereas based on the September data, a 4.36% increase in the Compressed Workweek 4/40 plan is expected.

The survey conducted on TDM participation showed that Staggered Hours was the most widely used TDM in this region, followed by Compressed Workweeks, Flex Time, and Telecommuting. Overall, for the year 2007 projection, these TDMs are expected to reduce VOC's by 3.3% and NO_X by 2.4%, which are all produced by on-road sources during peak hours.

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Voluntary Air Quality Control Strategies

An integral part of air quality planning for the San Antonio EAC Region is the involvement of area leaders in business and industry, local school district officials, and other agencies in the adoption of voluntary measures. As part of the Clean Air Plan, AACOG compiled a special list of participating businesses and agencies within the area that have begun to adopt voluntary measures which will help clean the air. Responding companies and agencies categorized their actions as "Commitment Measures" or "Voluntary Measures" for incorporation into the plan.

> Commitment Measures - These commitments are provided to the Texas Commission on Environmental Quality (TCEQ) and the US Environmental Protection Agency (EPA) as part of the Clean Air Plan and the State Implementation Plan (SIP). The commitments are evidence of an ongoing commitment by local leaders in support of clean air policy.
>
> Voluntary Measures - These commitments will be done on a voluntary basis to minimize emissions to the best of a company's ability.

It is important to understand that the following commitments were obtained from the agencies, and authorized by signature. The authorization consent form signed contains the following specific language, followed by the signature block:

> Authorization - I authorize the Air Improvement Resources Committee to include our actions and commitments, as described and classified above (referring to the "Commitment" and "Voluntary" definitions above), in the Clean Air Plan that will be submitted to EPA and TCEQ. I understand that copies of our letters describing our commitment may be included in the Clean Air Plan.

A copy of one of the signed commitment letters (from the San Antonio Water System) is attached to the end of this appendix as an example of this process and the form mailed out to each agency.

The following pages contain strategy descriptions of companies, agencies, and school districts that have volunteered to practice these air-cleaning strategies.

Bexar County

Commitment Measures: Commitment letter signed by Renee D. Greene, P.E. – Director of Environmental Service, Bexar County, February 4, 2004

Converted eighty percent of its eligible fleet to propane.
Alternative fuels with low Reid Vapor Pressure (RVP) are purchased for gasoline powered vehicles.
Providing bus pass subsidies to all employees
A public outreach program has been developed and information is posted on the county's website.
On Air Quality Health Alert Days, the county suspends activities such as refueling, paving, mowing and painting. Air Quality Health Alert flags are flown at all county offices.
Low RVP gasoline is used in all Bexar County sheriff patrol vehicles. The County continues to replace fleet vehicles with low emission vehicles (LEV).
Texas Ultra Low Sulfur Diesel Fuel is used in Bexar County diesel fleet vehicles.

Voluntary Measures

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Encourage employees to use general energy conservation measures (i.e., turn off lights and equipment when they are not in use, at home and at work.
Maintain fleet vehicles and buses according to manufacturer's tune-up and emissions control standard.
Post signs at facilities promoting ozone reduction measures.
Commit to using cleaner burning fuel
Achieve code compliance in the International Energy Conservation Code (IECC).

City of Converse
Commitment Measures: Commitment letter signed by Sam Hughes – City Manager, City of Converse, March 16, 2004
Encourage employees to use general energy conservation measures (i.e., turn off lights and equipment to reduce power load when not in use, both at work and home).
Maintain fleet vehicles and buses according to manufacturer's tune-up and emissions standards.
Refuel fleet vehicles and buses carefully and in the cooler evening hours during an AQHA.
Instruct employees and fleet drivers to practice efficient driving such as avoiding excessive idling, minimizing cold starts by combining trips, avoiding jackrabbit acceleration, and driving 55 mph maximum.

Voluntary Measures
Give incentives to those employees who are participating in a carpool or vanpool.
Encourage employees to bring lunch to work or walk to avoid car travel during lunchtime.

City of Leon Valley
Commitment Measures: Commitment letter signed by the Honorable Marcy Meffert, Mayor of the City of Leon Valley, March 11, 2004
Encourage employees to use general energy conservation measures (i.e., turn off all lights and equipment to reduce power load, both at work and home).
Maintain all 55 fleet vehicles and buses according to manufacturer's tune-up and emissions control standards.
Refuel all fleet vehicles and buses during cooler evening hours during an AQHA.
Will limit the use of oil-based paints, varnishes and degreasers to days that are not AQHA days.
Instruct all employees and fleet drivers to practice efficient driving, such as avoiding excessive idling, minimizing cold starts by combining trips, avoiding jackrabbit acceleration and driving 55mph maximum.
Post signs at facilities promoting ozone reduction measures at 3 city-owned locations.
Achieve code compliance in the International Energy Conservation Code (IECC).

Voluntary Measures
Consider alternative fuels for vehicle fleets (10 or more vehicles per fleet).
Participate in voluntary vehicle emissions testing and maintenance programs.
Encourage approximately 30% of city employees to bring a lunch or walk to avoid car travel during lunchtime.
Commit to using cleaner burning fuel when financially feasible.

City of San Antonio (COSA)

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Commitment Measures: Commitment letter (subject to further City Council action) signed by David E. Newman – Environmental Services Manager, City of San Antonio, March 5, 2004
Allow flextime or telecommuting for approximately 3000 city employees.
Maintain fleet vehicles according to manufacturers tune-up and emission control standard. The City performs inspection/maintenance on approximately 3000 city fleet vehicles.
Consider alternative fuels for small vehicle fleets. Approximately 900 city fleet vehicles are currently alternative fuel vehicles.
Post signs at facilities promoting ozone reduction measures for 12,000 city employees.
Commit to using cleaner burning fuel.
Delay construction operations, such as pothole repair, street striping, and mowing activities, to days that are not Air Quality Health Alert days.
Stage II VRS are in place on gasoline dispenser pumps at four service centers and police/fire substations.
Use thermoplastics for highway markings
COSA's Landscape and Tree Preservation Ordinance attempts to preserve existing trees, encourage the planting of new trees, and encourage responsible development.
Prohibit use of approximately 20 motorpool vehicles on AQHA days.

Voluntary Strategies
Requested and obtained a lower RVP level for all gasoline shipped into the San Antonio metropolitan region for the ozone season of 1999.
Stage I Vapor Recovery Systems (VRS) are in place on UST's at all city fueling facilities.
The Purchasing Department implements a modified I/M program using a four-gas emission analyzer. All vehicles are tested by the I/M Program during the annual safety inspection.
To encourage employee bus ridership, the City has a bus pass subsidy program for its employees. The City offers approximately 1500 bus pass subsidies at $5 off.
Synchronization of stoplights by COSA.
Public Outreach Participation.
Sponsorship of Public Vehicles Emissions Testing & Media Events.
Creation of a COSA-wide Air Quality Health Alert Program.
Creation of Intelligent Transportation System (TransGuide).
Encourage approximately 12,000 employees to use general energy conservation measures (ie. Turn off lights and equipment to reduce power load when not in use, both at work and home).
Instruct employees and fleet drivers to practice efficient driving such as avoiding excessive idling, minimizing cold starts by combining trips, avoiding jackrabbit acceleration, and driving 55 mph maximum.
Successfully apply for emissions reductions grants available through theTexas Emission Reduction Program (TERP).
Expedited permitting for mixed use, transit oriented or in-fill development
Use low VOC striping material.
Open burning restrictions.
Renewable energy program.
Low emission vehicles.
Offer direct deposit to employees.
Fuel city-owned vehicles during the cooler, evening hours.
Promote limiting the idling of city-owned vehicles.

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Transit-Oriented Development.
Encourage approximately 12,000 employees to carpool by giving incentives for carpooling activities.
Encourage approximately 12,000 employees to bring a lunch or walk to avoid car travel during lunchtime.
Achieve code compliance in the International Energy Conservation Code (IECC).
Limit use of oil-based paints, varnishes, and degreasers in the city's sign shop during an AQHA.

City of Stockdale
Voluntary Measures: Letter signed by the Honorable Tony Malik, Mayor of the City of Stockdale, February 20, 2004
Encourage employees to use general energy conservation measures (i.e., turn off all lights and equipment to reduce power load, both at work and home).
Maintain fleet vehicles according to manufacturer's tune-up and emissions control standards.
Post signs at facilities promoting ozone reduction measures.
Refuel fleet vehicles carefully and in the cooler evening hours during an AQHA.
Will limit the use of oil-based paints, varnishes and degreasers to days that are not AQHA days.
Instruct employees to practice efficient driving, such as avoiding excessive idling, minimizing cold starts by combining trips, avoiding jackrabbit acceleration and driving 55mph maximum.

City Public Service (CPS)
Commitment Measures: Commitment letter signed by Joe Fulton – Director, Research and Environmental Management, City Public Service, March 19, 2004
Renewable Energy Program – Windtricity program launched in April 2000
Emission Reduction Program
CPS has reduced NOx at gas and coal units to 50% of 1997 levels and will "net out" of NOx emissions when the new coal unit is scheduled to come on line in 2009.
CPS' program includes combustion tuning and installation of advanced technology.
CPS has state and federal air permits for all gas and coal units.
New combined cycle gas turbine and simple cycle gas turbines have add-on NOx controls.
New coal unit will have BACT controls of NOx, sulfur dioxide and particulate matter.
An additional monitoring station will be operated on the southeast side of San Antonio monitoring NOx, SO2, CO, PM-10 and PM 2.5. This will be in addition to the current operating station. Also, four PM-10 monitors will be located on all four sides of the coal plant property.
Two compressed natural gas (CNG) trucks are operated and a CNG station is used to fuel the vehicles.
Fleet Vehicle Emission Reductions
CPS uses ethanol (E-85) in approximately 136 flex-fueled vehicles.
Two hybrid vehicles (Super Ultra Low Emission Vehicles) purchased
Two compressed natural gas (CNG) trucks used.
Night fueling service – approximately 300 fleet vehicles or equipment are fueled at night
Vehicles periodically checked with 2-gas analyzer and opacity meter.
Texas Emissions Reduction Program (TERP) grant successfully obtained for diesel engine bulldozer

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Purchase of five propane forklifts
Removal of older vehicles and equipment that have been replaced by vehicles and equipment that meet today's more stringent emissions standards.

Voluntary Measures
Give incentives to CPS employees that are interested and participating in a carpool.
Give incentives to CPS employees that are interested and use buses for their daily trip to work.
Encourage approximately 2500 CPS employees to bring a lunch or walk to avoid car travel during lunchtime via email notices.
All flextime or telecommuting for CPS employees for which this option is feasible and allowed by the management of that area.
Encourage approximately 2500 CPS employees to use general energy conservation measures (i.e., turn off lights and equipment when they are not in use, at home and at work.)
Maintain CPS fleet vehicles according to manufacturer's tune-up and emissions control standard.
Instruct approximately 2500 CPS employees and fleet drivers to practice efficient driving, such as, avoiding excessive idling, minimizing cold starts by combining trips, avoiding jackrabbit acceleration, driving 55 mph maximum.
Limit use of oil-based paints, varnishes, and degreasers during an AQHA.

Fort Sam Houston Independent School District
Commitment Measures: Commitment Letter signed by Gail E. Siller – Superintendent, Fort Sam Houston ISD, February 25, 2004
Instruct employees and fleet drivers to practice efficient driving such as avoiding excessive idling, minimizing cold starts by combining trips, avoiding jackrabbit acceleration and driving 55 mph maximum.
Encourage 225 district employees to use general energy conservation measures (i.e., turn off lights and equipment when they are not in use, at home and at work).
Maintain 10 district buses according to manufacturer's tune-up and emissions control standard.
Will not mow the lawn or use gas powered lawn equipment during an AQHA on the two district campuses.

Guadalupe County
Voluntary Measures: Letter signed by Stan Burrier – County Engineer, Guadalupe County, March 17, 2004
Employees are encouraged to participate in voluntary programs, such as carpooling whenever possible.
Encourage employees to bring a lunch of walk to avoid car travel during lunchtime.
Encourage employees to use general energy conservation measures (i.e., turn off lights and equipment when they are not in use, at home and at work).
Maintain fleet vehicles and buses according to manufacturer's tune-up and emissions control standard.
Instruct employees and fleet drivers to practice efficient driving, such a, avoiding excessive idling, minimizing cold starts by combining trips, avoiding jackrabbit acceleration, driving 55 mph maximum.

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Harlandale ISD
Commitment Measures: Commitment letter signed by Henry Galindo - Director of Transportation and Maintenance Support, Harlandale ISD, February 10, 2004
Uses nine alternative fuel buses and will continue to consider alternative fuels for all vehicle purchases.
Maintain 150 maintenance vehicles and 59 buses according to manufacturer's tune-up and emissions control standard.
Consider alternative fuels for vehicle fleets (10 or more vehicles per fleet).
Will not mow lawns or use gas powered lawn equipment during an AQHA at all 25 district facilities.
Will limit the use of oil-based paints, varnishes, and degreasers to days that are not designated as AQHA days at all 25 district facilities.
Instruct employees and fleet drivers to practice efficient driving, such as, avoiding excessive idling, minimizing cold starts by combining trips, avoiding jackrabbit acceleration, driving 55 mph maximum.

Voluntary Measures
Encourage all 2,100 employees to use general energy conservation measures (i.e., turn off lights and equipment when they are not in use to reduce power load, both at home and at work).

Lackland Independent School District
Commitment Measures: Commitment letter signed by David F. Splitek – Superintendent, Lackland ISD, February 9, 2004
Encourage employees to use general energy conservation measures (i.e., turn off lights and equipment to reduce power load when not in use, both at work and home).
Maintain fleet vehicles and buses according to manufacturer's tune-up and emissions control standard.
Will not use oil-based paints, varnishes or degreasers on days that are AQHA's.
Encourage employees to bring lunch to work or walk to lunch to avoid car travel during lunchtime.
Instruct employees and fleet drivers to practice efficient driving such as avoiding excessive idling, minimizing cold starts by combining trips, avoiding jackrabbit acceleration and driving 55 mph maximum.
Post signs at facilities promoting ozone reduction measures
Investigate the possibility in applying for emission reduction grants through the Texas Emissions Reductions Plan (TERP).
Will comply to a feasible extent the delay of construction operations (using gasoline or diesel equipment) to days that are not Air Quality Health Alert days.
During an AQHA, fleet vehicles and buses will be refueled in the cooler evening hours when possible.
Gas powered lawn equipment will not be used during an AQHA. Rather, grounds personnel will be assigned alternative tasks.

Voluntary Measures
Consider alternative fuels for vehicle fleets (10 or more vehicles per fleet).
Participate in voluntary vehicle emissions testing and maintenance programs.
Give incentives to those employees who are participating in a carpool
Give incentives to those employees who use buses for their daily trip to work
Check availability of fuel stations that dispense cleaner burning fuel.

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Will explore International Energy Conservation Code (IECC) compliance.

Our Lady of the Lake University
Voluntary Measures: Letter signed by Darrell Glasscock – Director of Physical Plant, Our Lady of the Lake University, February 13, 2004
Encourage employees to use general energy conservation measures (i.e., turn off lights and equipment to reduce power load when not in use, both at work and home).
Maintain fleet vehicles and buses according to manufacturer's tune-up and emissions standards.
Post signs at facilities promoting ozone reduction measures.
On Air Quality Health Alert Days, the University will not mow the lawn or use gas powered lawn equipment.

Randolph Air Force Base
Commitment Measures: Commitment letter signed by Colonel Mark W. Graper – USAF, Commander, 12th Flying Training Wing, February 25, 2004
Converted from higher volatility fuel (JP-4) to a more environmentally friendly JP-8 fuel.
Encourage RAFB populace of 17,000 to use general energy conservation measures (ie. Turn off lights and equipment to reduce power load when not in use, both at work and home).
Consider alternative fuels for vehicle fleets. Currently, over 60 vehicles have been converted to alternative fuel capability.
Post signs at facilities promoting ozone reduction measures.
Encourage RAFB populace of over 17,000 people to bring a lunch or walk to avoid car travel during lunchtime.
Maintain approximately 280 fleet vehicles and buses according to manufacturer's tune-up and emissions control standard.
Instruct the base populace of over 17,000 people to practice efficient driving, such as avoiding excessive idling, minimizing cold starts by combining trips, avoiding jackrabbit acceleration, driving 55 mph maximum.

Voluntary Measures
Elevated research on development of sources for fuel alternatives. Review new technologies to ensure that they comply and that law does not hinder the use of new technologies.
During AQHA days, refuel fleet vehicles and buses carefully and in cooler evening hours and on days that are not AQHA days.
On AQHA days, will not use oil-based paints, varnishes, or degreasers on days that are AQHA's.

San Antonio / Bexar County Metropolitan Planning Organization
Commitment Measures: Commitment letter signed by Jeanne Geiger – Deputy Director, San Antonio-Bexar County MPO, March 9, 2004
Provides funding for the Rideshare Program
Participating in an ongoing public outreach program that encourages commuters to consider alternatives to driving alone.
Allow employees to use flextme to encourage travel outside of the peak periods. Eight of eight employees use flex time.

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The MPO flies the AQHA flag on appropriate days to help create awareness of the AQ situation.

Voluntary Measures
Encourage employees to bring lunch or walk and/or carpool to lunch to reduce cold starts and emissions.
Encourage employees to use general energy conservation measures (i.e., turn off lights and equipment when they are not in use at home and at work.)
Instruct employees to practice efficient driving, such as avoiding excessive idling, minimizing cold starts by combining trips, avoiding jackrabbit acceleration, driving 55 mph maximum.

San Antonio Water System
Commitment Measures: Commitment letter signed by Eugene E. Habiger – President/Chief Executive Officer, San Antonio Water Systems, March 2, 2004
SAWS has an internal Air Quality Committee that meets as needed to update or address air quality issues that affect SAWS operations.
Once a year SAWS distributes information to 280,000 customers, encouraging them to practice emission reduction measures during the ozone season.
Encourage employees to use general energy conservation measures.
At SAWS, demand side management is practiced.
A lighting erplancement program to high efficiency T8 lighting with electronic ballasts is in place at the SAWS Service Centers and will be implemented at all other SAWS owned facilties.
An energy database is being created to determine pump efficiencies.
Building heating and cooling leaks will be determined using thermal imaging, as well as, preventative maintenance for pumps by setting thermal baselines.
Evaluating all existing HVAC systems.
Evaluating new roofing.
Central Heating & Cooling retrofits.
Maintain fleet vehicles according to manufacturer's tune-up and emissions control standards.
Considers alternative fuels for vehicle fleets.
Have 5 propane trucks and 5 propane forklifts.
Have 69 bi-fuel (unlead/propane) vehicles and 4 electric forklifts.
Working with AACOG, Ford, and CleanFuels on a LPG Fueling Station at the new Northwest Service Center.
Looking into testing hydrogen fuel cell powered vehicles.
Continue to post AQHA signs at SAWS facilities when an AQHA is issued.
Flags and signs will be posted at the following Water Recycling Centers: Dos Rios, Leon Creek, Salado Creek, and Medio Creek.
Flags and signs will be posted on the following Service Centers: Eastside, Mission Road, Northeast, Northwest, and Van Dyke.
Will institute contract language to preclude mowing lawns or using gas-powered lawn equipment during an AQHA.
Encourage employees to bring lunch to work to avoid car travel during lunchtime.
Instruct employees and fleet drivers to practice efficient driving, such as avoiding excessive idling, minimizing cold starts by combining trips, avoiding jackrabbit acceleration.
Stage I and II Vapor Recovery Systems at fleet fuel sites. Fleet fuel sites:

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Dos Rios
Eastside Service Center
Northeast Service Center
Northwest Service Center
Mission Road
Van Dyken
SAWS is currently complying with SECO reporting requirements in achieving code compliance in the International Energy Conservation Code (IECC).
Once a year, SAWS distributes information to approximately 340,000 accounts about encouraging them to practice emission reduction measures during the ozone season.

Voluntary Measures
Allows flextime, compressed workweek, and / or telecommuting for employees.
To encourage bus ridership, SAWS has a bus pass subsidy program for its employees.
Consider posting signs and flags at SAWS facilities promoting ozone reduction measures.
The Kelly Service Center is considering posting a flag and sign.
The following Heating & Cooling Facilities are considering posting flags and signs: Central, Alamodome, Brooks, and Kelly.
Commit to using cleaner burning fuel.
Successfully apply for emissions reductions grants available through the TeXas Emissions Reductions Plan (TERP).
Refuel fleet vehicles in the cooler evening hours during an AQHA.
Limit use of oil-based paints, varnishes, and degreasers during an AQHA in parts-washers procedures.

Seguin Independent School District
Commitment Measures: Commitment document signed by Rene Ramos, Chief Operations Officer, Seguin ISD, February 13, 2004
The district does not use oil-based paints.
A district-wide energy conservation program has been implemented. Energy conservation measures are included in district procedure manual.
Maintain fleet vehicles (26) and buses (54) according to manufacturer's tune-up and emissions control standards.
Encourage employees (1,068) to use general energy conservation measures (i.e., turn off lights and equipment to reduce power load when not in use, both at work and home).
Post signs at facilities promoting ozone reduction measures.
Do not mow lawns or use gas-powered lawn equipment during an AQHA. Grounds personnel will be given alternative duties.
Refuel district's 26 maintenance vehicles and 54 buses during cooler evening hours during an AQHA.
Limit use of oil-based paints, varnishes and degreasers to days that are not designated AQHA days. Painters will be instructed on measures during an AQHA.
Instruct employees and fleet drivers to practice efficient driving, such as avoiding excessive idling, minimizing cold starts by combining trips, avoiding jackrabbit acceleration, driving 55 mph maximum during employee training sessions.
Post signs at facilities promoting ozone reduction measures in a district-wide email forum.

Voluntary Measures

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Encourage employees to bring lunch to work or walk to lunch to avoid car travel during lunchtime by providing a break area and opportunities to by lunch in office.

South San Antonio ISD

Commitment Measures: Commitment letter signed by Ruben G. Flores – Administrator, South San Antonio ISD, February 26, 2004

Encourage employees to use general energy conservation measures (i.e., turn off lights and equipment to reduce power load when not in use, both at home and work) during staff/faculty meetings.

Maintain fleet vehicles and buses according to manufacturer's tune-up and emission control standard.

Participate in voluntary vehicle emissions testing and maintenance programs.

Refuel fleet vehicles and buses carefully and in the cooler evening hours during an AQHA.

All maintenance personnel will be informed about limiting use of oil-based paints, varnishes, and degreasers to days that are not AQHA days.

Encourage employees to bring lunch or walk to avoid car travel during lunchtime.

Instruct employees and fleet drivers to practice efficient driving such as avoiding excessive idling, minimizing cold starts by combining trips, avoiding jackrabbit acceleration and driving 55mph, maximum.

Post signs at facilities promoting ozone reduction measures at district schools and administrative offices.

All maintenance personnel will be informed to not mow lawns or use gas powered lawn equipment during an AQHA.

Voluntary Measures

South San Antonio ISD will research and evaluate the consideration of alternative fuels for district vehicle fleet.

Texas Department of Transportation (TxDOT)

Commitment Measures: Commitment letter signed by Ken Zigrang – District Planner, TxDOT, March 19, 2004

TxDOT allows VIA to operate and maintain 4 VIA Park and Ride public parking facilities for the public to access VIA buses on state highway right-of way through Multiple Use Agreements.

TxDOT maintains 25 carpool public parking facilites in San Antonio and the surrounding area counties on state highway right-of-way for citizens to use for carpooling.

TxDOT allows the City of San Antonio to operate and maintain 16 general public parking areas on state highway right-of-way through Multiple Use Agreements.

Courtesy Patrol Crews assist stranded motorists on Bexar County freeways 24 hours per day thus heloing minimize obstructions and traffic congestion.

For highway maintenance in Bexar County, postpone highway mowing on the right-of-way until after 12:00 noon on Air Quality Health Alert (AQHA) days.

For highway construction and maintenance, postpone of delay highway work activities that require lane closures and would result in significant traffic congestion.

Propane fueling facilities were installed at all 16 maintenance offices in San Antonio District in FY 2002.

Use of TransGuide changeable message signs to inform motorists of vehicle accidents ahead, estimated travel times, lanes closed, detours etc. and thereby help reduce

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congestion and minimize the time required to open lanes after accidents and other highway incidents.
Maintain state vehicles according to manufacturer's tune-up and emissions control standards.
Continue to purchase alternative fueled sedans and pick-ups for the state fleet.
TxDOT has in place several strategies to allow flexibility on Air Quality Health Alert Days. These include but are not limited to:
Notifying all employees of pending Air Quality Health Alert Days by electronic mail the day before; allowing employees to better plan their travel.
Refueling of TxDOT vehicles is restricted until the cooler evening hours.
TransGuide messages to travelers to limit driving due to ozone levels.
Postpone lawn mowing or use of gas powered lawn equipment at office grounds and for landscape maintenance contracts on AQHA days.
In highway construction, contractors may not close any lanes during rush hours.
Use alternative fuels in state vehicles.
Agency diesel vehicles are fueled with Tx-LED

Voluntary Measures
Utilizing flextime by employees, staggering staff arrival to avoid rush hour during the ozone season.
During AQHAs, ask outlying offices to restrict travel to the main complex.
Use of propane fuel in state vehicles in strongly encouraged.
Encourage employees to use energy conservation measures (ie., turn off vehicle engines when not in use at home and at work).
Instruct employees to practice efficient driving practices such as avoiding excessive idling, minimizing cold starts by combining trips, and avoiding jackrabbit acceleration.
Ask outlying offices to postpone or minimize travel to the district headquarters complex.

UT Health Science Center at San Antonio
Commitment Measures: Commitment letter signed by Michael A. Charlton, Ph.D. – Director of Environmental Health and Safety, UTHSCSA, February 27, 2004
An on-site vehicle preventive maintenance program to reduce fleet vehicle emissions.
The University has a lighting retrofit project in place, which will decrease energy consumption.
Maintain fleet vehicles and buses according to manufacturer's tune-up and emissions control standard on all UTHSCSA vehicles.
All grounds keeping staff will not mow lawns or use gas-powered lawn equipment during an AQHA.
Refuel vehicles and buses carefully and in the cooler evening hours during an AQHA.
All Paint Shop employees will limit use of oil-based paints, varnishes, and degreasers to days that are not an AQHA.
Have reduced the number of University Police vehicles and have officers on bike patrol.

Voluntary Measures
Participate in voluntary vehicle emissions testing and maintenance programs.
Allow flextime, compressed workweek, and/or telecommuting to employees. The University has policies in place for flextime and telecommuting, with a 20 % employee participation rate.
Encourage employees to use general energy conservation measures (i.e., turn off lights and equipment to reduce power load when not in use, both at home and work).

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Instruct employees and fleet drivers to practice efficient driving, such as avoiding successive idling, minimizing cold starts by combining trips, avoiding jackrabbit acceleration, driving 55 mph.
Consider alternative fuels for vehicle fleets (10 or more vehicles per fleet).
Encourage employees to bring lunch to work or walk to avoid car travel during lunchtime.

Further Ozone Reduction Measures
UTHSCSA has entered into a contract to upgrade boiler controls and reduce emissions from the main campus central energy plant. Upgrades will be done by July 31, 2005 and include emissions controls, burner management system, combustion controls, and emissions testing and verification. NOx emissions will be reduced by greater than 75%; CO will be reduced by 25%.

Valero Energy Corporation
Voluntary Measures: Letter signed by Julie Klumpyan, Government Affairs, Valero Energy Corporation, March 12, 2004
Valero provided lower RVP gasoline during the ozone season of 1998.
All area refineries voluntarily provided lower RVP (7.8) during ozone season of 1999.
Valero Energy Corporation has provided fuel with a lower average sulfur level (150 ppm or less) in their gasoline over the past three years.
Valero now produces Texas Low Emission Diesel.
Valero's Three River's Refinery averaged 80 ppm sulfur in 2003.
Encourage employees to bring a lunch or walk to avoid car travel during lunchtime.
Valero Energy Corporation has a company cafeteria which reduces car travel during lunch.

VIA Metropolitan Transit
Commitment Measures: Commitment letter signed by Priscilla Ingle – Vice President Public Affairs, VIA Metropolitan Transit, February 26, 2004
Diesel Fleet Emissions Reductions
Voluntarily retrofitted all pre 19998 EPA emissions certified, Heavy-Duty (HD), diesel powered buses with exhaust catalysts (catalytic converters).
Since 1999, 345 early model, HD diesel buses have been replaced with late model propane and clean burning, diesel engine HD buses for a minimum 67% reduction in NOx emissions.
61 HD buses better CFFV ULEV emissions standards.
Streetcars:
5-each, diesel powered streetcars replaced with LPG (CFFV LEV) streetcars for a 71% reduction in NOx emissions on a per vehicle basis.
4-each, diesel powered streetcars repowered with LPG (CFFV LEV) engines for a 56% reduction in NOx emissions on a per vehicle basis.
Bus Garage Improvements
Currently expanding LPG fuel dispensing capacity
Replacing solvent based parts cleaners with water/steam type cleaners
On-Street Improvements
Bike racks on all HD buses
Instruct employees and fleet drivers to practice efficient driving, such as, avoiding excessive idling, minimizing cold starts by combining trips, avoiding jackrabbit acceleration, driving 55 mph maximum. These practices are taught and monitored.
Electricity Consumption

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Committed to include International Energy Conservation Codes on new construction projects.

Voluntary Measures
Propane (LPG) Fleet Emissions Reductions
Operates alternatively fueled (LPG) vehicles
92-each, dedicated and bi-fuel, transit patrol cars and support vehicles
105-each, dedicated LPG, paratransit vehicles
67-each, dedicated LPG, 30-ft passenger buses certified to CFFV LEV standards
9-each, dedicated LPG, streetcars. Certified to CFFV LEV standards
A TERP grant application is being prepared to repower/retrofit 67 each CFFV LEV propane engines to achieve a 28% reduction in NOx emissions on a per vehicle basis, bettering CFFV ULEV standards.
Preparations are underway to replace the current paratransit fleet vehicles with new vehicles that are expected to better CFFV ULEV standards and provide a minimum, 70% reduction in NOx emissions on a per vehicle basis.
Supports efforts to expand the use of propane as an automotive fuel
Provides propane related technical support to other fleets
Actively participates in propane engine and motor fuel R&D
Diesel Fleet Emissions Reductions
281 HD buses operate on Diesel #1 versus Diesel #2 for reduced levels of NOx and PM emissions.
61 HD buses operated on Texas Low Emissions Diesel (ULSD).
Preliminary grant approval has been received to retrofit 217 diesel powered HD buses with EGR and PM filters. One retrofitted the NOx emissions, on a per vehicle basis, will be reduced at least 40% and will better CFFV ULEV standards.
Preliminary grant approval has been received to fund the pull-ahead use of Texas Low Emission Diesel in all pre-2004 emissions certified HD diesel buses for a 7% reduction in NOx.
Scheduled to replace, within 2 years, 1998 and 1992 year model HD buses to achieve a 77% and 50% (respectively) reductions in NOx emissions on a per vehicle basis.
Within 2-years, following the approval and implementation of retrofit and replacement programs, all diesel operated HD buses are expected to operate at emissions levels that are better CFFV ULEV standards. This reduction will provide an overall 46% reduction in diesel fleet NOx emission compared to current (early 2004) levles and a 77% reduction in HD diesel fleet NOx emissions since 1999.
Bus Garage Improvements
Recovers paint solvents
Planned CARB compliant booth replacement
61-buses equipped with dry-break fuel nozzles
On-Street Improvements
Tree planting at bus stops program
Employee Incentives
Provides fee fares to employee bus riders
Allows flextime reducing utility peaks
Provides reserved parking spaces for employees who carpool
Education and Cooperation:
Business

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Operates a business pass program (over 100 companies currently provide bus passes to their employees on site, at cost or reduced price).
Public
Provides advertising to encourage transit ridership
Encourages employers to provide discounts as incentives to transit riders
Sponsors a yearly Environmental Symposium (3 years)
Educates students about transit (Classroom on Wheels Project)
Promotes AACOG's Guaranteed Ride Home Program
Electricity Consumption
Since 2001, VIA has reduced electricity consumption by 8%
VIA continues its efforts to reduce electricity consumption
Lighting retrofits
Employee awareness
Garage facility retrofits
VIA is an active member of the Metropolitan Partnership for Energy working to increase energy efficiency and reduce pollution in the San Antonio area.
Encourage employees to bring a lunch or walk to avoid car travel during lunchtime.
Maintain fleet vehicles and buses according to manufacturer's tune-up and emissions control standard.
Signs are posted throughout the VIA facility that promote ozone reduction measures.
Ninety percent of all vehicles are refueled after 8:00 p.m. during an AQHA.
Will not mow the lawn or use gas powered lawn equipment during an AQHA as much as possible.
Will limit the use of oil-based paints, varnishes, and degreasers during an AQHA as much as possible.

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Transportation Emission Reduction Measures
Fiscal Years 2002-2003

Introduction
Transportation Emission Reduction Measures (TERMs) are strategies or actions that can be employed to offset increases in nitrogen oxide (NOx) and volatile organic compound emissions from mobile sources. All TERMs are intended to reduce either the number of vehicle trips, vehicle miles traveled, or both. These strategies may include ridesharing and telecommuting programs, clean fuel vehicle programs, which were all described in previous sections, and improved transit/ bicycling facilities, or other possible actions such as intersection improvement and signalization.

Many of the transit and highway projects included in the MPO's Transportation Improvement Programs (TIP) provided in the following pages qualify as a TERM project, as they target vehicle trip reduction and, ultimately, improvement in the air quality.

- It is important to note that TERMS can be quantified as creditable reductions. While the quantity of reductions have not been calculated and included in the attainment demonstration of the San Antonio proposed revisions to the State Implementation Plan, local air quality planners are now researching measures to make the TERMS enforceable. The region is intent on making them enforceable and calculating credit for them in coordination with the state and the local San Antonio / Bexar County Metropolitan Planning Organization. Even if credit is not taken here for the TERMS projects in the region, the benefits of the reductions accrue as Additional Evidence that the San Antonio region will reach attainment.

San Antonio-Bexar Metropolitan Area Transportation Improvement Program (TIP)
Completed FY 2002 Roadway Projects

CSJ Number: 17 2 63 Federal Cost: $22,744
Project ID: 3286 State Cost: $2,527
County: Bexar Local Cost: $0
Roadway Name: IH 35 Project Cost: $25,272
Limit From: 0.17 Miles E of Benton City Road Let Date: 8/02
Limit To: IH 410 Funding Category: 4A STP Safety
Project Description: Texturize shoulders (milled) Completion Date: 2/02

CSJ Number: 17 3 53 Federal Cost: $64,735
Project ID: 3287 State Cost: $7,192
County: Bexar Local Cost: $0
Roadway Name: IH 35 Project Cost: $71,928
Limit From: Atascosa County Line Let Date: 08/02
Limit To: 0.17 Miles E of Benton City Road Funding Category: 4A STP Safety
Project Description: Texturize shoulders (milled) Completion Date: 12/02

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CSJ Number: 17 10 205 Federal Cost: $32,000
Project ID: 3110 State Cost: $8,000
County: Bexar Local Cost: $0
Roadway Name: I H 35 Project Cost: $40,000
Limit From: SB Mainlanes Let Date: 11/01
Limit To: At Coliseum Rd. Funding Category: 6A BRDG-ON SYS
Project Description: Rehabilitate bridges & approaches Completion Date: 10/02

CSJ Number: 17 10 213 Federal Cost: $1,400,850
Project ID: 3174 State Cost: $155,500
County: Bexar Local Cost: $0
Roadway Name: I H 35 Project Cost: $1,556,500
Limit From: Fratt Interchange Let Date: 05/02
Limit To: Funding Category: 2 IM
Project Description: Asphaltic overlay Completion Date: 11/02

CSJ Number: 17 10 215 Federal Cost: $247,592
Project ID: 3284 State Cost: $61,898
County: Bexar Local Cost: $0
Roadway Name: IH 35 Project Cost: $309,490
Limit From: At Coliseum & Walters Let Date: 11/01
Limit To : Funding Category: 2 IM
Project Description: Landscape development & right turn lanes Completion Date: 10/02

CSJ Number: 25 2 161 Federal Cost: $1,800,000
Project ID: 3264 State Cost: $200,000
County: Bexar Local Cost: $0
Roadway Name: IH 10 Project Cost: $2,000,000
Limit From: On IH 10 at Houston Let Date: 11/01
Limit To: Funding Category: 2 IM
Project Description: Restore existing SB frontage road Completion Date: 10/02

CSJ Number: 25 2 162 Federal Cost: $98,820
Project ID: 3288 State Cost: $10,980
County: Bexar Local Cost: $0
Roadway Name: IH 10 Project Cost: $109,800
Limit From: IH 410 Let Date: 08/02
Limit To: Guadalupe County Line Funding Category: 4A STP Safety
Project Description: Texturize shoulders (milled) Completion Date: 12/02

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CSJ Number: 25 2 163 Federal Cost: $1,440,000
Project ID: 3330 State Cost: $160,000
County: Bexar Local Cost: $0
Roadway Name: IH 10 Project Cost: $1,600,000
Limit From: at Loop 1604 Let Date: 08/02
Limit To: Funding Category: 2 IM
Project Description: Reconfiguring Intersection Completion Date: 02/04

CSJ Number: 72 12 159 Federal Cost: $66,061,360
Project ID: 703 State Cost: $16,515,340
County: Bexar Local Cost: $0
Roadway Name: IH 10 Project Cost: $82,576,700
Limit From: 0.2 Mi S of Callaghan Rd. Let Date: 07/02
Limit To: 0.2 Mi S of Crossroads Blvd. Funding Category: 3A NHS Mobility
Project Description: Reconstruct Interchange & TMS Completion Date: 02/08
(Phase 2) IH 10/IH 410 (Phase 2)

CSJ Number: 521 4 242 Federal Cost: $768,000
Project ID: 3283 State Cost: $192,000
County: Bexar Local Cost: $0
Roadway Name: IH 410 Project Cost: $960,000
Limit From: At SH 151 Let Date: 06/02
Limit To: Funding Category: 3E NHS Misc
Project Description: Construct turnarounds at IH 410 & SH 151 Completion Date:
08/04

CSJ Number :521 5 120 Federal Cost: $59,374
Project ID: 3289 State Cost: $6,597
County: Bexar Local Cost: $0
Roadway Name: IH 410 Project Cost: $65,972
Limit From: US 281 Let Date: 08/02
Limit To: IH 35 Funding Category: 4A STP Safety
Project Description: Texturize shoulders (milled) Completion Date: 12/02

CSJ Number: 521 5 121 Federal Cost: $46,331
Project ID: 3331 State Cost: $5,147
County: Bexar Local Cost: $0
Roadway Name: IH 410 Project Cost: $51,479
Limit From: IH 35 Let Date: 08/02
Limit To: US 90 Funding Category: 4A STP Safety
Project Description: Texturize Shoulders (Milled) Completion Date: 12/02

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CSJ Number: 521 6 90 Federal Cost: $88,964
Project ID: 3290 State Cost: $9,884
County: Bexar Local Cost: $0
Roadway Name: IH 410 Project Cost: $98,849
Limit From: IH 10 Let Date: 08/02
Limit To: US 281 Funding Category: 4A STP Safety
Project Description: Texturize shoulders (milled) Completion Date: 12/02

CSJ Number: 849 1 42 Federal Cost: $0
Project ID: 3350 State Cost: $85,000
County: Bexar Local Cost: $0
Roadway Name: FM 471 Project Cost: $85, 000
Limit From: 130' East of Bexar County Line Let Date: 08/02
Limit To: Bexar/Medina County Line Funding Category: 7 Prev. Maint.
Project Description: Drainage Improvement Completion Date: 12/02

CSJ Number: 915 0 79 Federal Cost: $900,000
Project ID: 3245 State Cost: $100,000
County: Bexar Local Cost: $0
Roadway Name: Districtwide Project Cost: $1,000,000
Limit From: Various locations Let Date: 01/02
Limit To: Funding Category: 2 IM
Project Description: Small sign safety upgrade (FY2002) Completion Date: 10/02
- Cat 2

CSJ Number: 915 12 228 Federal Cost: $2,029,689
Project ID: 18.1 State Cost: $0
County: Bexar Local Cost: $507,422
Roadway Name: Pleasanton Project Cost: $2,537,111
Limit From: Southcross Let Date: 12/01
Limit To: Mayfield Funding Category: 4C STP MM
Project Description: Rehabilitate & widen narrow Completion Date: 10/03
pavement for center left turn lane, provide
sidewalksand intersection improvements at
Southcross
CSJ Number :915 12 263 Federal Cost: $164,800
Project ID: 2032 State Cost: $0
County: Bexar Local Cost: $41,200
Roadway Name: Alamo Area Commute Solutions Prog. Project Cost:
$206,000
Limit From: In San Antonio-Bexar Co. Area Let Date: 08/02
Limit To: Funding Category: 4C STP MM

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Project Description: Operational costs for air quality program, Completion Date: 07/03
Ridematching and carpool services

CSJ Number: 915 12 276 Federal Cost: $4,160,000
Project ID: 2050 State Cost: $0
County: Bexar Local Cost: $1,040,000
Roadway Name: Hunt Lane Project Cost: $5,200,000
Limit From: Marbach Let Date: 03/02
Limit To: US 90 Funding Category: 4C STP MM
Project Description: Reconstruct & widen for CLTL between Completion Date: 02/04
Demya & US 90 w/, sidewalks, & intersection improvements at Marbach and Adams Hill

CSJ Number: 915 12 297 Federal Cost: $1,200,800
Project ID: 2072 State Cost: $0
County: Bexar Local Cost: $300,200
Roadway Name: New World Project Cost: $1,501,000
Limit From: Crestway Let Date: 06/02
Limit To: Montgomery Funding Category: 4C STP MM
Project Description: Rehabilitate and widen narrow pavement Completion Date: 03/04
w/curbs & sidewalks

CSJ Number: 915 12 298 Federal Cost: $1,338,800
Project ID: 2073 State Cost: $0
County: Bexar Local Cost: $334,700
Roadway Name: New World Project Cost: $1,673,500
Limit From: Montgomery Dr Let Date: 06/02
Limit To: Walzem Rd (FM 1976) Funding Category: 4C STP MM
Project Description: Rehabilitate and widen narrow pavement Completion Date: 03/04
w/curbs & sidewalks

CSJ Number: 915 12 308 Federal Cost: $149,940
Project ID: 2075 State Cost: $0
County: Bexar Local Cost: $37,485
Roadway Name: Rideshare/ Air Quality Prog., FY 2001 Project Cost: $187,425
Limit From: In San Antonio-Bexar Co. Area Let Date: 10/01
Limit To: Funding Category: 4C STP MM
Project Description: Operational costs for air quality program Completion Date: 07/02

US EPA ARCHIVE DOCUMENT

Ridematching and carpool services

CSJ Number; 915 12 309 Federal Cost: $0
Project ID: 3116 State Cost: $1,800,000
County: Bexar Local Cost: $0
Roadway Name: Park Road Project Cost: $1,800,000
Limit From: In Government Canyon State Park Let Date: 09/01
Limit To: Funding Category: 9 Park
Project Description: Construct a two lane State Park Roadway Completion Date: 03/03

CSJ Number: 915 12 340 Federal Cost: $224,880
Project ID: 3035 State Cost: $0
County: Bexar Local Cost: $56,200
Roadway Name: City Wide ADA Sidewalk Program (Pha Project Cost: $281,100
Limit From: City Wide Let Date: 01/02
Limit To: Funding Category: 4C STP MM
Project Description: Reconstruct and/or provide ADA accessible sidewalks Completion Date: 09/03

CSJ Number: 915 12 350 Federal Cost: $233,860
Project ID: 3131 State Cost: $0
County: Bexar Local Cost: $58,465
Roadway Name: Alamo Project Cost: $292,326
Limit From: Cedar Let Date: 01/02
Limit To: San Antonio River Funding Category: 4C STP MM
Project Description: Construct sidewalks Completion Date: 09/03

CSJ Number: 915 12 395 Federal Cost: $2,588,197
Project ID: 3291 State Cost: $0
County: Bexar Local Cost: $810,771
Roadway Name: Mission Trails (Espada to the Alamo) Project Cost: $3,398,968
Limit From: Phase 3A - E Southcross to Mitchell Let Date: 06/02
Limit To: Funding Category: 4B STP Enhance
Project Description: Enhance roadways, trails, and markers that lead to the Missions Completion Date: 12/03

CSJ Number: 915 12 396 Federal Cost: $162,000
Project ID: 3310 State Cost: $18,000

US EPA ARCHIVE DOCUMENT

County: Bexar Local Cost: $0
Roadway Name: Donop Road Project Cost: $180,000
Limit From: At UPRR Let Date: 01/02
Limit To: Funding Category: 4A STP Safety
Project Description: Install railroad warning lights and gates Completion Date: 12/04

CSJ Number: 915 12 397 Federal Cost: $144,000
Project ID: 3309 State Cost: $16,000
County: Bexar Local Cost: $0
Roadway Name: South Graf Road Project Cost: $160,000
Limit From: At UPRR Let Date: 01/02
Limit To: Funding Category: 4A STP Safety
Project Description: Install railroad warning lights and gates Completion Date: 12/04

CSJ Number: 1548 2 5 Federal Cost: $0
Project ID: 3271 State Cost: $260,100
County: Bexar Local Cost: $0
Roadway Name: FM 1303 Project Cost: $260,100
Limit From: Loop 1604 Let Date: 09/01
Limit To: Wilson County Line Funding Category: 14 State Rehab
Project Description: Widen Pavement, Seal Coat & ACP Overlay Completion Date: 02/03

CSJ Number: 3212 6 12 Federal Cost: $624,000
Project ID: 3040 State Cost: $156,000
County: Bexar Local Cost: $0
Roadway Name: Ralph Fair Rd. (FM 3351) Project Cost: $780,000
Limit From: @Fawn Mountain, Pimlico, Dietz-Elkhorn Let Date: 10/01
Limit To: and Fair Oaks Parkway Funding Category: 4C STP MM
Project Description: Widen pavement for left turn lanes Completion Date: 10/02

CSJ Number: 3508 1 18 Federal Cost: $13,632,000
Project ID: 3232 State Cost: $3,408,000
County: Bexar Local Cost: $0
Roadway Name: SH 151 Project Cost: $17,040,000
Limit From: 0.22 Miles West of Callaghan Rd. Let Date: 01/02
Limit To: 0.3 Miles East of IH 410 Funding Category: 4C(S) STP MM (S)
Project Description: Expand to 4 lane freeway with frontage roads Completion Date: 06/04

US EPA ARCHIVE DOCUMENT

CSJ Number: 3508 1 19 Federal Cost: $17,630,400
Project ID: 3233 State Cost: $4,407,600
County: Bexar Local Cost: $0
Roadway Name: SH 151 Project Cost: $22,038,000
Limit From: 0.3 Miles East of IH 410 Let Date: 06/02
Limit To: 1.00 Miles East of Loop 1604 Funding Category: 4C(S) STP MM (S)
Project Description: Expand to 4 lane freeway with rehabilitation on frontage roads Completion Date: 08/04

San Antonio-Bexar Metropolitan Area TIP
Completed FY 2002 Transit Projects

CSJ Number: N/A Federal Cost: $307,218
Project ID: 3090 State Cost: N/A
County: Bexar Local Cost: $76,804
Project Name: Revenue Vehicles Total Cost: $384,022
Project Description: Purchase Replacement Low Floor Buses Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $123,600
Project ID: 3094 State Cost: N/A
County: Bexar Local Cost: $30,900
Project Name: Revenue Vehicles Total Cost: $154,500
Project Description: Purchase Paratransit Vans Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $37,808
Project ID: 3195 State Cost: N/A
County: Bexar Local Cost: $9,452
Project Name: Preventative Maintenance Total Cost: $47,260
Project Description: Preventative Maintenance Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $90,000
Project ID: 3097 State Cost: N/A
County: Bexar Local Cost: $22,500
Project Name: Service Vehicles - Sedans Total Cost: $112,500
Project Description: Purchase Replacement Sedans Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $56,543

US EPA ARCHIVE DOCUMENT

Project ID: 3161 State Cost: N/A
County: Bexar Local Cost: $14,136
Project Name: Service Vehicles - Trucks Total Cost: $70,679
Project Description: Purchase Service Trucks Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $1,662,046
Project ID: 3162 State Cost: N/A
County: Bexar Local Cost: $415,511
Project Name: Headquarters Rehabilitation Total Cost: $2,077,557
Project Description: PE, Final Design, Construction,
Construction Management Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $202,022
Project ID: 3022.2 State Cost: N/A
County: Bexar Local Cost: $50,506

Project Name: Passenger Facilities - Kel-Lac P&R Total Cost: $252,528
Project Description: PE, Final Design, Land Acq (if needed)
Construction, Construction Management Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $4,816
Project ID: 3171.2 State Cost: N/A
County: Bexar Local Cost: $1,204
Project Name: Passenger Facilities - US 281/Loop 1604 Total Cost:
$6,020
Project Description: PE, Final Design, Land Acq (if needed)
Construction, Construction Management Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $4,816
Project ID: 3171.2 State Cost: N/A
County: Bexar Local Cost: $1,204
Project Name: Passenger Facilities - US 281/Loop 1604 Total Cost: $6,020
Project Description: PE, Final Design, Land Acq (if needed)
Construction, Construction Management Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $418,471
Project ID: 3196 State Cost: N/A
County: Bexar Local Cost: $104,618

US EPA ARCHIVE DOCUMENT

Project Name: Passenger Facilities - Rehab P&R Total Cost: $523,089
Project Description: PE, Final Design, Land Acq (if needed)
Construction, Construction Management Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $136,609
Project ID: 3197 State Cost: N/A
County: Bexar Local Cost: $34,152
Project Name: Passenger Facilities - Bus Shelters &
Benches Total Cost: $170,761
Project Description: PE, Final Design, Land Acq (if needed)
Construction, Construction Management Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $727,078
Project ID: 3113 State Cost: N/A
County: Bexar Local Cost: $181,770
Project Name: Equipment Total Cost: $908,848

Project Description: MIS Hardware Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $679,131
Project ID: 3158 State Cost: N/A
County: Bexar Local Cost: $169,783
Project Name: Equipment Total Cost: $848,914
Project Description: MIS Software Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $160,209
Project ID: 3073 State Cost: N/A
County: Bexar Local Cost: $40,052
Project Name: Equipment Total Cost: $200,261
Project Description: Miscellaneous Equipment Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $397,004
Project ID: 3170.1, 3170.2 State Cost: N/A
County: Bexar Local Cost: $99,251
Project Name: Planning Study Total Cost: $496,255
Project Description: Comprehensive Service Assessment Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

US EPA ARCHIVE DOCUMENT

CSJ Number: N/A Federal Cost: $722,573
Project ID: 3169.1, 3169.2 State Cost: N/A
County: Bexar Local Cost: $180,643
Project Name: Planning Study Total Cost: $903,216
Project Description: Business Process Review Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $119,847
Project ID: 3076.1, 3076.2 State Cost: N/A
County: Bexar Local Cost: $29,962
Project Name: Passenger Facilities - Downtown West Total Cost: $149,809
Project Description: PE, Final Design, Land Acq (if needed)
Construction, Construction Management Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $205,035
Project ID: 3176.1, 3076.2 State Cost: N/A
County: Bexar Local Cost: $51,259
Project Name: Passenger Facilities - South Central Total Cost: $256,294
Project Description: PE, Final Design, Land Acq (if needed)
Construction, Construction Management Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

San Antonio-Bexar Metropolitan Area TIP
Completed FY 2003 Roadway Projects

CSJ Number: 16 7 116 Federal Cost: $729,000
Project ID: 3247 State Cost: $81,000
County: Bexar Local Cost: $0
Roadway Name: IH 35 Project Cost: $810
Limit From: 0.189 Mi N of Crestway Let Date: 01/03,000
Limit To: 0.189 Mi N of Topperwein Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Seal coat and overlay frontage roadsCompletion Date: 01/04

CSJ Number: 17 1 22 Federal Cost: $0
Project ID: 3275 State Cost: $381,900
County: Bexar Local Cost: $0
Roadway Name: Loop 353 Project Cost: $381,900
Limit From: 150 ft South of Loop 13 Let Date: 01/03
Limit To: Indian Creek Funding Category: 1 - Prvnt Mnt/Rehab

US EPA ARCHIVE DOCUMENT

Project Description: Planing, Seal Coat, ACP Overlay, & Pavement Markings Completion Date: 12/03

CSJ Number: 17 10 222 Federal Cost: $270,000
Project ID: 3351 State Cost: $30,000
County: Bexar Local Cost: $0
Roadway Name: IH 35 Project Cost: $300,000
Limit From: 0.068 Mi. South of Walzem Road Let Date: 05/03
Limit To .164 Mi. S of Whirlwind Drive Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Seal coat and overlay frontage roads Completion Date: 01/04

CSJ Number: 24 7 44 Federal Cost: $0
Project ID: 3265 State Cost: $1,014,500
County: Bexar Local Cost: $0
Roadway Name: US 90 Project Cost: $1,014,500
Limit From: Loop 1604 Let Date: 09/02
Limit To: IH 410 Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Seal Coat, ACP Overlay, & Pavement Markings Completion Date: 12/03

CSJ Number: 24 7 45 Federal Cost: $0
Project ID: 3266 State Cost: $593,800
County: Bexar Local Cost: $0
Roadway Name: US 90 Project Cost: $593,800
Limit From: Loop 1604 Let Date: 09/02
Limit To: SH 211 Funding Category: 1 - Prvnt Mnt/Rehab

CSJ Number: 24 7 46 Federal Cost: $0
Project ID: 3267 State Cost: $539,100
Project Description: Seal Coat, ACP Overlay, & Pavement Markings Completion Date: 12/03
County: Bexar Local Cost: $0
Roadway Name: US 90 Project Cost: $539,100
Limit From: Bexar/Medina County Line Let Date: 09/02
Limit To: SH 211 Funding Category 1 - Prvnt Mnt/Rehab:
Project Description: Seal Coat, ACP Overlay, & Pavement Markings Completion Date: 12/03

US EPA ARCHIVE DOCUMENT

CSJ Number: 24 7 47 Federal Cost: $0
Project ID: 3268 State Cost: $44,300
County: Bexar Local Cost: $0
Roadway Name: US 90 Project Cost: $44,300
Limit From: US 90 EB Exit Ramp (Beg) Let Date: 09/02
Limit To: US 90 EB Exit Ramp (End) Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Rework Base, Seal Coat, ACP Overlay, Completion Date: 03/03
& Pavement Markings

CSJ Number: 24 8 110 Federal Cost: $6,800,000
Project ID: 3082 State Cost: $5,237,000
County: Bexar Local Cost: $0
Roadway Name: US 90 Project Cost: $12,037,000
Limit From: At 36th Street intersection Let Date: 05/03
Limit To: Funding Category: 4 - State Connect
Project Description: Reconstruct intersection Completion Date: 04/05

CSJ Number: 24 8 115 Federal Cost: $0
Project ID: 3269 State Cost: $157,200
County: Bexar Local Cost: $0
Roadway Name: US 90 Project Cost: $157,200
Limit From: US 90 NE Frontage Road Let Date: 09/02
Limit To: SB IH 410 Entrance Ramp Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Rework Base, Seal Coat, ACP Overlay, Completion Date: 03/03
& Pavement Markings

CSJ Number: 72 7 50 Federal Cost: $0
Project ID: 3342 State Cost: $73,000
County: Bexar Local Cost: $0
Roadway Name: IH 10 Project Cost: $73,000
Limit From: Bexar County Line EB Frontage Road Let Date: 01/03
Limit To: Boerne Stage Road Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Seal Coat and Pavement Markings Completion Date: 01/04

CSJ Number: 72 7 51 Federal Cost: $0
Project ID: 3343 State Cost: $59,000
County: Bexar Local Cost: $0
Roadway Name: IH 10 Project Cost: $59,000

US EPA ARCHIVE DOCUMENT

Limit From: Bexar County Line WB Frontage Road Let Date: 01/03
Limit To: West of FM 3351 Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Seal Coat and Pavement Markings Completion Date: 01/04

CSJ Number: 72 12 130 Federal Cost: $42,653,760
Project ID: 3236 State Cost: $10,663,440
County: Bexar Local Cost: $0
Roadway Name: IH 10 Project Cost: $53,317,200
Limit From: 0.2 Miles South of Crossroads Blvd. Let Date: 06/03
Limit To: Fulton Avenue Funding Category: 7 - Metro Mobility
Project Description: Upgrade to 10 Lane Freeway & Traffic Management System Completion Date: 09/07

CSJ Number: 73 8 134 Federal Cost: $225,000
Project ID: 3175 State Cost: $25,000
County: Bexar Local Cost: $0
Roadway Name: IH 37 Project Cost: $250,000
Limit From: Fair Ave. S Let Date: 09/02
Limit To: SPRR Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Refurbish signs Completion Date: 11/03

CSJ Number: 73 8 140 Federal Cost: $0
Project ID: 3276 State Cost: $489,200
County: Bexar Local Cost: $0
Roadway Name: US 281 Project Cost: $489,200
Limit From: Rhapsody Drive Let Date: 01/03
Limit To: IH 410 Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Seal Coat, ACP Overlay, & Pavement Markings Completion Date: 08/03

CSJ Number: 73 9 24 Federal Cost: $72,000
Project ID: 3176 State Cost: $8,000
County: Bexar Local Cost: $0
Roadway Name: IH 37 Project Cost: $80,000
Limit From: SPRR Let Date: 09/02
Limit To: Loop 1604 Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Refurbish signs Completion Date: 11/03

US EPA ARCHIVE DOCUMENT

CSJ Number: 143 1 53 Federal Cost: $0
Project ID: 3333 State Cost: $1,500,000
County: Bexar Local Cost: $0
Roadway Name: US 87 Project Cost: $1,500,000
Limit From: FM 1516 Let Date: 09/02
Limit To: FM 1628 Funding Category: 1 - Prvnt Mnt/Rehab

Project Description: Base repair, surface treatment, overlay, pavement markings Completion Date: 09/03

CSJ Number: 143 2 22 Federal Cost: $0
Project ID: 3334 State Cost: $693,400
County: Bexar Local Cost: $0
Roadway Name: US 87 Project Cost: $693,400
Limit From: FM 1628 Let Date: 09/02
Limit To: Loop 1604 Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Base repair & ACP overlay Completion Date: 09/03

CSJ Number: 253 4 119 Federal Cost: $0
Project ID: 3277 State Cost: $476,400
County: Bexar Local Cost: $0
Roadway Name: US 281 Project Cost: $476,400
Limit From: Bitters Road Let Date: 01/03
Limit To: Rhapsody Drive Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Seal Coat, ACP Overlay, & Pavement Markings Completion Date: 08/03

CSJ Number: 253 4 124 Federal Cost:
Project ID: 3299 State Cost: $200,000
County: Bexar Local Cost: $400,000
Roadway Name: US 281 Project Cost: $600,000
Limit From: At Borgfeld, Bulverde, Wilderness Oaks, Let Date: 09/02
Limit To: and Stone Oak Roads Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Signalizing intersections and traffic operations Completion Date: 12/03

CSJ Number: 291 9 125 Federal Cost: $180,000

US EPA ARCHIVE DOCUMENT

Project ID: 3250 State Cost: $20,000
County: Bexar Local Cost: $0
Roadway Name: SH 16 Project Cost: $200,000
Limit From: 0.1 Mi N of Chimney Creek Road Let Date: 09/02
Limit To: 0.1 Mi S of Chimney Creek Road Funding Category: 11 - Distr Discretionary
Project Description: Install median barrier Completion Date: 08/03

CSJ Number: 470 2 10 Federal Cost: $0
Project ID: 3336 State Cost: $27,600
County: Bexar Local Cost: $0
Roadway Name: FM 1863 Project Cost: $27,600
Limit From: Comal County Line Let Date: 09/02
Limit To: Comal County Line Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: ACP overlay and pavement markings Completion Date: 12/03

CSJ Number: 521 1 40 Federal Cost: $4,610,236
Project ID: 1050 State Cost: $1,152,559
County: Bexar Local Cost: $0
Roadway Name: W.W. White Rd. (Loop 13) Project Cost: $5,762,795
Limit From: Seale Road Let Date: 10/02
Limit To: IH 10 Funding Category: 7 - Metro Mobility
Project Description: Widen existing 4 lane road to 4 lanes Completion Date: 08/04
w/ cont. left turn, sidewalks and drainage

CSJ Number: 521 4 243 Federal Cost: $129,150
Project ID: 3177 State Cost: $14,350
County: Bexar Local Cost: $0
Roadway Name: IH 410 Project Cost: $143,500
Limit From: US 90 Let Date: 09/02
Limit To: Callaghan Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Refurbish Signs Completion Date: 05/03

CSJ Number: 521 4 251 Federal Cost: $90,000
Project ID: 3186 State Cost: $10,000
County: Bexar Local Cost: $0
Roadway Name: IH 410 Project Cost: $100,000
Limit From: On westbound frontage Rd at Ingram Rd Let Date: 01/03
Limit To: Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Widen existing pavement to provide Completion Date: 07/03

US EPA ARCHIVE DOCUMENT

right turn lane

CSJ Number: 521 4 253 Federal Cost: $492,750
Project ID: 3188 State Cost: $54,750
County: Bexar Local Cost: $0
Roadway Name: IH 410 Project Cost: $547,500
Limit From: NB and SB frontage Rd from US 90 Let Date: 01/03
Limit To: SH 151 Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Planing, seal coat, asphaltic overlay, Completion Date: 08/03
& pavement markings

CSJ Number: 521 5 116 Federal Cost: $50,850
Project ID: 3178 State Cost: $5,650
County: Bexar Local Cost: $0
Roadway Name: IH 410 Project Cost: $56,500
Limit From: 2.6 MI S of Valley Hi Dr, N Let Date: 09/02
Limit To: US 90 Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Refurbish Signs Completion Date: 05/03

CSJ Number: 849 1 39 Federal Cost: $753,012
Project ID: 3124 State Cost: $188,253
County: Bexar Local Cost: $0
Roadway Name: Grissom/Culebra (FM 471) Project Cost: $941,265
Limit From: SH 16 Let Date: 08/03
Limit To: Loop 1604 Funding Category: 7 - Metro Mobility
Project Description: Construct sidewalks (East side of roadway only) Completion Date: 08/04

CSJ Number: 849 1 40 Federal Cost: $0
Project ID: 3270 State Cost: $1,378,500
County: Bexar Local Cost: $0
Roadway Name: Culebra Rd (FM 471) Project Cost: $1,378,500
Limit From: SH 16 Let Date: 09/02
Limit To: Loop 1604 Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Seal Coat, ACP Overlay, & Pavement Markings Completion Date: 10/03

CSJ Number: 915 0 82 Federal Cost: $160,000

US EPA ARCHIVE DOCUMENT

Project ID: 3273 State Cost: $40,000
County: Bexar Local Cost: $0
Roadway Name: Various Locations Project Cost: $200,000
Limit From: DISTRICTWIDE Let Date: 10/02
Limit To: Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Thermoplastic Re-striping (FY2002) – Completion Date: 10/03
Cat 10A

CSJ Number: 915 0 94 Federal Cost: $760,000
Project ID: 3345 State Cost: $190,000
County: Bexar Local Cost: $0
Roadway Name: Districtwide Traffic Management (FY 2 Project Cost: $950,000
Limit From: Various Let Date: 09/02
Limit To: - Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Districtwide Traffic Management Completion Date: 08/03
(FY 2002)

CSJ Number: 915 0 98 Federal Cost: $480,000
Project ID: 3292 State Cost: $120,000
County: Bexar Local Cost: $0
Roadway Name: Districtwide Project Cost: $600,000
Limit From: Non-site specific (2001) Let Date: 09/02
Limit To: Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Districtwide traffic signals (2001) Completion Date: 08/04

CSJ Number: 915 12 172 Federal Cost: $2,297,647
Project ID: 546 State Cost: $0
County: Bexar Local Cost: $574,412
Roadway Name: Houston St. Project Cost: $2,872,059
Limit From: Bowie Let Date: 12/02
Limit To: Pine Funding Category: 7 - Metro Mobility
Project Description: Reconstruct Existing Street Completion Date: 12/04

CSJ Number: 915 12 231 Federal Cost: $1,520,800
Project ID: 979 State Cost: $0
County: Bexar Local Cost: $380,200
Roadway Name: Bitters Project Cost: $1,901,000
Limit From: East of West Ave (W.of US 281) Let Date: 06/03
Limit To: East of Heimer (E. of US 281) Funding Category: 7 - Metro Mobility
Project Description: Widen narrow pavement for turn lanes Completion Date: 01/05

US EPA ARCHIVE DOCUMENT

(signals)

CSJ Number: 915 12 281 Federal Cost: $2,412,800
Project ID: 2062 State Cost: $0
County: Bexar Local Cost: $603,200
Roadway Name: Southcross Blvd. Project Cost: $3,016,000
Limit From: S. New Braunfels Let Date: 06/03
Limit To: S. Presa St. Funding Category: 7 - Metro Mobility
Project Description: Reconstruct & expand from 2 to 4 lanes Completion Date: 01/05
(curbs, sidewalks, signals)

CSJ Number: 915 12 323 Federal Cost: $8,000
Project ID: 3033 State Cost: $0
County: Bexar Local Cost: $2,000
Roadway Name: Bicycle Route Street Map Project Cost: $10,000
Limit From: City Wide Let Date: 12/02
Limit To: Funding Category: 7 - Metro Mobility
Project Description: Map delineating existing bicycle facilities Completion Date: 07/03

CSJ Number: 915 12 328 Federal Cost: $1,644,962
Project ID: 3041 State Cost: $0
County: Bexar Local Cost: $411,241
Roadway Name: Isom Project Cost: $2,056,203
Limit From: Ramsey Let Date: 12/02
Limit To: US 281 Funding Category: 7 - Metro Mobility
Project Description: Reconstruct & widen narrow pavement Completion Date: 07/04
w/CLTL (sidewalks, drainage)

CSJ Number: 915 12 370 Federal Cost: $165,309
Project ID: 3146 State Cost: $0
County: Bexar Local Cost: $41,327
Roadway Name: Alamo Area Commute Solutions Prog. Project Cost: $206,636
Limit From: In San Antonio-Bexar Co. Area Let Date: 08/03
Limit To: Funding Category: 7 - Metro Mobility
Project Description: Operational costs for air quality program, Completion Date: 08/04
ridematching and carpool services

US EPA ARCHIVE DOCUMENT

CSJ Number: 915 12 406 Federal Cost: $153,000
Project ID: 3371 State Cost: $17,000
County: Bexar Local Cost: $0
Roadway Name: Benton City Road Project Cost: $170,000
Limit From: @ UPRR DOT 764273E - 2002 FED RR Let Date: 01/03
Limit To: Funding Category: 8 - Safety
Project Description: Upgrade RR Crossing Warning Devices Completion Date: 10/03

CSJ Number: 1437 1 28 Federal Cost:
Project ID: 3204 State Cost: $2,757,300
County: Bexar Local Cost: $0
Roadway Name: Houston St. (FM 1346) Project Cost: $2,757,300
Limit From: FM 1516 Let Date: 05/03
Limit To: LP 1604 Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Rehab & widen narrow pavement & shoulder Completion Date: 08/05

CSJ Number: 1741 2 27 Federal Cost: $0
Project ID: 3278 State Cost: $369,800
County: Bexar Local Cost: $0
Roadway Name: FM 2790 Project Cost: $369,800
Limit From: Loop 1604 Let Date: 01/03
Limit To: Medina River Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Seal Coat, ACP Overlay, & Pavement Markings Completion Date: 12/03

CSJ Number: 2104 2 26 Federal Cost: $0
Project ID: 3279 State Cost: $741,800
County: Bexar Local Cost: $0
Roadway Name: Potranco Rd. (FM 1957) Project Cost: $741,800
Limit From: Bexar/Medina County Line Let Date: 01/03
Limit To: Loop 1604 Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Seal Coat, ACP Overlay, & Pavement Markings Completion Date: 12/03

CSJ Number: 2452 2 68 Federal Cost: $0
Project ID: 3280 State Cost: $1,431,900
County: Bexar Local Cost: $0
Roadway Name: Loop 1604 Project Cost: $1,431,900

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Limit From: IH 10 (EBFR & WBFR) Let Date: 01/03
Limit To: US 281 Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Seal Coat, ACP Overlay, & Pavement Completion Date: 08/03
Markings

CSJ Number: 2452 2 69 Federal Cost: $179,460
Project ID: 3251 State Cost: $19,940
County: Bexar Local Cost: $0
Roadway Name: Loop 1604 Project Cost: $199,400
Limit From: Kyle Seale Parkway Let Date: 09/02
Limit To: BabcocK Funding Category: 11 - Distr Discretionary
Project Description: Install median barrier Completion Date: 08/03

CSJ Number: 2452 3 91 Federal Cost: $0
Project ID: 3272 State Cost: $672,000
County: Bexar Local Cost: $0
Roadway Name: Loop 1604 Project Cost: $672,000
Limit From: Lower Seguin Road Let Date: 09/02
Limit To: IH 10 Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Spot Base Repair & Overlay Completion Date: 12/03

CSJ Number: 2452 3 92 Federal Cost: $179,460
Project ID: 3252 State Cost: $19,940
County: Bexar Local Cost: $0
Roadway Name: Loop 1604 Project Cost: $199,400
Limit From: Green Mountain Road Let Date: 09/02
Limit To: UPRR Overpass Funding Category: 11 - Distr Discretionary
Project Description: Install median barrier Completion Date: 08/03

CSJ Number: 2452 4 9 Federal Cost:
Project ID: 3257 State Cost: $565,900
County: Bexar Local Cost: $0
Roadway Name: Loop 1604 Project Cost: $565,900
Limit From: FM 1518 Let Date: 09/02
Limit To: US 87 Funding Category: 1 - Prvnt Mnt/Rehab
Project Description: Rehabilitation & widen narrow pavement Completion Date: 12/03
& shoulders

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CSJ Number: 5000 0 32 Federal Cost: $5,625,000
Project ID: 3406 State Cost: $0
County: Bexar Local Cost: $0
Roadway Name: Austin-San Antonio Corridor ProjectsProject Cost: $5,625,000
Limit From: Let Date:
Limit To: Funding Category: 2 Metro Corridor
Project Description: Proposed Engineering & Analytical Completion Date:
Studies

San Antonio-Bexar Metropolitan Area TIP
Completed FY 2003 Transit Projects

CSJ Number: N/A Federal Cost: $7,848,428
Project ID: 9001 State Cost: N/A
County: Bexar Local Cost: $1,962,107
Project Name: Revenue Vehicles Total Cost: $9,810,535
Project Description: Purchase Replacement Low Floor Buses Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $73,936
Project ID: 9005 State Cost: N/A
County: Bexar Local Cost: $18,484
Project Name: Non-Revenue Vehicles Total Cost: $92,420
Project Description: Purchase Service Vehicles Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $1,858,860
Project ID: 9007 State Cost: N/A
County: Bexar Local Cost: $464,715
Project Name: Facility Rehabilitation Total Cost: $2,323,575
Project Description: PE, final design, construction Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $172,000
Project ID: 9011 State Cost: N/A
County: Bexar Local Cost: $43,000
Project Name: Passenger Facilities Total Cost: $215,000
Project Description: Bus Stop Improvements Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $156,000

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Project ID: 9012 State Cost: N/A
County: Bexar Local Cost: $39,000
Project Name: Equipment Total Cost: $195,000
Project Description: MIS Hardware Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

CSJ Number: N/A Federal Cost: $224,000
Project ID: 9013 State Cost: N/A
County: Bexar Local Cost: $56,000
Project Name: Equipment Total Cost: $280,000
Project Description: MIS Software Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies
CSJ Number: N/A Federal Cost: $51,648
Project ID: 9015 State Cost: N/A
County: Bexar Local Cost: $12,912
Project Name: Equipment Total Cost: $64,560
Project Description: Miscellaneous Equipment Let Date: Varies
Funding Category: Section 5307 Completion Date: Varies

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Traffic Resignalization Emission Reduction Estimates

Of many projects shown in the MPO's TIP in this appendix, certain traffic signals for various intersections in the Bexar County have been separately evaluated for their impacts on the air quality and included in the Chapter 8 of the 2003 UPWP report. The results of this analysis would provide additional evidence indicating future lower ozone levels for the San Antonio area. The following pages present this evaluation.

Introduction

Traffic flow improvements have been used for air quality planning due to their ability to reduce traffic congestion, reducing congestion-related emissions, and are also a cost-effective method of reducing congestion and emissions.[1] Arterial management systems manage traffic by employing various detection and control devices along arterial roadways.

Traffic signalization is one of the most common traffic management techniques utilized in the United States. Signal control systems are methods of arterial roadway management is practiced because such control systems improve traffic flow as well as simplify system maintenance.[2] Some improvements can include:

Updating traffic signal hardware to utilize more modern technology, allowing for more sophisticated traffic flow strategies to be planned;

Timing traffic signals to correspond with current traffic flows, reducing unnecessary delays;

Coordinating and interconnecting signals to better interface pre-timed and traffic actuated signals, actively managed timing plans, and master controllers to minimize the number and frequency of stops necessary at intersections; and

Removing signals at intersections no longer requiring signalized stop control to reduce vehicle delays and unwarranted stops on the major street.[1]

The use of flexible traffic signal systems has been used since the early 1960's when computerized systems began to come into existence. Signalization projects can reduce carbon monoxide (CO) and hydrocarbon (HC) by reducing the number of vehicular stops and idling, which would reduce travel times and traffic delays. Reductions in fuel consumption have also been observed through traffic signal re-timing. Traffic flow at intersections can be improved in interconnection and coordination of signals.

Resignalization in Bexar County

The prospect of traffic signal retiming has been evaluated for various intersections in Bexar County in order to efficiently deal with the existing levels of traffic volumes. A program was recently conducted for Bexar County, as it is recommended that traffic signal timing patterns be checked and updated every 5 to 7 years. Such programs focus on three factors: 1) public benefit from improved traffic operation, 2) the inherent cost-effectiveness of operations improvements, and 3) establishing a baseline for measuring effectiveness in future re-timing projects.

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[1] MOSERS Handbook, June 2003. Texas Department of Transportation

[2] Miretek Systems, "Intelligent Transportation Systems Benefits: 2001 Update." Federal Highway Administration, June 2001.

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Approximately seven traffic signal systems were assessed as to their benefit and functionality in handling traffic volume within the San Antonio area. Table K-8-1 lists the systems that were analyzed during the months of May 2001 to November 2001.

Table K-22. Traffic Signal Systems Evaluated

Traffic Signal Systems	
Wetmore System	Bandera System
Jones Maltsberger System	Rittiman System
Bitters/West System	Nacogdoches/Perrin Beitel System
Eisenhauer System	

Traffic Signal Evaluation

The evaluation of the selected traffic signal systems involved several steps. Traffic light systems in the San Antonio area were evaluated bv Pape-Dawson Engineers, Inc. The evaluation involved collection of data, design improvements, optimal timing plan development and implementation, and simulation of before and after conditions. Several models were used in the evaluation and assessment of the traffic signal systems. These models included TRANSYT-7F, Synchro 3.2, and PASSER II.

Information on arterial data, "before" signal timing data, saturation flow rates, and speed/travel time data were gathered through various sources. Traffic volumes, which are the numbers of vehicles that pass a specific point during a given period of time, were collected at the intersections.[3] Lane configuration, link speed data, and link distance information were provided by the City of San Antonio. The data gathered for model input was first run through Synchro 3.2 to produce a simulation file. The file was calibrated to reflect specific "before" conditions and then converted to a TRANSYT-7F file. The TRANSYT-7F analyzed the traffic system and produced a "before" traffic flow simulation.

The simulation data originally provided by Synchro 3.2 was then modified to reflect optimal time cycles for improved efficiency. PASSER II analyzed alternative phasing arrangements and cycle lengths. The cycle lengths that generated the least amount of delay were deemed most efficient and thus recommended. The following sections describe the arterial intersections that were analyzed and the recommended timing plans.

Wetmore System

The Wetmore System is located on Wetmore Road, which is classified as a primary arterial, Type A. In evaluating this system, three timing plans were developed for the A.M Peak, Midday/Off Peak, and P.M. Peak periods. Four intersections were analyzed on the Wetmore System and their operation is detailed in Table K- 8-2.[4]

[3] "Detection Technology: For IVHS-Volume 1: Final Report Addendum." July 1995. http://ntl.bts.gov/DOCS/96100/ch02/body_ch02_03.html

[4] Traffic Signal Re-Timing Study, "Wetmore System Technical Memorandum." Pape Dawsom Engineers, May 2001.

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Table K-23. Intersections Evaluated for Traffic Signal Re-Timing on Wetmore Rd.

Signalization Details		
Before Conditions		
Intersection Name	Operation	No. of Phases
Wetmore Rd. & Ridge Country	Coordinated	4
Wetmore Rd. & Gunn Sports Park	Coordinated	4
Wetmore Rd. & Wurzbach Pkwy West	Coordinated	4
Wetmore Rd. & Wurzbach Pkwy East	Coordinated	4
After Conditions		
Intersection Name	Operation	No. of Phases
Wetmore Rd. & Ridge Country	Coordinated	4
Wetmore Rd. & Gunn Sports Park	Coordinated	4
Wetmore Rd. & Wurzbach Pkwy West	Coordinated	4
Wetmore Rd. & Wurzbach Pkwy East	Coordinated	4

The Wetmore System was evaluated as described in Traffic Signal Evaluation. Analysis of the evaluation provided cycles that would improve efficiency in a number of areas. These areas include bandwidth efficiency, vehicle delay, and fuel consumption.

The 115 second cycle for the AM peak hour was selected since it provided the best bandwidth efficiency, largest bands for northbound and southbound traffic, and had a lower delay value. The 75 second cycle for off peak hours is the lowest delay for the arterial. The 80 second cycle for the PM peak hour had a high bandwidth efficiency, lowest delay, and the lowest fuel consumption.

Eisenhauer System

The Eisenhauer System is located on Eisenhauer Road and is designated as a secondary arterial, Type A, east of Interstate 35 and Type B, west of Interstate 35. Three timing plans were developed for the A.M. Peak, Midday/Off Peak, and P.M. Peak periods. Nine intersections were evaluated, as listed in Table K- 8-3.[5]

Table K-24. Evaluated Intersections on Eisenhauer Rd

Signalization Details		
Before Conditions		
Intersection Name	Operation	No. of Phases
Eisenhauer and Corrine	Uncoordinated	2
Eisenhauer and Holbrook	Uncoordinated	2
Eisenhauer and Harlow	Uncoordinated	2
Eisenhauer and Kingston	Uncoordinated	2
Eisenhauer and Molokai	Uncoordinated	2
Eisenhauer and Interstate 35 Diamond	Uncoordinated	TTI 4 Phase

[5] Traffic Signal Re-Timing Study, "Eisenhauer System Technical Memorandum." Pape Dawsom Engineers, November 2001.

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Eisenhauer and Fratt	Uncoordinated	5
Eisenhauer and Ray Bon	Uncoordinated	8
Eisenhauer and Mid Crown	Uncoordinated	6
After Conditions		
Intersection Name	Operation	No. of Phases
Eisenhauer and Corrine	Coordinated	2
Eisenhauer and Holbrook	Coordinated	2
Eisenhauer and Harlow	Coordinated	2
Eisenhauer and Kingston	Coordinated	2
Eisenhauer and Molokai	Coordinated	2
Eisenhauer and Interstate 35 Diamond	Coordinated	TTI 4 Phase
Eisenhauer and Fratt	Coordinated	5/2
Eisenhauer and Ray Bon	Coordinated	8/2
Eisenhauer and Mid Crown	Coordinated	6/2

The Eisenhauer System was evaluated as described in Traffic Signal Evaluation. Analysis of the evaluation provided cycles that would improve efficiency in a number of areas. These areas include bandwidth efficiency, vehicle delay, and fuel consumption. The AM peak hour's cycle was chosen to be 120 seconds since it provided the best bandwidth efficiency and largest bands for northbound and southbound traffic. The cycle also coincided with low values of delay and low fuel consumption. The 90 second cycle was recommended for the system during off peak hours. This cycle provided the lowest delay at the I-35 diamond interchange.

Bitters/West System

The Bitters/West System is located on Bitters Road and West Avenue. Bitters Road is a Type A secondary arterial. West Avenue is a Type A arterial and meets Bitters. Three timing plans were developed for the A.M. Peak, Midday/Off Peak, and P.M. Peak periods. Six intersections were evaluated, as listed in Table K-8-4.[6]

Table K-25. Intersections Evaluated for Traffic Signal Re-Timing on Bitters/West

Signalization Details		
Before Conditions		
Intersection Name	Operation	No. of Phases
Bitters Road and Heimer Road	Uncoordinated	7
Bitters Road and US 281	Uncoordinated	TTI 4 Phase
Bitters Road and Embassy Row	Uncoordinated	4
Bitters Road and West Avenue	Uncoordinated	5
West Avenue and Embassy Oaks	Uncoordinated	2
West Avenue and Interpark Blvd	Uncoordinated	4
After Conditions		

[6] Traffic Signal Re-Timing Study, "Bitters/West System Technical Memorandum." Pape Dawsom Engineers, October 2001.

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Intersection Name	Operation	No. of Phases
Bitters Road and Heimer Road	Uncoordinated	7
Bitters Road and US 281	Uncoordinated	TTI 4 Phase
Bitters Road and Embassy Row	Uncoordinated	4
Bitters Road and West Avenue	Uncoordinated	5
West Avenue and Embassy Oaks	Uncoordinated	2
West Avenue and Interpark Blvd	Uncoordinated	4

The Bitters/West System was evaluated as described in Traffic Signal Evaluation. Analysis of the evaluation provided cycles that would improve efficiency in a number of areas. These areas include bandwidth efficiency, vehicle delay, and fuel consumption.

The best cycle for the A.M. peak hour was 108 seconds. It provided the best bandwidth efficiency and low delay. A cycle length of 90 seconds for off peak hours yielded low delay but were the lowest in effectiveness of all categories. For P.M. peak hours, the 120 second cycle length provided high bandwidth efficiency, low fuel consumption, and low delay values.

Bandera System

The Bandera System is on Bandera Road, which is designated as a primary arterial, Type A. The lanes on Bandera Road vary from six-lanes with exclusive left turn lanes to a four-lane roadway with exclusive right and left turn lanes. Three timing plans were developed for the A.M. Peak, Midday/Off peak, and P.M. Peak periods. Eight intersections were evaluated on Bandera Road, as listed in Table K-8-5.[7]

Table K-26: Intersections Evaluated for Traffic Signal Re-Timing on Bandera Rd

Signalization Details		
Before Conditions		
Intersection Name	Operation	No. of Phases
Bandera and Prue/Tezel	Coordinated	6
Bandera and Old Prue/Camino Villa	Coordinated	6
Bandera and Braun	Coordinated	5
Bandera and Mystic Park/Bresnahan	Coordinated	6
Bandera and Guilbeau/Bristle Cone	Coordinated	6
Bandera and Mainland	Coordinated	6
Bandera and Eckhert	Coordinated	6
Gilbeau and Mystic Park	Free/Coordinated	3
After Conditions		
Intersection Name	Operation	No. of Phases
Bandera and Prue/Tezel	Coordinated	6
Bandera and Old Prue/Camino Villa	Coordinated	6

[7] Traffic Signal Re-Timing Study, "Bandera System Technical Memorandum." Pape Dawsom Engineers, June 2001.

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Bandera and Braun	Coordinated	5
Bandera and Mystic Park/Bresnahan	Coordinated	6
Bandera and Guilbeau/Bristle Cone	Coordinated	6
Bandera and Mainland	Coordinated	6
Bandera and Eckhert	Coordinated	6
Gilbeau and Mystic Park	Coordinated	3

The Bandera System was evaluated as described in Traffic Signal Evaluation. Analysis of the evaluation provided cycles that would improve efficiency in a number of areas. These areas include bandwidth efficiency, vehicle delay, and fuel consumption.

For the A.M. peak hour, a cycle of 130 seconds was chosen due to good bandwidth efficiencies. The 90 second cycle was recommended for off peak hours since it provided a low delay time. The P.M. peak hour was recommended the 130 second cycle length due to high bandwidth efficiency, low delay, and low fuel consumption.

Rittiman System

Rittiman Road is designated a secondary arterial, Type A east of I-35 and Type B, west of I-35. Rittiman road is a four lane roadway with a diamond interchange at the intersection with Interstate 35. Three timing plans were developed for the A.M. Peak, Midday/Off peak, and P.M. Peak periods. Table K-8-6 lists the five intersections that were evaluated on this system.[8]

Table K-27. Intersections Evaluated for Traffic Signal Re-Timing on Rittiman

Signalization Details		
Before Conditions		
Intersection Name	Operation	No. of Phases
Rittiman Rd and Rittiman Plaza	Uncoordinated	2
Rittiman Rd and Fairdale	Uncoordinated	2
Rittiman Rd and IH 35 Diamond	Uncoordinated	TTI 4 Phase
Rittiman Rd and Goldfield	Uncoordinated	2
Rittiman Rd and Fratt/Business Park	Uncoordinated	8
After Conditions		
Intersection Name	Operation	No. of Phases
Rittiman Rd and Rittiman Plaza	Coordinated	2
Rittiman Rd and Fairdale	Coordinated	2
Rittiman Rd and IH 35 Diamond	Coordinated	TTI 4 Phase
Rittiman Rd and Goldfield	Coordinated	2
Rittiman Rd and Fratt/Business Park	Coordinated	8

[8] Traffic Signal Re-Timing Study, "Rittiman System Technical Memorandum." Pape Dawsom Engineers, November 2001.

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The Rittiman System was evaluated as described in Traffic Signal Evaluation. Analysis of the evaluation provided cycles that would improve efficiency in a number of areas. These areas include bandwidth efficiency, vehicle delay, and fuel consumption.

For the A.M. peak hour, the 120 second cycle was bandwidth efficient and had the lowest delay values. The 90 second cycle for the off peak period allows low delay at the diamond interchange as well as along the arterial. The 120 second cycle was also recommended for the PM peak hour due to it high bandwidth efficiency, low delay, and low fuel consumption.

Jones-Maltsberger System

Jones-Maltsberger is a secondary arterial, Type A and has four lanes. Three timing plans were developed for the A.M. Peak, Off Peak, and P.M. Peak periods. Five intersections were evaluated on Jones-Maltsberger, which are listed on Table K-8-7.[9]

Table K-28. Intersections Evaluated for Traffic Signal Re-Timing on Jones-Maltsberger

Signalization Details		
Before Conditions		
Intersection Name	Operation	No. of Phases
Jones Maltsberger and Starcrest	Free	8
Jones Maltsberger and Perennial/Budding	Free	6
Jones Maltsberger and Money Tree	Free	5
Jones Maltsberger and Burning Trail	Free	5
Jones Maltsberger and Thousand Oaks	Free	8
After Conditions		
Intersection Name	Operation	No. of Phases
Jones Maltsberger and Starcrest	Coordinated	8
Jones Maltsberger and Perennial/Budding	Coordinated	6
Jones Maltsberger and Money Tree	Coordinated	5
Jones Maltsberger and Burning Trail	Coordinated	5
Jones Maltsberger and Thousand Oaks	Coordinated	8

The Jones-Maltsberger System was evaluated as described in Traffic Signal Evaluation. Analysis of the evaluation provided cycles that would improve efficiency in a number of areas. These areas include bandwidth efficiency, vehicle delay, and fuel consumption.

The best cycle for the A.M. peak period was one that consisted of 90 seconds since it had the best bandwidth efficiency and low delay. A cycle of 120 seconds was optimal for off peak. A good candidate for the P.M. peak period would be a cycle of 115 seconds since it had good bandwidth efficiency, low fuel consumption, and low delay values.

Nacogdoches/Perrin Beitel System

[9] Traffic Signal Re-Timing Study, "Jones-Maltsberger System Technical Memorandum." Pape Dawsom Engineers, May 2001.

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Both Nacogdoches and Perrin Beitel are Type A secondary arterial, each being a four-lane roadway. Twenty intersections were evaluated on the Nacogdoches/Perrin Beitel system, as detailed on Table K-8-8. Three timing plans were developed for the A.M. Peak, Off Peak, and P.M. Peak periods.[10]

Table K-29: Intersections Evaluated for Traffic Signal Re-Timing on Nacogdoches/Perrin Beitel

Signalization Details		
Before Conditions		
Intersection Name	Operation	No. of Phases
Nacogdoches and Topperwien	Coordinated	4
Nacogdoches and Judson	Coordinated	8
Nacogdoches and Dreamwood	Coordinated	3
Nacogdoches and O'Connor	Coordinated	8
Nacogdoches and El Charro	Coordinated	2/3*
Nacogdoches and Higgins	Coordinated	3
Nacogdoches and El Sendero	Coordinated	4
Nacogdoches and Bell	Coordinated	3
Nacogdoches and Leonhardt	Coordinated	5
Nacogdoches and Thousand Oaks	Coordinated	8
Perrin Beitel and Naco-Perrin	Coordinated	6
Perrin Bietel and El Sendero	Coordinated	3
Perrin Beitel and Wurzbach Parkway	Coordinated	TTI 4 Phase
Perrin Beitel and Perrin Central	Coordinated	5
Perrin Beitel and Post Office	Coordinated	3
Perrin Beitel and Clear Spring	Coordinated	3
Perrin Beitel and Comstock	Coordinated	5
Perrin Beitel and Center Gate	Coordinated	3
Thousand Oaks and Bulverde	Coordinated	5
Thousand Oaks and Uhr	Coordinated	2
After Conditions		
Intersection Name	Operation	No. of Phases
Nacogdoches and Topperwien	Coordinated	4
Nacogdoches and Judson	Coordinated	8
Nacogdoches and Dreamwood	Coordinated	3
Nacogdoches and O'Connor	Coordinated	8
Nacogdoches and El Charro	Coordinated	2/3*
Nacogdoches and Higgins	Coordinated	3
Nacogdoches and El Sendero	Coordinated	4
Nacogdoches and Bell	Coordinated	3
Nacogdoches and Leonhardt	Coordinated	5
Nacogdoches and Thousand Oaks	Coordinated	8
Perrin Beitel and Naco-Perrin	Coordinated	6
Perrin Beitel and El Sendero	Coordinated	3

[10] Traffic Signal Re-Timing Study, "Nacogdoches/Perrin Beitel System Technical Memorandum." Pape Dawsom Engineers, November 2001.

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Perrin Beitel and Wurzbach Parkway	Coordinated	TTI 4 Phase
Perrin Beitel and Perrin Central	Coordinated	5
Perrin Beitel and Post Office	Coordinated	3
Perrin Bietel and Clear Spring	Coordinated	3
Perrin Beitel and Comstock	Coordinated	5
Perrin Beitel and Center Gate	Coordinated	3
Thousand Oaks and Bulverde	Coordinated	5
Thousand Oaks and Uhr	Coordinated	2

The Nacogdoches/Perrin Beitel System was evaluated as described in Traffic Signal Evaluation. Analysis of the evaluation provided cycles that would improve efficiency in a number of areas. These areas include bandwidth efficiency, vehicle delay, and fuel consumption.

The 90 second cycle for the AM peak hour was selected since it provided the one of the best bandwidth efficiencies, large bands for northbound and southbound traffic, and lowest combination of delay values. Off peak period was recommended the 90 second cycle. It presented the lowest delay and low fuel consumption. The 130 second cycle length for PM peak hour had high bandwidth efficiency, low delay, and low fuel consumption.

In summary, the traffic signal systems included in this study were recommended to have cycle lengths reduced while maintaining efficient bandwidth, reduced vehicle delays, and reduced fuel consumption. Table K-8-9 details the various traffic signal systems included in the study as well as data on vehicle stop frequency, vehicle delay, and fuel consumption.

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Table K-30. Traffic Signal System Statistics before & with Recommended Improvements

Traffic Signal System		Number of Hours	Stops		Total System Delay		Fuel Consumption	
			Before	After	Before	After	Before	After
Wetmore	AM	2.33	7814	6244	61	37	221	190
	Off Peak	7.5	3040	2550	20	14	105	94
	PM	2	4471	4510	32	26	166	160
Eisenhauer	AM	2	17195	14734	677	525	773	655
	Off Peak	7	13207	2787	112	24	331	81
	PM	2	18224	14552	543	384	725	585
Bitters/West	AM	2	16464	12664	329	281	454	431
	Off Peak	7	14761	15872	613	472	620	600
	PM	2	40344	22853	2463	868	2065	979
Bandera	AM	1.25	31743	24221	834	724	1474	1300
	Off Peak	6.5	17108	14290	132	110	732	624
	PM	3.75	60293	29076	3640	738	3625	1406
Rittiman	AM	2	19116	11822	702	412	1192	552
	Off Peak	7	7048	5270	55	40	222	203
	PM	2	17651	15939	1380	663	1295	759
Jones-Maltsberger	AM	2	8356	8069	82	66	381	334
	Off Peak	7	6697	6168	71	64	314	283
	PM	2	14926	11797	246	175	596	487
Nacogdoches/Perrin Beitel	AM	1.5	25721	22211	201	179	834	783
	Off Peak	7	23273	21934	163	157	801	785
	PM	3	47198	37977	793	760	1626	1513

On-Road Emission Reduction

According to the 1999 AACOG Emission Inventory, on-road sources provides a substantial amount of VOC and NOx emissions to Bexar County. The 2007 projection of the September photochemical modeling episode accounts for the updated MOBILE6 on road emissions and it is against these emissions that the proposed traffic signal timing cycle improvements were performance evaluated. Average weekday (Monday-Friday) emissions for on-road sources in Bexar County are 61 tons/day of NOx and 49 tons/day of VOC[11].

The "Traffic Signal Re-Timing Study"[12] reports describing the evaluations and timing cycle recommendations of the traffic signal systems were not consistent in detailing

[11] See Chapter 4 for the methodology to calculate on-road emissions in 2007 projection and Table k- 4.3 and 4.4 for complete on-road emission data.

[12] "Traffic Signal Re-Timing Study," Pape Dawson Engineers Inc. May 2001-November 2001.

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correct delay values and provided confusing details. The purpose of this report was to evaluate the proposed signal timing improvements for the areas under study as well as their potential emission reduction. It was concluded after much analysis that analyzing the increase or decrease of total delay time the vehicles experienced during the before and after traffic flow simulations would be the more suitable approach. The difference of the total delay times was multiplied by an emission factor for idling vehicles.

The idling emission factor was utilized since vehicles idle while being delayed at traffic light stops. MOBILE6 provided the emission factor for a vehicle speed of 2.5 miles per hour. A speed of 2.5 miles per hour was used because it was the slowest speed that mobile6 model can calculate emissions. All the other factors for the mobile6 model (temperature, RVP and Sulfur levels, VMT Mix, etc.) used local data input[13]. For the Mobile idling emissions, VOC was 7.03 grams/mile and NOx was 2.17 grams/mile. Once the idling emissions factor was estimated, the result was applied to each intersection. The equation for calculating emissions reductions per hour is:

(Total Delay Time Before per hour – Total Delay Time After per hour) x Mobile6 Idling Emission Factor = Emission Reductions per hour

The delay times were evaluated for 3 time periods: AM Peak, PM Peak, and Off Peak. The AM peak, PM peak, and Off Peak hours varied for each traffic signal system. For example, AM peak periods varied between 1.25 hours and 3.75 hours. These time frames are listed in Table K-8-9 for each intersection involved in the study. The emissions (grams/hr) were multiplied by the number of hours in the respective time period to result in the total emission reduction per time period. The total emissions in grams/day were then converted to pounds/day.

(Total Emissions grams/day x 2.205) /1000 = Total Emissions lbs/day

The following tables and figures illustrate the emission reductions for the traffic signal systems with the implementation of recommended timing cycles.

Wetmore System Emission Reductions

AM peak period reductions were significant on a per hour scale than the off peak period reductions for the Wetmore system. An average reduction of 1.1 lbs/hr was observed in the AM peak hours compared to an average of 0.2 lbs/hr of VOC idling emissions was reduced in the off peak hours by the recommended timing plans.

PM peak only had an emissions reduction of approximately 0.24 lbs/hr. The PM period for idling NOx emissions had the most significant emission reduction of the periods included in the study, based per hour. The PM peak period had a reduction of 0.72 lbs/hr while the AM peak period had a reduction of 0.33 lbs/hr and the off peak period had a reduction of 0.08 lbs/hr.

Table K-31 list the emissions reductions by time period, while figures K-1 and K-2 graphically compare the before and after case. Overall VOC emissions decrease 4

[13] See UPWP 3.8, 2003 "Analysis of On-Road Control Strategies and Alternative Fuels for San Antonio Metropolitan Statistical Area September 13-20, 1999 Modeling Episode" (unpublished report) for a complete description of the Moble6 model and the data inputs used.

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lbs/day and NOx emissions decreased 1.3 lbs/day. This system had the smallest reduction in VOC and NOx emissions among the seven systems analyzed.

Table K-31. Idling VOC and NOx Emission for the Wetmore Traffic System, lbs/day

Time Period	VOC		NOx		Percent Change (VOC&NOx)
	Before	After	Before	After	
AM Peak	5.51	3.34	1.70	1.03	-39.33%
Off Peak	5.81	4.07	1.79	1.25	-30.00%
PM Peak	2.48	2.02	0.76	0.62	-18.72%
Total	13.80	9.43	4.25	2.90	-31.69%

Figure K-1. Idling VOC Emissions before and after New Timing Cycle Implementation on the Wetmore System

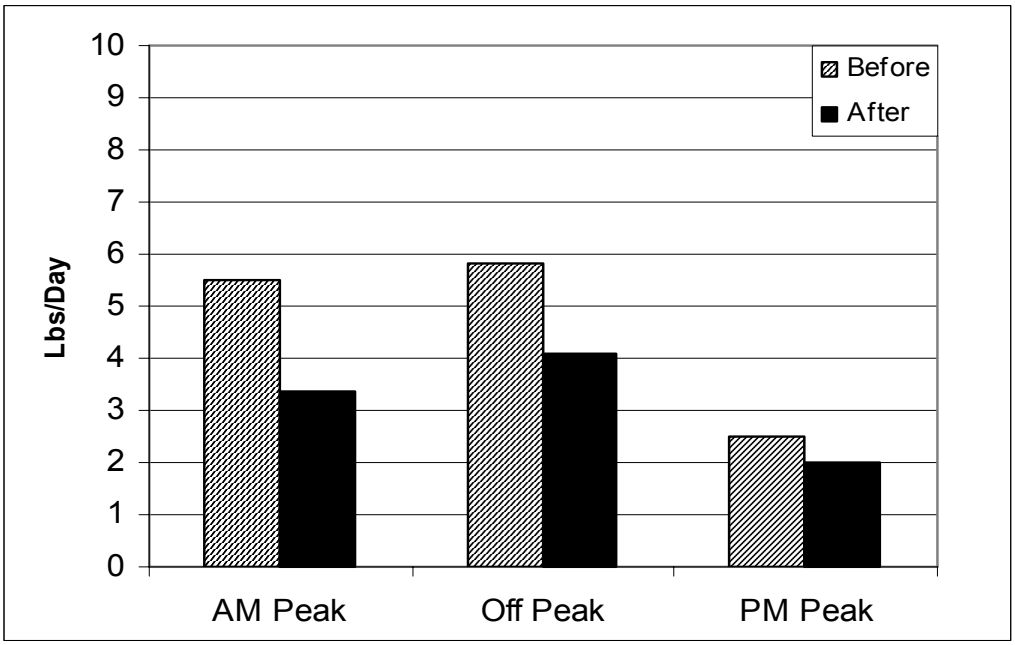

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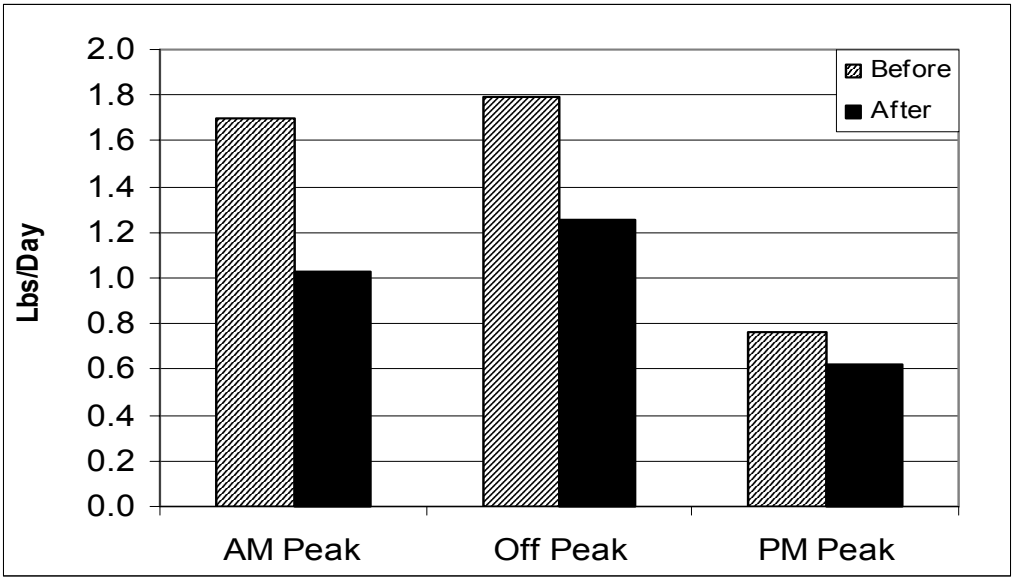
Figure K-2. Idling NOx Emissions before and after New Timing Cycle Implementation on the Wetmore System



Eisenhauer System Emissions Reductions

The recommended timing cycles for the Eisenhauer traffic signal system provided a constant reduction in idling VOC emissions. The AM peak, off peak, and PM peak idling VOC emission reduction on a per hour basis is about 6 lbs/hr. The cycles reduced idling NOx emissions at almost the same constancy as the idling VOC reductions, reducing AM peak and PM peak idling NOx emission reductions by about 2 lbs/hr and off peak idling NOx emission reduction by 1 lb/hr.

Table K-32 shows the emissions reductions for the 3 time periods. Also, Figures K-3 and K-4 provide VOC and NOx bar charts of the before and after the traffic re-signalization. Compared to the Off-Peak time of the other traffic light systems, this system had the greatest percentage reductions for the off peak period.

Table K-32. Idling VOC and NOx Emissions for the Eisenhauer Traffic Signal System, lbs/day

Time Period	VOC		NOx		Percent Change (VOC&NOx)
	Before	After	Before	After	
AM Peak	52.48	40.70	16.16	12.53	-22.45%
Off Peak	30.39	6.51	9.36	2.01	-78.57%
PM Peak	42.09	29.77	12.96	9.17	-29.28%
Total	124.96	76.98	38.47	23.70	-38.40%

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Figure K-3. Idling VOC Emissions before and after New Timing Cycle Implementation on the Eisenhauer System

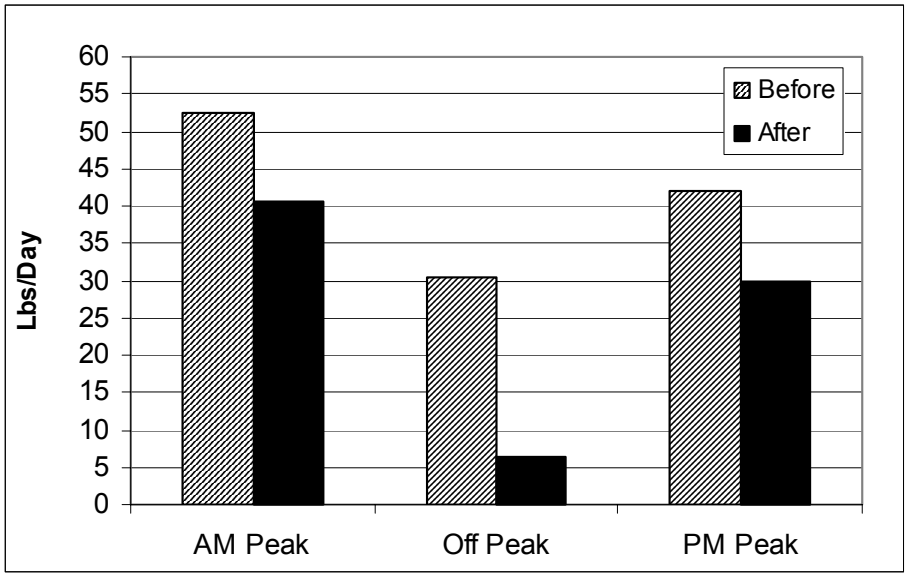
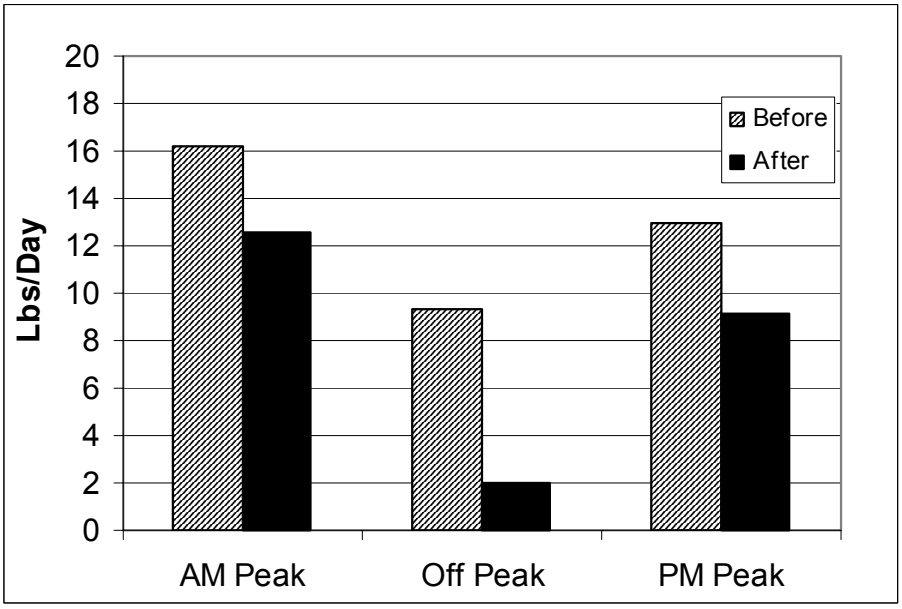


Figure K-4. Idling NOx Emissions before and after New Timing Cycle Implementation on the Eisenhauer System



Bitters/West Emission Reduction

The recommended timing cycles for the Bitters/West system reduced emissions during the time periods under study, with some reductions being more than others. Idling VOC emissions during the AM peak period were reduced on average by 2 lbs/hr. Off peak

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idling VOC emissions were reduced by 6 lbs/hr and PM peak idling VOC emissions were reduced by approximately 60 lbs/hr. Regarding reductions in idling NOx emissions, emissions were reduced in all three time periods with PM reductions being more significant than the other two periods. Idling NOx emissions were reduced by about 0.5 lbs/hr during the AM peak period and 2 lbs/hr during the off peak period. The idling NOx emission reduction during the PM peak period was observed at 19 lbs/hr.

As listed in Table K-33, overall VOC emissions were reduced by 166 lbs/day and NOx emissions were reduced 51 lbs/day. This represents the second greatest total reduction of all the single systems studied. The results are graphically display in Figures K-5 and K-6.

Table K-33. Idling VOC and NOx Emission for the Bitters/West Traffic Signal System, lbs/day

Time Period	VOC		NOx		Percent Change (VOC&NOx)
	Before	After	Before	After	
AM Peak	25.50	21.78	7.85	6.71	-14.58%
Off Peak	166.32	128.06	51.21	39.43	-23.00%
PM Peak	190.93	67.29	58.79	20.72	-64.76%
Total	382.76	217.14	117.85	66.85	-43.27%

Figure K-5. Idling VOC Emissions before and after New Timing Cycle Implementation on the Bitters/West System

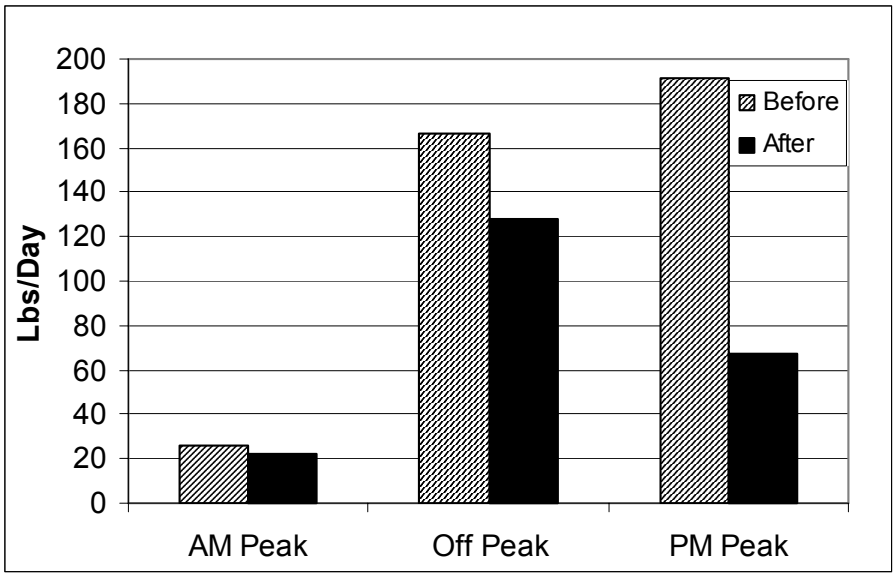

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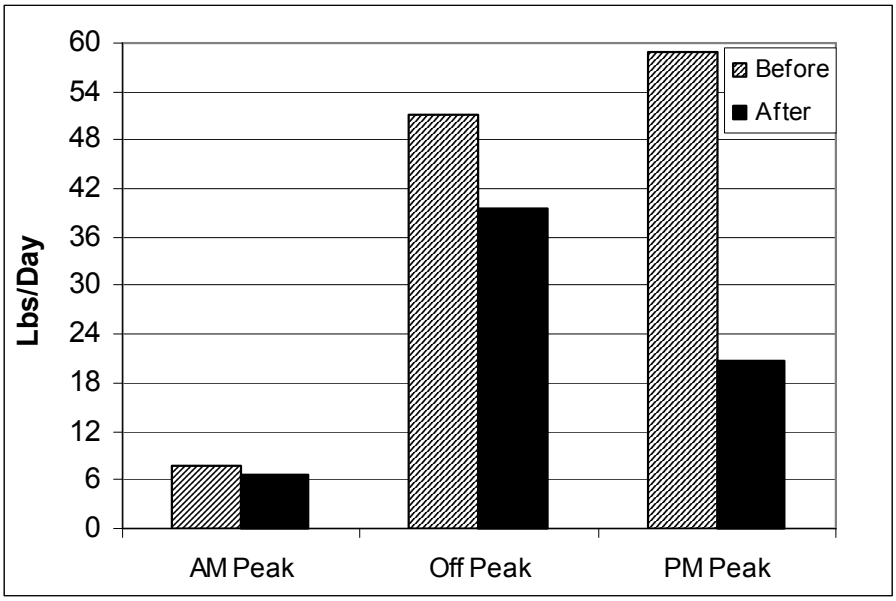
Figure K-6. Idling NOx Emissions before and after New Timing Cycle Implementation on the Bitters/West System



Bandera Emission Reduction

The timing cycle implemented on the Bandera traffic system reduced idling emissions. The emission reduction of idling VOC precursors was 1 lb/hr and 2 lbs/hr during the off peak period and AM peak period, respectively. The idling emission reduction for the PM peak period is significantly higher with a reduction of 200 lbs/hr.

Listed in Table K-34 are the VOC and NOx emissions reductions for each other the three time periods for this system. As expected, this intersection had the greatest reduction in VOC (433lbs) and NOx (133lbs) emissions. This system also had the highest percentage reduction in emissions too. The dramatic drops in emissions are shown in figures K-7 and K-8.

Table K-34. Idling VOC and NOx Emissions for the Bandera Traffic Signal System, lbs/day

Time Period	VOC		NOx		Percent Change (VOC&NOx)
	Before	After	Before	After	
AM Peak	40.41	35.08	12.44	10.80	-13.19%
Off Peak	33.26	27.71	10.24	8.53	-16.66%
PM Peak	529.08	107.27	162.90	33.03	-79.73%
Total	602.74	170.06	185.58	52.36	-71.79%

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Figure K-7. Idling VOC Emissions before and after New Timing Cycle Implementation on the Bandera System

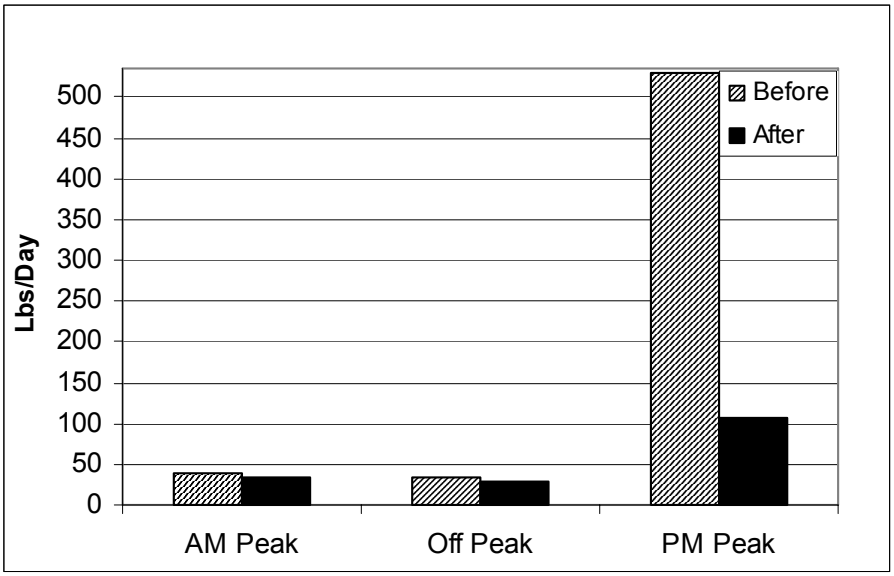
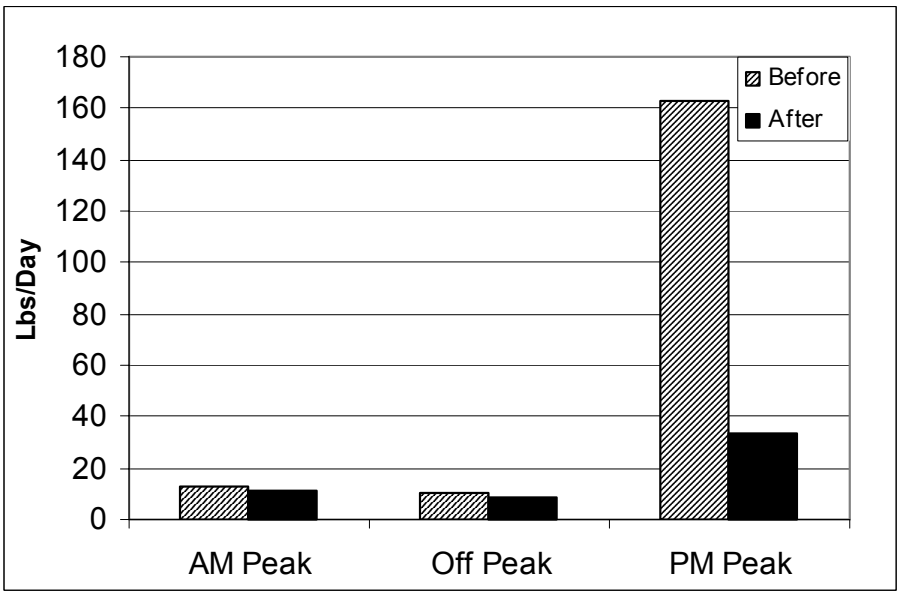


Figure K-8. Idling NOx Emissions before and after New Timing Cycle Implementation for the Bandera System



Rittiman Emission Reduction

For the Rittiman traffic signal system, VOC and NOx emission reductions are significant during the PM peak hour periods than the AM peak periods or the off peak periods. The VOC reduction for the PM peak period was 27 pounds per hour. The AM peak had a reduction of 11 pounds per hour and off peak had a reduction of 0.5 pounds her hour. NOx emissions were reduced by 8 pounds per hour during the PM peak period. The AM

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peak period had a reduction of 3.5 pounds per hour and the off peak period had a reduction of 0.2 pounds per hour.

Overall, there was a reductions of 82lbs of VOC and 25 lbs reduction in NOx (Table K-35). This represented the second highest overall percentage reduction at 47%. Figures K-9 and K-10 graphically displays the results for VOC and NOx reductions.

Table K-35. Idling VOC and NOx Emission Reductions for the Rittiman Traffic Signal System, lbs/day

Time Period	VOC		NOx		Percent Change (VOC&NOx)
	Before	After	Before	After	
AM Peak	54.42	31.94	16.76	9.83	-41.31%
Off Peak	14.92	10.85	4.60	3.34	-27.29%
PM Peak	106.98	51.40	32.94	15.82	-51.96%
Total	176.32	94.19	54.29	29.00	-46.58%

Figure K-9. Idling VOC Emissions before and after New Timing Cycle Implementation on the Rittiman System

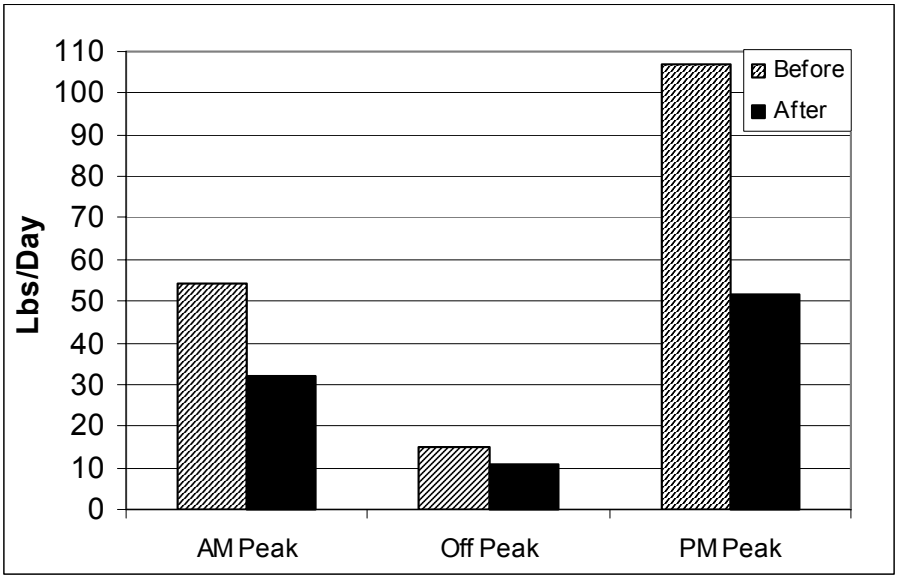

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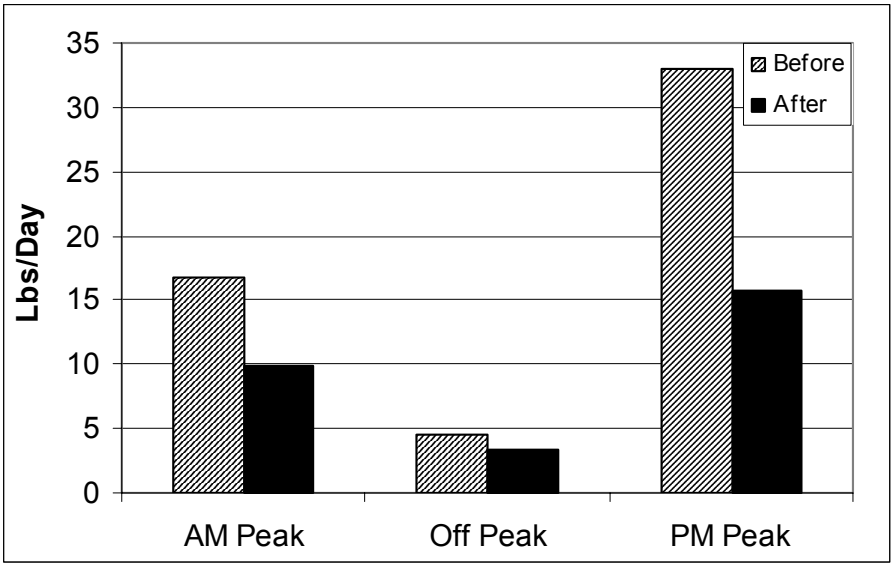
Figure K-10. Idling NOx Emissions before and after New Timing Cycle Implementation for the Rittiman System



Jones-Maltsberger Emission Reduction

Minimal emission reduction was evident once the recommended timing cycles were modeled for the Jones Maltsberger traffic signal system (Table K-36). The AM peak period had a VOC emission reduction of 0.6 pounds per hour and a NOx emission reduction of 0.2 pounds per hour. An emission reduction of 3 pounds per hour in VOC emissions and 0.8 pounds per hour in NOx emissions was noted for their PM peak period. The off peak period had an emission reduction of 0.3 pounds per hour of VOC emissions and 0.1 pounds per hour of NOx emissions. Figures K-11 and K-12 shows the emissions reductions by time period in bar graph format.

Table K-36. Idling VOC and NOx Emissions for the Jones Maltsberger Traffic Signal System, lbs/day

Time Period	VOC		NOx		Percent Change (VOC&NOx)
	Before	After	Before	After	
AM Peak	6.36	5.12	1.96	1.58	-19.52%
Off Peak	19.26	17.37	5.93	5.35	-9.86%
PM Peak	19.07	13.57	5.87	4.18	-28.85%
Total	44.69	36.05	13.76	11.10	-19.34%

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Figure K-11. Idling VOC Emissions before and after New Timing Cycle Implementation on the Jones Maltsberger System

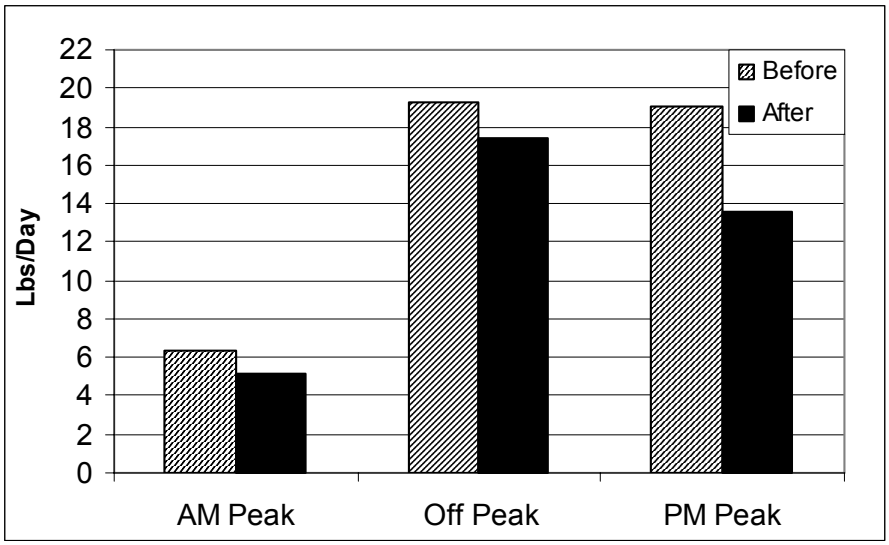
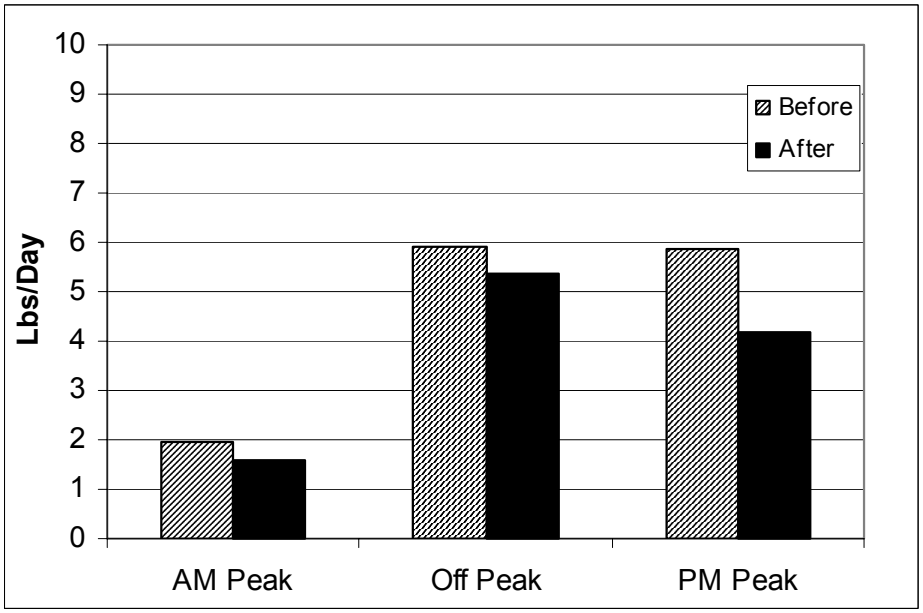


Figure K-12. Idling NOx Emissions before and after New Timing Cycle Implementation on the Jones Maltsberger System



Nacogdoches/Perrin Beitel Emission Reduction

The new timing cycles for the Nacogdoches/Perrin Beitel traffic signal system provided small emission reductions as well. The most emission reduction was noted in VOC emissions during the PM peak period, which amounted to two pounds per hour. The AM peak had an emission reduction of 0.6 pounds per hour and the off peak period had an emission reduction of 0.3 pounds per hour. Reductions in NOx emissions were small in

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all three periods, the AM peak period having a reduction of 0.15 pounds per hour, off peak had a reduction of 0.09 pounds per hour and the PM peak having a reduction of 0.5 pounds per hour.

This system had the lowest percentage reduction in emissions with only an overall reduction on 5 percent. Also, table K-37 show that this intersection had the second lowest reduction in overall emissions with (7 lbs for NOx and 2 lbs for VOC). The results are also displayed in figures K-13 and K-14.

Table K-37. Idling VOC and NOx Emissions for the Nacogdoches/Perrin Beitel Traffic Signal System, lbs/day

Time Period	VOC		NOx		Percent Change (VOC&NOx)
	Before	After	Before	After	
AM Peak	11.69	10.41	3.60	3.20	-10.95%
Off Peak	44.23	42.57	13.62	13.12	-3.68%
PM Peak	92.21	88.37	28.39	27.21	-4.16%
Total	148.12	141.35	45.61	43.53	-4.55%

Figure K-13. Idling VOC Emissions before and after New Timing Cycle Implementation on the Nacogdoches/Perrin Beitel System

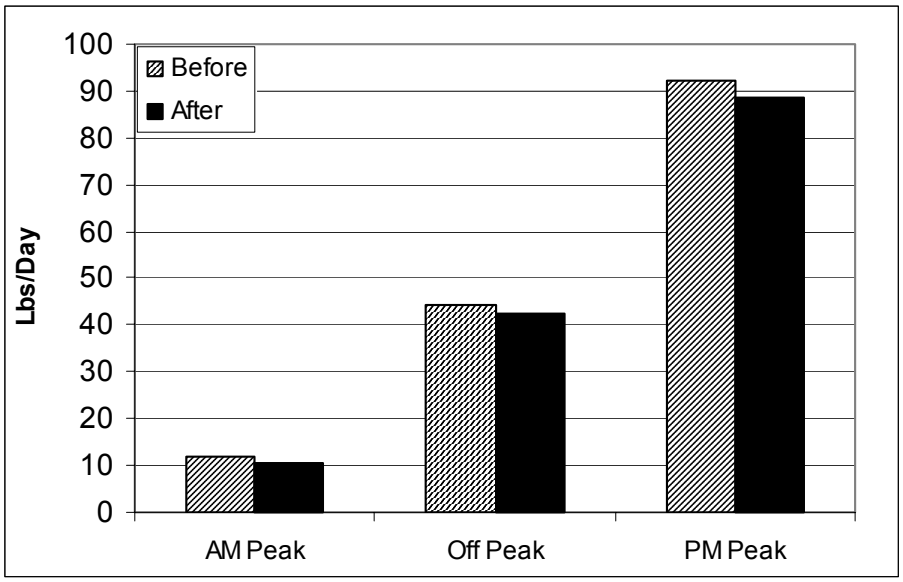

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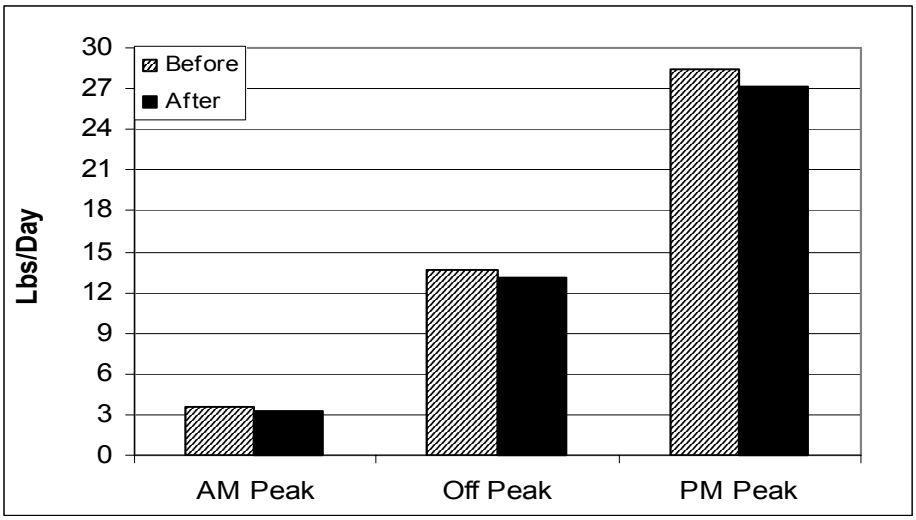
Figure K-14. Idling NOx Emissions before and after New Timing Signal Implementation for the Nacogdoches/Perrin Beitel System



The overall reduction of emissions over the selected time frame is illustrated in Figure K-8-15. There was a higher incidence of reduction in VOC emissions than in NOx emissions, however, for both precursors the highest reduction was noted in the PM peak hours followed by the AM peak hours. The figure graphically depicts the first modeling day for an example of the time curve. The graph shows that the PM peak emissions reductions were significant, while morning peak hour reductions were not as high as expected. The same trend was noted during all the days analyzed in the photochemical model.

Conclusion

Several steps were utilized to analyze selected traffic signal systems to estimate the emission reduction due to the improved timing cycles. Preliminary evaluation of the traffic signal systems Pape-Dawson Engineers, Inc involved data collection, design improvements, optimal timing plan development and implementation, and simulation of before and after conditions. Several models, the TRANSYT-7F, Synchro 3.2, and PASSER II, were used in the evaluation and assessment of the traffic signal systems. These models provided simulation files, “before” traffic flow simulations, and optimal timing cycles for the traffic signal systems.

Analysis of the recommended timing cycles for the various traffic signal systems indicated a reduction of ozone precursors if the cycles were implemented. The highest reduction was noted in the PM peak hours, followed by the AM peak hours, and then off peak had a consistent yet small reduction in VOC and NOx emissions.
The amount of the emission reduction was not a substantial amount to cause a notable and significant reduction in ozone levels. This could be due to the fact that approximately seven intersections were involved in the study rather than several dozen to several hundred. If more systems had been involved with the study then it is possible that a great amount of reduced emissions could equivocate to a greater reduction in ozone levels.

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Also, since most of the ozone reduction occurred during the PM Peak Hours, the reductions had minimal impact on ozone levels. For the San Antonio area, On Road emissions impact ozone levels the greatest during the late morning and lunch periods, while late afternoon on-road emissions have a minimal impact on ozone levels[14].

[14] For a further description please see San Antonio-Bexar County MPO, June 2002, "UPWP 3.12: Photochemical Analysis of Transportation Control Measures and Alternative Fuel Vehicle Fleets", San Antonio, Texas.

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ENERGY EFFICIENCY / RENEWABLE ENERGY PROJECTS
On December 13, 2002, the TCEQ revised the Houston-Galveston (HGA) SIP to include a protocol for implementing and calculating reductions from energy savings resulting from state Senate Bill 5 and Senate Bill 7 measures. This revision was followed by a revision to the Dallas-Fort Worth (DFW) SIP on March 5, 2003, which included an estimate of NOx reductions associated with SB5 and SB7. (Source: EEIRE)

Since that time, efforts have been underway both to implement the energy reductions required by the state and to quantify the associated ozone precursor reductions. Air quality planners in the San Antonio region currently benefit from a partnership created by the TCEQ between AACOG, the Energy Systems Laboratory (ESL) of Texas A&M University, the local Metropolitan Partnership for Energy, and the Brooks Energy Sustainability Laboratory (BESL) of the Texas Engineering Experiment Station.

ESL is charged by the state to assist local entities subject to Energy Efficiency mandates with these reduction quantification estimates. Under a recently-signed Memorandum of Agreement, BESL is to assist the ESL with technical assistance as part of its duties under Senate Bill 5 by producing an inventory of energy use and savings from existing and planned (through 2007) energy efficiency and renewable energy (EE/RE) projects. The Metropolitan Partnership for Energy (MPE) is assisting these other entities in the identification and inventory of existing and planned EE/RE using its reasonable best efforts.

The TCEQ guidance, "Incorporating Energy Efficiency and Renewable Energy (EEIRE) Projects in the SIP" is being used to provide specific guidance to BESL on content and reporting requirements, including requirements for a spreadsheet to facilitate conversion into creditable NOx reductions by the ESL.

The inventory is due to contain EE/RE project data from local, State, Federal and major private sector companies such as USAA and Toyota.

Types of projects will include, but not be limited to:
1. State-mandated IECC building codes and above code construction as well as special rating programs such as Build San Antonio Green and LEED ratings;
2. Local distributed energy projects including PV, solar-thennal, and fuel cells; renewable energy projects from remote locations planned;
3. Local government energy improvement projects including water and wastewater, street lighting and traffic signals;
4. Major energy conservation retrofits for existing facilities including Continuous Commissioning®, major equipment and control upgrades, and cool roofs, etc.

Deliverables will include:
a) Development of inventory of creditable local area SIP EE/RE projects.
b) Final report in spread sheet format of existing and planned energy efficiency projects by category, level of energy savings or clean energy from renewable energy projects.

Although credit is not taken here for the Energy Efficiency / Renewable Energy Projects in the region, the benefits of the reductions accrue as Additional Evidence that the San Antonio region will reach attainment. With the completion of the work accomplished

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through this partnership, the San Antonio regional air quality planners will include the SIP credit available.

According to the very first draft efforts of the BESL/ESL/TCEQ/MPE/AACOG team, Energy Efficiency measures under Senate Bill 5 give the following reductions in energy production, in megawatt-hours per year (MWH/year):

- For Bexar County, the electricity savings are 18.179 MWH/year.
- For Guadalupe County, the electricity savings are 1.217 MWH/year.

With further research, these energy reductions will be quantified and precursor reductions located, as given in the outline above.

Executive Order 13123: Greening the Government Through Efficient Energy Management

Executive Order 13123 calls for Federal agencies to improve the energy efficiency of their buildings, promote the use of renewable energy, and reduce greenhouse gas emissions associated with energy use in their buildings, among other energy-related requirements. AACOG is working with several state sponsors to petition the federal government for emissions reductions credits for energy reductions in federal buildings. San Antonio has a high concentration of federal buildings subject to EO 13123. Just as credit for energy efficiency is afforded by state rules in Texas, credit should be available for energy efficiency measures installed in local federal buildings, as appropriate.

References:

"Incorporating Energy Efficiency and Renewable Energy (EEIRE) Projects in the SIP," February 5, 2004, Texas Commission on Environmental Quality, Austin, Texas

Federal Register Publication of Executive Order 13123 - Greening the Government Through Efficient Energy Management; published June 8, 1999. Online: http://www.eere.energy.gov/femp/pdfs/eo13123.pdf

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PUBLIC EDUCATION

Introduction

The following pages describe the public outreach and education projects undertaken by AACOG staff for the purpose of disseminating information on air quality and informing the public of seriousness of air pollution problem in the San Antonio area. The main goal is to familiarize the public with actions they can take to improve the air quality.

Public Education to Encourage Voluntary Pollution Reduction Measures

The Air Improvement Resources Committee (AIR Co) has always recognized and will continue to recognize that public education is crucial to achieving long-term air quality improvement. Shortly after its formation, AIR Co created a Public Education subcommittee, comprised of public outreach specialists from local governments, utilities, and non-profits and chaired by AACOG staff, to oversee public outreach and education efforts.

The main goals of the Public Education committee are two fold; 1) to educate the public on the health risks posed by ozone pollution and how they can protect themselves, and 2) to encourage the public to take voluntary action to reduce ozone pollution. The primary method of basic ozone pollution and health education is the Air Quality Health Alert (AQHA) notification system and associated publicity and outreach efforts. The main voluntary pollution reduction measures advocated through publicity, paid media and presentations are:

Maintain your vehicle. (basic car care)
Drive less. (Commute Solutions, combining errands, walking and bicycling)
Don't idle. (Adopt-A-School Bus No-Idle Program)
Re-fuel in the evening.
Don't "top off".

To achieve its goals, the Public Education committee makes full use of advertising funds made available through grants from the Texas Commission on Environmental Quality, the Texas Department of Transportation, and, when available, the Environmental Protection Agency. In addition, AACOG staff makes significant efforts to obtain free publicity for air quality issues. Public education and outreach efforts, including paid advertising, publicity and other voluntary measures campaigns are summarized in the following paragraphs.

Air Quality Health Alert Notification System

AACOG provides and will continue to provide free AQHA notification for citizens, organizations, and companies within the region. The AQHA system informs citizens of TCEQ's forecast of high ozone pollution levels on a given day through emails and faxes distributed the afternoon prior to that day. The faxes not only advise recipients of the high ozone pollution forecast and advocate health protection, but also suggest voluntary measures that citizens can make year-round to help reduce ozone pollution. AACOG actively promotes this free service and has more than doubled the number of recipients in the last two years. As of March 2004, the number of registered recipients of AQHA notifications was approximately 1,000, many of whom spread the email to their entire organization, increasing the number of recipients to several thousand.

AQHA notifications are also provided to major media outlets and AACOG maintains relationships with those outlets to ensure that Alerts are broadcast with local news and

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weather. In the near future, AACOG hopes to increase pressure on local media outlets to provide a daily Air Quality Index (AQI) report in addition to AQHAs. Past efforts have already resulted in daily AQI reports from two outlets, News 9 San Antonio (cable television news) and the San Antonio Express-News (primary metropolitan newspaper). As a part of actively promoting the AQHA notification system, AACOG staff routinely presents air quality and health issues to local community groups, businesses and students of all ages. Information on regional clean air policy and voluntary pollution reduction measures is and will continue to be included as a part of these presentations.

Paid Advertising

Paid advertising campaigns are broadcast on various local radio and television stations, in local newspapers, on highway billboards, and on Internet "hub" websites. Messages used promote clean air actions such as vehicle maintenance, fueling in the evening, and driving less by carpooling, combining errands, or using mass transit. A summary of paid media campaigns for 2001, 2002, and 2003 is available upon request as an example of standard advertising campaigns undertaken by this program. In general, the program advertises using radio "traffic" advertisements because they reach individuals where they are most susceptible to messages about alternate commuting, vehicle maintenance, and cleaner air: while they sit in their vehicles in traffic. The program also uses limited television advertising to convey both air quality and Commute Solutions promotion messages and, additionally, uses newspaper to advertise special events, such as the annual Ozone Season Kickoff event, which is described in later sections. The paid advertising budget is provided through the Alamo Area Commute Solutions grant funds from the Texas Department of Transportation. Advertising Commute Solutions transportation alternatives and their relation to improved air quality has been a major task in the Commute Solutions grant work plan for over five years and will continue to be as long as AACOG is the recipient of those grant funds.

Publicity

AACOG staff regularly issue news briefs, news releases, and Air Quality Health Alerts to local media in order to obtain coverage of air quality issues and events. Media coverage for 2001-2003, provided to show the continually increasing effort and result of AACOG staff work, is summarized in the table below:

Table K-38. Media coverage for 2001-2003

Media Coverage	2001	2002	2003	2004 Goals
Television Pieces	10	32	34	50
Radio Pieces	9	32	37	50
Print News Pieces	16	38	70	100

In 2003 alone, AACOG issued over 40 news items. AACOG staff will continue to issue news items and plans to increase the number of items issued each year.

Outreach Events & Presentations

AACOG staff also hosts and/or participates in community events, gives presentations to civic groups, and gives interactive lessons to student groups. As an example of the region's continuing commitment to educating individuals on a personal or small group basis, events, presentations, and interactive lessons given in the past three years are summarized below:

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Table K-39. Outreach Activities

Outreach Type	2001	2002	2003	2004 Goals
Civic Group Presentations	27	23	34	50
School-Related Presentations	12	9	20	25
Events	18	19	27	40

At each of these outreach events or presentations, staff disseminates informational and promotional items to remind the public of ozone pollution's health effects and encourage individual voluntary pollution reduction measures. Materials are produced by AACOG through the Commute Solutions budget and are also donated to AACOG by various state and federal agencies, including the Texas Department of Transportation, the Texas Commission on Environmental Quality and the Environmental Protection agency. An example of this materials dissemination lies in the first eight weeks of 2004, in which staff has distributed over 4,000 items and reached over 1,600 individuals.

Website

In addition to external outreach efforts, AACOG staff maintains an air quality website, www.aacog.com/air, that provides extensive information on ozone pollution, its causes, its health effects, and voluntary measures citizens can take to help reduce the pollution problem. The website is constantly updated and expanded, providing weekly air quality facts and the latest news on air pollution and policy issues. Beyond just providing information, the website allows users to make requests of staff, including online registration for the AQHA program, informational and promotional materials requests and requests for air quality presentations for students or organizations.

Alamo Area Commute Solutions Program

The Alamo Area Commute Solutions Program, funded by the Texas Department of Transportation, seeks to reduce traffic and air pollution by promoting commute alternatives, including:

RideShare (carpooling and vanpooling)
Alternate Schedule (compressed work week and flex scheduling)
Mass Transit
Telework
Bicycling and Walking

The Commute Solutions Program has experienced great success in the past by targeting not only individual commuters with radio and television outreach, but by approaching businesses to institute Commute Solutions programs as benefits for their employees. Over 4,000 individuals currently participate in the Commute Solutions program. Commute Solutions will continue to increase success by further targeting outreach to companies through the Best Workplaces for Commuters program. As this program allows employers to receive substantial tax savings and improved public image by meeting a national standard of excellence in commuter benefits, it is a much improved tool for encouraging and actually achieving a reduction in single occupancy vehicle travel and, hence, air pollution.

In addition, Commute Solutions promotes and assists with the implementation of two commute assistance programs for schools, SchoolPool and Walking School Bus. By

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reaching out to parents and schools through Parent Teacher Association meetings, mailings, and contact with administrators, Commute Solutions staff establishes and maintains School Pool and Walking School Bus programs that allow parents to share the responsibilities of driving or chaperoning a group of walking children on the way to and from school. This reduces the number of cars idling in the school's student pick-up/drop-off zone, which directly reduces pollution and also improves safety by reducing potential student-vehicle interaction in the parking lot.

All Commute Solutions services are available through the Commute Solutions website, www.aacog.com/commutesolutions, which is constantly updated and expanded. This website will be maintained throughout the coming years and will be used to provide ever quicker, more responsive, more accurate services to the region's commuters.

Adopt-A-School Bus Idling Reduction Program

Through the Adopt-A-School Bus grant, AACOG is embarking upon a new air quality outreach campaign focused on idling reduction. The No Idle program will educate students, parents, teachers and administrators on the air quality improvements possible through reduced idling, both by buses and passenger vehicles, during student drop-off and pick-up. The program will encourage drivers to "Clean it up. Turn it off. Keep it Green." by turning off their passenger vehicle engines when the vehicle will remain idle for more than ten seconds. Similar idling limits will be sought of bus drivers.

The main methods for this outreach will be personal contact and presentations to students, parents, school staff, and bus drivers. Students will participate as a "Green Patrol", tracking and rewarding drivers who are not idling. Parents and bus drivers will take the "No Idle Pledge." Schools will become certified "No Idle Zones."

Though schools will be the first focus of this program, once success is achieved at the schools, the program will be expanded to encourage reduced idling while waiting in parking lots and drive-through lanes.

A projected replacement of 275 school buses for the San Antonio area over the course of three school fiscal years could realize a reduction of approximately 110 tons/year of NO_x and 11 tons/year of PM. There would be an added benefit of a substantial reduction in the emissions of air toxins as well. There could be a combination of replacement and retrofitting of buses to achieve NO_x and PM reductions, depending on technology available and the availability of low-sulfur fuel.

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LAWNMOWER RECYCLING PROGRAM

Introduction

Lawnmowers, rotary tillers, lawn and garden tractors, leaf blower/vacuums, and chainsaws are examples of this residential equipment category. When aggregated, residential equipment represents a major source of emissions that contribute to the pollution of air. There are ongoing efforts, with a degree of success, in the San Antonio area to mitigate pollution generated by residential lawn and garden equipment. In the following pages these efforts and attributed emissions benefits are discussed.

Calculating Emission Factors

An essential part of calculating residential equipment emissions is the use of an accurate emission factor (EF) for each pollutant. In the process of 1999 emission inventory, AACOG staff developed techniques for calculating residential equipment EFs, which have been documented in a report entitled " *1999 Emissions Inventory for the Alamo Area Council of Governments Region, August 2001*." These EFs will be used here to calculate the amount of emission reduction due to the CPS's "Mow Down Smog" lawnmower recycling initiative. The followings, taken from the above mentioned report, will describe this calculation procedure in more detail.

"In an effort to find more recent and specific equipment type EFs, EPA's recently updated (April 2000) Nonroad Emission Inventory Model was used.[15] The EFs for residential equipment were developed using the following process:[16]

A 1999 Nonroad Model run for residential equipment was done for Texas.
The output from this run was used to obtain the following for all types of residential equipment:
HC, CO (i.e., a colorless, odorless and tasteless gas released primarily by incomplete combustion of fossil fuels) and NO_x (i.e., a group of gases released by the combustion of fossil fuels and natural sources such as forest fires, lightning and decaying vegetation) emissions in tons/year for each type of equipment
Equipment populations (Eqmt. Pop) for each type of equipment
The Nonroad Model input file activity.dat, was then used to obtain the following values:
The activity rate of each type of equipment in hrs/yr. (HRS)
A LF (the average power level at which the engine operates divided by the maximum available power) for each type of equipment
The average horsepower (Avg. hp) for each type of equipment was then determined from the Nonroad Model input file Tx.pop.
With all the factors in place, EFs for HC, CO, and NO_x were then calculated using the following formula:

EF (g/bhp-hr) = (tons/year of pollutant) x (2000 lbs./ton) x (453.6 g/lb.)/ (Eqmt. Pop) x hrs/yr.) x (Avg. Hp) x (LF)

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[15] U.S. Environmental Protection Agency, 1992. Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources. Research Triangle Park, NC., and U.S. Environmental Protection Agency, 1991. Nonroad Engine and Vehicle Emissions Study Report. Washington, DC.

[16] U.S. Environmental Protection Agency, 2000. Nonroad Emission Inventory Model. Ann Arbor, MI.

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The resulting EFs are used in calculating emissions from each type of equipment."

For reference, the following tables, which describe the residential equipment parameters and the calculated EFs for the residential equipment, reported in the above mentioned 1999 EI, are presented in this appendix:

Table K-40: Residential Equipment

Residential Equipment Parameters		
Equipment Type and Category	Average Horsepower (HP)	Load Factor (LF)
RT/R/2S	2.321	0.4
RT/C/2S	2.321	0.4
CS/R/2S	2.110	0.7
CS/C/2S	3.532	0.7
LV/R/2S	1.363	0.94
LV/C/2S	1.956	0.94
LM/R/4S	4.070	0.33
LM/C/4S	4.070	0.33
RT/R/4S	4.712	0.4
RT/C/4S	4.712	0.4
LV/R/4S	3.420	0.94
LV/C/CS	10.924	0.94
RERM/R/4S	10.657	0.38
RERM/C/4S	10.657	0.38
FM/C/4S	13.519	0.65
OLGE/R/4S	5.356	0.58
OLGE/C/4S	5.387	0.58

Table K-41: Emissions Factors

Calculated EFs for Residential Equipment (grams/hp-hr)							
Equipment Type	VOC					CO Exhaust	NOx Exhaust
	Exhaust	Crank	Diurnal	Displ.	Spillage		
LM/R/4S	52.0869	2.0697	3.3551	0.8595	7.2977	658.3792	2.7479

The next step in our calculation process entails estimation of length of time that a typical lawnmower is used in San Antonio area. By applying the EFs for NOx and VOC emissions to this length of time, the amount of emissions generated by a typical residential lawnmower can be calculated.

Lawnmower Usage Time

This length of time, according to the 1999 EI report, is 35.9872 hours per a year for Bexar County, which is the assumed area of interest for this calculation and the CPS's "Mow Down Smog" recycling program. Table K-42 illustrates how this usage time has been calculated.

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Table K-42: Adjusted Lawnmower Usage Time

How many hours per summer week is the gasoline powered lawnmower used?					Lawnmower Use Ratio	Use (hr/yr.)
Choice (minutes per week)	Survey Response	Survey Response Ratio	Adjusted Survey Response	Adjusted Survey Response Ratio		
None	14	0.0388	0	0.0000	0.8643	0.0000
0-15	11	0.0305	11	0.0353		0.1234
15-30	24	0.0665	24	0.0769		0.8077
30-45	50	0.1385	50	0.1603		2.8045
45-60	75	0.2078	75	0.2404		5.8894
60-90	48	0.1330	48	0.1538		5.3846
90-120	25	0.0693	25	0.0801		3.9263
120-150	30	0.0831	30	0.0962		6.0577
>150	49	0.1357	49	0.1571		10.9936
Don't know	35	0.0970	0	0.0000	Total Use	35.9872
Total	361	1.0000	361	1.0000		

Emissions Reductions Amounts

The next step is to calculate the emission reduction amount (pound/day) due to the recycling of 4-cycle residential lawnmowers for emissions of VOC (exhaust, crank, diurnal, displacement, and spillage), CO exhaust, and NOx exhaust categories in Bear County. This process entailed use of EFs from Table K- 42 for LM/R/4S equipment and the following formula from 1999 EI report.

Emissions for VOC, NOx, and CO = EP x HRS x HP x LF x EF

Where:

EP = equipment population
HRS = annual hours of use
HP = average rated horsepower
LF = typical load factor
EF = average emissions of pollutant per unit of use

Table K-43 illustrates the results of this calculation for all VOC, CO, and NOx categories in Bexar County.

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Table K-43: Reduced Emissions from “Mow Down Smog” Recycling Program

2003 Emission Reduction due to City Public Service "Mow Down Smog" Program *pound per ozone season day**						
Emission	Exhuast	Crank	Diurnal	Displ.	Spillage	Total
VOC	90.62	3.60	5.84	1.50	12.70	114.24
NOx	4.78					4.78
CO	1145.39					1145.39

**Ozone season in 1999 EI report consists 196 days*

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TRUCKSTOP ANTI-IDLING PROGRAM

IdleAire provides individual electrical service for 53 parking spaces at the TransAmerica Truck Stop the intersection of Foster Road and IH-10 East. This has traditionally been referred to as “truck stop electrification (TSE).” On top of TSE, IdleAire provides other layers of services that comprise Advanced Travel Center Electrification (ATE), a flexible package that can be altered and customized to industry needs. Currently, a heating, cooling and ventilation unit sits above each parking space. The unit is connected to the Service Delivery Module by means of a flexible, reinforced, concentric hose, which also houses the delivery mechanisms for the communications and entertainment packages. All TSE and ATE services, including temperature, fan speed and all other service selections, are delivered to and independently controlled by each individual driver in the truck cab via the Service Delivery Module.

The IdleAire system *removes 100% of emissions associated with extended diesel idling,* including nitrogen oxides (NOx), particulate matter (PM), volatile organic compounds (VOC), carbon monoxide (CO) and carbon dioxide (CO2). The system has a net reduction of 98% of criteria pollutants under the Clean Air Act after accounting for the electricity from the grid used to power the system, and an overall 83% net emissions reduction. *Per each parking spaces each year (assuming 60% utilization)*, those diesel emissions amount to an estimated .71 metric tons of NOx, .014 tons of PM, .036 tons of VOC, 54.65 tons of CO2, and .30 tons of CO totaling 55.71 metric tons a year. Applied to the 53 parking spaces at this facility, those emissions would amount to about 2952.63 tons each year. The IdleAire system saves 100% of the diesel fuel associated with extended diesel idling, approximately 1.0 to 1.1 gallons per hour.

WALKING SCHOOL BUS PROGRAMS

Walking School Bus programs help provide a safe and healthy way for young students to travel to and from school while also decreasing vehicle-related pollution, increasing child activity, and relieving parents of extra morning stress. Currently, many students who live to near to school to ride the bus are driven to and from school by their parents. Both the additional vehicle miles traveled and vehicle time spent idling due to parental drop-off and pick-up are sources of air pollution. Walking School Bus matches parents of non-bus riding students who live near one another and attend the same school. The matched parents are then advised to set up a schedule by which they divide chaperoning duties for a small group of students on their walk to school. Parental supervision increases the safety of the student walkers and thus eases parent fears about allowing their children to walk rather than be driven. Walking to school provides the students with healthy daily activity, and, with fewer vehicles making the home-to-school commute air pollution and parental stress are significantly reduced.

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Lower Reid Vapor Pressure

Fuel control measures are effective strategies for states to use to reduce ozone pollution. The two primary approaches to fuel controls are state opt-in to the federal RFG program subject to certain conditions, and state adoption of a low Reid Vapor Pressure (RVP) requirement that is more stringent than the applicable federal RVP requirement. While both approaches reduce volatile organic compounds, which are precursors to ozone, they differ in their overall environmental benefits, whether the state or federal government administers them, and the statutory provisions governing their adoption.

About Credits for Lower RVP Under an Early Action Compact

In general, the Clean Air Act (CAA) provides that states are preempted from adopting their own fuel control requirements different from existing federal requirements. However, EPA may waive preemption under certain circumstances.

State opt-in to the RFG program is not preempted because EPA establishes and enforces the federal RFG requirements at the federal level and the Act provides explicit authority for states to opt-in to the federal requirements under section 211(k).

State adoption of low RVP gasoline requirements is controlled by section 211(c)(4) of the CAA. Section 211(c)(4)(A) prohibits[17] states from prescribing or attempting to enforce any "control or prohibition" of a "characteristic or component of a fuel or fuel additive" if EPA has promulgated a control or prohibition applicable to such characteristic or component under section 211(c)(1). This preemption does not apply if the state control is identical to the federal control. Section 211(c)(4)(C) provides an exception to this prohibition for a non-identical state standard contained in a state SIP where the standard is "necessary to achieve" the primary or secondary NAAQS that the SIP implements. EPA can approve such a state SIP provision as necessary if the Administrator finds that "no other measures that would bring about timely attainment exist," or that "other measures exist and are technically possible to implement, but are unreasonable or impracticable."

The 7.2 psi gasoline RVP of for the San Antonio region was proposed after undertaking careful and in depth modeling, cost-benefit analysis, and consideration of sentiments of the local communities and their elected officials. The local refineries have also been contacted to determine their ability to produce and market this fuel with considerable competition among each other. It was determined that the refiners were technologically capable of producing the proposed gasoline fuel and the market forces would drive the at-pump price.

If allowed, adoption of this fuel during the ozone season is expected to help reduce emissions of VOCs and NOx by 2.1 and 0.05 tons/day respectively. The requirement for gasoline refineries to provide such gasoline will only be during the months of March through October, which is usually the time of the year ozone levels exceed the national standard in San Antonio region. Currently, the State's Regional Low RVP Gasoline

[17] Federal Clean Air Act, Sec. 211. (a)(4)(A) "Except as otherwise provided in subparagraph (B) or (C), no State (or political subdivision thereof) may prescribe or attempt to enforce, for the purposes of motor vehicle emission control, any control or prohibition respecting any characteristic or component of a fuel or fuel additive in a motor vehicle or motor vehicle engine." Available online as http://www.epa.gov/oar/caa/caa211.txt.

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program requires that low RVP gasoline be used in 95 central and eastern Texas counties during the summer months when ozone pollution is at its worst. The program, which began May 1, 2000, requires that all gasoline sold from retail gasoline-dispensing facilities within the affected counties have a maximum Reid vapor pressure of 7.8 psi from June 1 through October 1 of each year. Gasoline suppliers are required to supply low RVP gasoline to the affected counties from May 1 through October 1 of each year.

Credit Calculations

Adoption of 7.2 psi fuel during the ozone season is expected to help reduce emissions of VOCs and NOx by 2.1 and 0.05 tons/day respectively. The requirement for gasoline refineries to provide such gasoline will only be during the months of March through October, which is usually the time of the year ozone levels exceed the national standard in San Antonio region.

Reduction Calculations Methodology Overview

Modeling scenarios with the MOBILE6 model indicated that lowering the RVP in gasoline to 7.2 from 7.8 would reduce emissions from the on-road mobile fleet in the SAER counties. The table below lists the emission reduction percentages for each of the SAER counties.

Reductions for SAER counties with RVP 7.2 gasoline, compared with RVP 7.8.

County	VOC % Reduction, 2007 On-Road Mobile Fleet	NOx % Reduction, 2007 On-Road Mobile Fleet
Bexar County	4.18	0.06
Comal County	3.73	0.05
Guadalupe County	3.69	0.05
Wilson County	3.14	0.06

The percentage reduction of precursor emissions was used to calculate actual reductions. The actual reduction was estimated by multiplying the 2007 daily on road emissions total for each county with the emission reduction percentage. The resulting number was then divided by 100 to provide the emission reduction total in tons per day.

(2007 tons/day VOC x emission reduction %) / 100 = 2007 tons/day of VOC reduced)

References:

Texas Commission on Environmental Quality (TCEQ), 2000. "Dallas/Fort Worth Attainment Demonstration." Available online: http://www.tnrcc.state.tx.us/oprd/rule_lib/4dfwsip.pdf

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APPENDIX L

MAINTENANCE FOR GROWTH

SAN ANTONIO EAC REGION ATTAINMENT DEMONSTRATION

MARCH 2004

AACOG
Alamo Area Council
Of Governments

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INTRODUCTION

Due to the rapid economic growth and expansion of residential areas that San Antonio area is experiencing, updates of emission sources must be considered and their impacts on regional air quality must be determined. As motorists from new residential areas commute to new businesses, new travel patterns emerge. The Early Action Compact mandates that the impacts of new travel patterns as well as new emission sources be continually measured to insure the region's maintenance of the 8-hour NAAQS beyond the 2007 attainment date. Therefore, emissions were projected to 2012 to demonstrate the San Antonio EAC Region's (SAER) maintenance of the 8-hour NAAQS five years beyond the 2007 attainment date.

Emission projections were done in accordance with EPA guidance and by utilizing various models. A vast array of data was put into different models to project the expected conditions, such as growth of population, distribution of residential areas, and increased numbers of vehicles and equipment.

One of the deliverables required under the Early Action Compact protocol is an analysis of emissions inventory trends. Specifically, the protocol states "emissions inventories will be compared and analyzed for trends in emission sources over time." The original deliverable, an Emissions Trend Analysis utilizing National Emissions Trends (NET) Emissions Inventories (EIs), was completed and submitted to the Texas Commission on Environmental Quality and the US Environmental Protection Agency by the due date of September 30, 2003. The entirety of this earlier report is incorporated into the present appendix, and has been expanded to meet the further analysis required for a comprehensive Maintenance for Growth report, completing an analysis to 2012.

EMISSIONS TREND ANALYSIS

The preceeding sections describe the methodologies and data employed in developing the trend analysis for the SAER. The descriptions will provide insight in the development of the 1999, 2007, and 2012 EIs.

Data Compiled for Analysis

Data from NET emissions inventories and projected NET emissions inventories were used in the development of air quality trends within the San Antonio EAC Region. Volatile organic compounds (VOC), oxides of nitrogen (NOx), and carbon monoxide (CO) emissions are the three main pollutants that are measured in the emission inventories. These emissions are presented in the following categories: Non-road source, airport/military, area source, point source, biogenic source, and on-road source.

The inventories utilized are as follows:

- 1996 Emission Inventory for the AACOG Region } Part of the NET EI
- 1999 Emission Inventory for the AACOG Region } Part of the NET EI
- 2007 Projected Emission Inventory for the AACOG Region - Attainment Year
- 2012 Projected Emission Inventory for the AACOG Region - 5 Yr. Past Attainment

These emission inventories were developed by employing various methodologies, some of which were recommended from local, state, or federal levels. The inventories provide data on many regional pollution sources, their emissions amounts, and their emission

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rates. By understanding these varied sources of ozone pollution, planners, political leaders, and concerned citizens can work together and find ways to better manage them. Thus, the emission inventory, as a means of record keeping, proves to be an important tool for the air quality planning and management process.

AACOG had compiled a 1994 Emissions Inventory, which is not incorporated in the trend analysis and deemed unusable for comparison purposes. One reason involves the differences in the methodologies used to calculate emissions. Also, some emissions were categorized differently in the 1994 EI.

Data Variation between Emission Inventories
The 1996 and 1999 emissions inventories were developed and produced by AACOG staff. When developing the 1999 EI, several sources were re-categorized and/or expanded in an effort to express emissions more clearly as compared to the 1996 EI. In addition, some methodologies were improved or replaced to produce more accurate results. The following categories underwent changes from the 1996 EI to the 1999 EI.

Non-Road Sources
The differences between each subcategory in the 1996 and 1999 EI's are described in greater detail in the following paragraphs.

Agricultural Equipment
Different from the 1996 Emission Inventory, agricultural equipment types were subdivided into 2 groups for the 1999 EI: tractors and combines. A number of new small polluters were added also, including: sprayers, hydro-power units, balers, agricultural mowers, tillers, swatters, other agricultural equipment, and irrigation sets. These new polluters were subdivided according to their fuel and engine type: 2-stroke, 4-stroke, LPG, CNG, and diesel.

Recreational Boating
The methodology, which had caused unrealistic results in the 1996 EI, was updated for 1999 by using the non-road model in place of population data. The 1999 methodology was based on the EPA's non-road emissions inventory model.

Residential Equipment
This category was renamed as the "Lawn & Garden Equipment" and was divided into "Residential" and "Commercial" categories in the 1999 EI to provide more detailed emission data. In the 1996 EI, the residential and commercial use were not identified separately, rather they were combined into the total emission estimates.

Airport/Military Sources
Several alterations were done to the methodology of calculating airport and military emissions for the 1999 EI as compared to the 1996 EI.

Small Airports
The airport category was added to various counties for small airports. This includes the Horizon Airport and Twin Oaks Airport were new additions for Bexar County in the 1999 EI, accounting for 0.0024 tons/day VOC and 0.0004 tons/day NOx. Also, The New Braunfels Municipal Airport and San Geronimo Airport were added to Guadalupe County in the 1999 EI, accounting for .0086 tons/day VOC and .0014 tons/day NOx.

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Brooks AFB
Several categories were added in regards to the "area source" emissions within Brooks AFB. These categories included: aboveground storage tanks, degreasing and solvent cleaning, surface coating, and underground storage tanks. Mobile source emissions were added to non-road emissions.

Lackland AFB and Randolph AFB
Many emission categories were removed from the 1996 EI while new categories were added to the 1999 EI. This reorganization did not significantly affect the amount of emissions for these bases.

Area Sources
There were minimal changes to the methodologies used for calculating area source emissions totals.

Asphalt Paving
The 1996 EI only accounted for one type of asphalt, cutback asphalt, for the AACOG region. The 1999 EI contained emission estimates for emulsified and cutback asphalt. Two methods were used for calculations of emissions for the 1999 EI. One formula multiplied the density of the used asphalt with the diluent volume percentage and the cure rate. The other method of calculation involved the multiplication of a volume based emission factor (lbs VOC/barrel of asphalt) to calculate emissions. The emission factor varied depending on whether the asphalt was cutback or emulsified.

Agricultural Fertilizer
The methodology for the 1999 EI differed than the methodology employed in the 1996 EI. In the 1999 EI, updated formulas were utilized to account for side-planting and side-dressing application of fertilizer. Ozone season duration was adjusted to include April and October (from 154 days/year in 1996, to 214 days/year in 1999).

Biogenic Sources
In the 1996 EI, PCBeis version 2.3 model was run by the AACOG staff to obtain biogenic emission total, however, this method did not produce estimations for NOx emissions. In the development of the 1999 EI, AACOG utilized emissions totals developed by The University of Texas in Austin (UT), which was generated with the GloBeis, version 2.2, model. The 1999 Emissions Inventory had both VOC and NOx emissions totals from biogenic source.

The base case used in projections of 2007 and 2012 emission data came from the 1999 Emissions Inventory, which is the most recent emission inventory. Several different methods were employed in the development of these two projections and are described in the following sections.

FORECASTING METHODOLOGIES
The 2007 projection was developed to produce the 2007 EI, which is described in detail in Appendix F, Future Year Modeling Emission Inventory Development. The 2007 emissions were projected using EPA approved methodologies and are described under their respective categories below. The methodologies for the forecast of 2012 emission sources are the same as methods employed for projecting 2007 emission estimates with some exceptions.

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For the 2012 projections, various federal, state, and local regulatory measures are expected to be fully implemented, whereas for the 2007 projections, some strategies were considered to be in the beginning and middle stages of implementation and did not have a substantial effect on emissions. Also, additional sources may have come into existence after 2007. These exceptions have been taken into account when estimating future emissions.

The population figures used to estimate some emission categories in 2012 were developed using a straight-line extrapolation from 2010 and 2020 population forecasts obtained from the Texas Water Development Board (TWDB) report, "Population Projections by County for 2000-2050" (TWDB, 2000).

Non Road Emissions

The 2007 and 2012 projected non-road emissions were developed using the EPA's NONROAD 2000 model. Federal programs including: Standards for Compression-ignition Vehicles and Equipment, Standards for Spark-ignition Off-road Vehicles and Equipment, Tier III Heavy-duty Diesel Equipment, Locomotive Standards, Recreational Marine Standards, and Lawn and Garden Equipment were accounted for. Detailed descriptions of these federally mandated programs are in Appendix F - 2007 Emission Inventory Development. The non-road emissions totals were calculated by using the following equation:

$$\frac{\textit{Base Case Year Non Road Model Emissions}}{\textit{Projection Year Non Road Model Emissions}} = \frac{\textit{Base Case Emission Inventory}}{\textit{Projection Year Emission Inventory}}$$

Several sources had other methodology for calculating emissions because factors are not available in the NONROAD model. In the non-road category, locomotives were calculated to reflect a larger population of engines that were compliant with Tier 2 and 3 standards in 2007 and 2012. Also, equipment populations were increased to account for additional equipment used at the Toyota Manufacturing Plant during Phase I operations in 2007. Phase II operations are expected to double the size of the plant in 2009. The non-road equipment emissions from the Toyota Plant were doubled to account for Phase I and II operations in 2012. Some of the diesel engines in non-road equipment will be Tier 3 compliant in 2007 and majority of diesel engines in 2012 are expected to be of Tier 3. These details are explained below.

Locomotives

The Environmental Protection Agency established emission standards for locomotive engines applied by the date of manufacture. (USEPA, 1997) Since locomotive engines manufactured in 2005 are subjected to Tier 2 standards, the locomotive population in 2007 will consisted of new and older engines. For the 2012 emission projection, locomotive emissions were calculated to reflect full Tier 2 implementation since the majority of locomotives are expected to have the newer engines adhering to the EPA requirement.

To calculate the projected locomotive emissions for 2007 and 2012, the 1999 base case emissions were multiplied by an emission factor that takes into account the stringent controls. Based on a reduction factor provided by the EPA, 2007 Hydrocarbons (HC) [1]

[1] HC emissions can be converted to VOC emissions by multiplying by 1.05

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emissions are projected nearly 10% less than emissions in 1999. HC emissions in 2012 are calculated to be 17% less than 1999. NOx emissions in 2007 are projected to be approximately 36% less than 1999 NOx emissions. NOx emissions in 2012 are expected to be 43% less than the 1999 locomotive emissions.

Table L-1 lists the emission reductions used to calculate the new locomotive emissions with the implementation of Tier 2. Table L-2 details the locomotive emissions in 1999, 2007, and 2012.

Table L-1. EPA Emission Factors Used in Calculating Locomotive Emissions

Year	HC		CO		NOx	
	g/bhp-hr	% reduction	G/bhp-hr	% reduction	g/bhp-hr	% reduction
1999	0.52	0.0	1.32	0.0	13.3	0.0
2007	0.47	9.6	1.32	0.0	8.51	36.0
2012	0.43	17.3	1.32	0.0	7.62	42.7

Table L-2. Locomotive Emissions 1999, 2007, and 2012 in the San Antonio EAC Region

County	1999		2007		2012	
	VOC	NOx	VOC	NOx	VOC	NOx
Bexar	0.13	2.99	0.12	1.91	0.11	1.71
Comal	0.04	0.82	0.03	0.53	0.03	0.47
Guadalupe	0.10	2.26	0.09	1.44	0.08	1.29
Wilson	0.00	0.00	0.00	0.00	0.00	0.00

Non-Road Equipment Usage at Toyota

Aside from the emissions emitted by the new Toyota plant, emissions will also be produced by non-road equipment usage at the plant. Table L-3 provides the projected emissions of the different equipment types that will be used as part of the manufacturing plant's operations in 2007 and table L-4 lists the 2012 emission estimates. These equipment emissions are based on 2,000 employees for Phase 1 in 2007 and 4,000 employees for Phase 2. A further description of the methodology to calculate these emissions is provided in Appendix F: 2007 EI Develop.

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Table L-3. 2007 Ton per Day Toyota Plant Non Road Emissions, Bexar County

SCC*	Equipment Description	Est. Equip. Pop.	VOC (t/d)	NOx (t/d)
2265003020	2-str Sweepers/Scrubbers	0.4	0.000017	0.000001
2267003020	4-str Aerial Lifts	4	0.000822	0.000315
2268003020	4-str Forklifts	2.3	0.002539	0.001134
2265003010	4-str Other General Ind. Equip.	9.8	0.001020	0.000203
2267003010	4-str Other Material Handling Equip.	0.2	0.000065	0.000025
2270003020	4-str Sweepers/Scrubbers	2.3	0.000599	0.000237
2270003010	4-str Terminal Tractors	0.7	0.000301	0.000135
2267003070	CNG Forklifts	4.6	0.000008	0.005978
2260003040	CNG Other General Ind. Equip.	0	0.000000	0.000000
2268003070	CNG Sweepers/Scrubbers	0	0.000000	0.000000
2265003040	CNG Terminal Tractors	0	0.000000	0.000000
2267003040	Dsl Aerial Lifts	4.1	0.000239	0.001159
2268003040	Dsl Forklifts	12.7	0.001344	0.013099
2265003050	Dsl Other General Ind. Equip.	8.3	0.000618	0.007399
2267003050	Dsl Other Material Handling Equip.	0.6	0.000072	0.000431
2270003040	Dsl Sweepers/Scrubbers	4.2	0.000826	0.006187
2265003030	LPG Forklifts	39.6	0.000001	0.001034
2260003030	LPG Aerial Lifts	2.1	0.000107	0.083179
2268003030	LPG Other General Ind. Equip.	0.2	0.000000	0.00022
2270003030	LPG Other Material Handling Equip.	0.1	0.000000	0.000055
2267003030	LPG Sweepers/Scrubbers	0.7	0.000001	0.00074
2265003070	LPG Terminal Tractors	0.1	0.000001	0.000466
TOTAL		97	0.008580	0.121997

* Source Classification Code

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Table L-4. 2012 Ton per Day Toyota Plant Non Road Emissions, Bexar County

SCC*	Equipment Description	Est. Equip. Pop.	VOC (t/d)	NOx (t/d)
2265003020	4-Str Forklifts	4.6	0.005078	0.002268
2267003020	LPG – Forklifts	79.2	0.000214	0.166358
2268003020	CNG – Forklifts	9.2	0.000016	0.005978
2270003020	Dsl – Forklifts	25.4	0.002688	0.026198
2265003010	4-Str Aerial Lifts	8.0	0.001644	0.000630
2267003010	LPG- Aerial Lifts	4.2	0.000002	0.002068
2270003010	Dsl – Aerial Lifts	8.2	0.000478	0.002318
2260003030	2-Str Sweepers/Scrubbers	0.8	0.000034	0.000002
2265003030	4-Str Sweepers/Scrubbers	4.6	0.001198	0.000474
2267003030	LPG- Sweepers/Scrubbers	1.4	0.000002	0.001480
2268003030	CNG- Sweepers/Scrubbers	0.0	0.000000	0.000000
2270003030	Dsl – Sweepers/Scrubbers	8.4	0.001652	0.012374
2265003070	4-Str Terminal Tractors	1.4	0.000602	0.000270
2267003070	LPG- Terminal Tractors	0.2	0.000002	0.000932
2268003070	CNG- Terminal Tractors	0.0	0.000000	0.000000
2260003040	2-Str Other General Industrial Eqp	0.0	0.000000	0.000000
2265003040	4-Str Other General Industrial Eqp	19.6	0.002040	0.000406
2267003040	LPG- Other General Industrial Eqp	0.4	0.000000	0.000440
2268003040	CNG- Other General Industrial Eqp	0.0	0.000000	0.000000
2270003040	Dsl – Other General Industrial Eqp	16.6	0.001236	0.014798
2265003050	4-Str Other Material Handling Eqp	0.4	0.000130	0.000025
2267003050	LPG- Other Material Handling Eqp	0.2	0.000000	0.000110
2270003050	Dsl – Other Material Handling Eqp	1.2	0.000144	0.000862
TOTAL	-	194	0.017160	0.243998

*Source Classification Code

Tier 3 Non- Road Equipment

Beginning in the year 2006, Tier 3 standards will start to be phased in for new non-road diesel equipment of 50 horsepower or greater. By 2008, it is required that all new equipment will be Tier 3 compliant. (USEPA, 1998) The non-road equipment in 2007 will reflect phasing in of Tier 3 standards while the non-road equipment in 2012 will have full implementation of Tier 3 standards. These reductions are accounted for when the projections are being developed in the NONROAD model.

Airport/Military Emissions

Airport and military emission data cannot be projected due to the uncertainty of future of airport and military bases in the region. Political influence or unusual circumstances, such as wartime situation, may increase emissions levels. In times of peace or poor economy, the military may cut back causing a decrease in emissions. Thus, emissions for this category will remain the same for 2012 as those in 1999. Also, improvements in equipment standards are expected to reduce emissions. Table L-5 details the airport/military emissions. For projection purposes, these emissions were incorporated into the non-road category when developing the non-road 2007 and 2012 projections.

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Table L-5. Airport/Military Emissions for the San Antonio EAC Region

County	1996		1999		2007		2012	
	VOC	NOx	VOC	NOx	VOC	NOx	VOC	NOx
Bexar	2.7	6.8	3.0	9.9	3.0	9.9	3.0	9.9
Comal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Guadalupe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wilson	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	2.7	6.8	3.0	9.9	3.0	9.9	3.0	9.9

Construction could occur at the San Antonio International Airport involving the tearing down of one terminal and the construction of two new terminals. The emissions from this activity is not expected to be more than 150% of the current airport emissions, which is 0.6 tons per day of VOC and 1.8 tons of NOx per day. It is important to note that the emissions generated will not put the SAER over its emission budget since they will not be significant. The possibility also exists that the construction may not take place for security purposes and public concerns for terrorist activity. Airport equipment would most likely be subject to emission controls in the future, therefore airport emissions most likely be reduced even if an additional terminal is constructed.

Area Source Emissions

The 2007 and 2012 area source categories were projected using two different methodologies. For some categories, the Economic Growth Analysis System (E-GAS) 4.0 was used to project the area source emission to 2007 and 2012. For the categories that are based on population emissions factors, growth in population was used. The U.S. Environmental Protection Agency endorses the use of E-GAS when emission source growth estimates are not available by facility survey or other local source. E-GAS generates surrogate growth indicators via a three-tiered modeling system. The first tier includes available national economic forecasts that are used to drive the regional economic models of the second tier. The third tier estimates fuel consumption, physical output, and VMT based on the second tier's regional economic forecasts. (Pechan, 2001)

Projecting Emissions with the EGAS Model

The Economic Growth Analysis System (EGAS) was developed by the EPA to provide "creditable growth factors" for projecting future emissions. (Pechan, 2001) The following sections will describe the methodology employed to develop the emission estimates as well as any state or federal regulation that would be applicable to the source category.

EGAS Version 4.0 was used to obtain growth factors for some area sources by Source Classification Codes (SCCs). These growth factors are ratios of the projection years' (2012) activity level to the 1996 activity level; 1996 being the base case. (Pechan, 2001)

Data selected to run EGAS Version 4.0:
W5 Attainment portion of Texas: 12 AACOG counties

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Years desired for growth factors: 1999 & 2012
Output Format: SCC form

Output files from EGAS Version 4.0:
Ind_fuel.scc: SCCs 2102004000 - 2102007000
Com_fuel.scc: SCCs 2103004000 - 2103007000
Res_fuel.scc: SCCs 2104001000 - 2104008001
Other.scc: SCCs 2810001000 - 2810015000
Phy.scc: Contains all other Area Sources not listed above

The EGAS model outputs three emission growth factors.

To figure out the emissions for the projection year, the output growth factor for that year is multiplied by the emission for 1996. For example, if the output growth factor for 2012 is 1.2323 for SCC xxxxxxxxxx, and the VOC emission in 1996 was 2.0000 tons/yr. for SCC xxxxxxxxxx, then the projected 2012 VOC emission for that SCC equals 2.4646 tons/yr.

2012 VOC Emissions (tons/yr.)	=	1.2323 (EGAS Growth Factor for 2012)	X	2.0000 tons/yr. (1996 Emissions)

= 2.4646 tons/yr.

However, the 1999 AACOG NET EI was the most recent inventory and, thus, was used as the base case in the development of the 2012 EI for AACOG. The 2012 growth factors were adjusted based on the factor for 1996 (which is always 1.0000), 1999, and 2012 to reflect 1999 as the base Emission Inventory. Therefore, the 2012 projected emissions were figured as follows:

2012 VOC Emissions (tons/yr.)	=	y.yyyy (Adjusted EGAS Growth Factor 1999 to 2012)	X	z.zzzz tons/yr. (1999 Emissions)

Control Measures in 2007 and 2012
Some emission sources within the area source category required additional calculations to account for federal and /or state regulations that would reduce VOC and/or NOx emissions. The following sections describe the emission source and its regulation.

<u>Degreasing Emissions</u>
The 1999 base case and its 2007 projection did account for emission reductions from degreasing units due to TAC Chapter 106. Chapter 106 affects degreasing units throughout Texas as specified in Control of Air Pollution From Volatile Organic Compounds §115.412-415. These reductions were applied to the growth of emissions between 1999 to 2007 and 1999 to 2012. Chapter 115 requires a 85% reduction of VOC emissions. Therefore, the difference in emissions from 1999 to 2007 and 1999 to 2012 are reduced by 85% and then subtracted from the original 2007 and 2012 emissions. Table L-6 lists the degreasing emissions before and after Chapter 106 was accounted for.

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Table L-6. Degreasing Emissions with and without Chapter 106 Reductions

County	2007 VOC (ton/day)		2012 VOC (ton/day)	
	w/o Ch.106	w/ Ch. 106	w/o Ch.106	w/ Ch. 106
Bexar	14.027	9.745	16.468	10.111
Comal	0.849	0.590	0.997	0.612
Guadalupe	0.014	0.010	0.016	0.010
Wilson	0.200	0.139	0.235	0.144

On-Board Refueling Vapor Recovery (ORVR)

The concept of ORVR requires a system within an automobile that captures vapors that accumulate in the fuel tank, as well as fuel vapors generated during refueling. ORVR system is installed on the vehicle ("onboard") as compared to external methods (known as Stage II vapor recovery) and efficiently collects the vapors before they can escape into the atmosphere. Current ORVR technologies generally consist of Activated Carbon Canisters (ACC) which absorb the hydrocarbons (HCs) contained in the vapors forced out of the vehicle while refueling is occurring.

In the past, vapor recovery systems that addressed this problem have been termed Stage II vapor recovery systems, with Balance and Vacuum Assist being the major forms of Stage II systems. With the introduction of ORVR, the vapors do not leave the internal system of the vehicle. Starting in 2000, all 2000 and later model vehicles will have ORVR systems. Light duty trucks will have ORVR phased in over a six-year period, beginning with 2001 models. The EPA expects ORVR vehicles to be in wide spread use by 2010. Thus, emission benefits from this control would be increasingly evident in 2012 than in 2007. (USEPA, 2003) The schedule for implementation of ORVR is:

- Automobiles: 40% of 1998, 80% of 1999, and 100% of 2000 and beyond models will be equipped with ORVR.
- "Light Duty Trucks" and similar vehicles: 40% of 2001, 80% of 2002, and 100% of 2003 and beyond models will be equipped with ORVR.
- "Medium Duty Trucks" and similar vehicles: 40% of 2004, 80% of 2005, and 100% of 2006 and beyond models will be equipped with ORVR.
- Heavy Duty Trucks and other Vehicles: At this time, it is not required in these vehicles (Synergetic, 2004)

To estimate the effect of ORVR, the NO CLEAN AIR ACT command was used in the MOBILE6 command file to model vehicle emissions as if the Federal Clean Air Act Amendments of 1990 had not been implemented. The MOBILE6 by default assumes that the Clean Air Act (CAA) Amendments of 1990 did occur and includes a number of vehicle and fuel requirements mandated by the 1990 Clean Air Act Amendments in its forecasts and analyses of future year. These include Tier1, low emissions vehicle (LEV),

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and Tier2 tailpipe exhaust emission standards, and new evaporative emission test procedure requirements.

For the study of effects of the absence of CAA, we ran two 2007 base year with and without the effects of CAA and calculated the differences in the amounts of VOC for 4 counties in the SAER and for each days of the week. The amounts of VOC for 2007 for each modeled day and for each county in our study area were higher by approximately 60% when the CAA requirements in MOBIE6 were disabled. This reduction percentage was reflected in the emission inventory to account for the presence of the effects of CAA in the year 2007. The reductions were applied to the Vehicle Refueling category (SCC 2501060100).

The following table lists the reduction/adjustment values for VOC emissions for each county in San Antonio region.

Table L-7. 2007 ORVR Reductions for the SAER by Modeling Episode Days

Episode Day	Bexar		Comal		Guadalupe		Wilson	
	Percent Reduction	Tons per Day	Percent Reduction	Tons per Day	Percent Reduction	Tons per Day	Percent Reduction	Tons per Day
Sept. 13	62.3%	7.26	62.7%	0.39	60.3%	0.41	59.7%	0.15
Sept. 14	62.3%	7.26	62.7%	0.39	60.3%	0.41	59.7%	0.15
Sept. 15	62.3%	7.26	62.7%	0.39	60.3%	0.41	59.7%	0.15
Sept. 16	62.3%	7.26	62.7%	0.39	60.3%	0.41	59.7%	0.15
Sept. 17	63.7%	7.42	63.5%	0.39	61.5%	0.42	60.7%	0.15
Sept. 18	64.3%	4.80	64.4%	0.26	62.0%	0.27	61.6%	0.10
Sept. 19	64.0%	2.43	63.7%	0.13	61.4%	0.14	61.1%	0.05
Sept. 20	62.3%	7.26	62.7%	0.39	60.3%	0.41	59.7%	0.15

The table below details the emission reductions predicted for 2007 and 2012. As listed in the table, an emission reduction of approximately 50% for each county in the San Antonio EAC region is anticipated between 2007 and 2012. (USEPA, 2004)

Table L-8. Comparison of Average Weekday VOC tons/day Emissions from Vehicle Refueling (SCC 2501060100)

County	2007	2012	Difference
Bexar	4.36	2.13	48.7%
Comal	0.23	0.12	48.2%
Guadalupe	0.27	0.13	49.5%
Wilson	0.10	0.05	48.8%

Stage I Vapor Recovery Systems

As a tank of volatile fuel such as gasoline is gradually emptied, the empty space will be occupied by vapors of the fuel, or by a mixture of air and vapors, if an inlet air vent is provided. When a tanker truck delivers fuel to a gas station, the new fuel entering the underground tank forces accumulated gasoline vapors out of the tank into the air.

Stage I vapor recovery systems are designed to control the escape of these vapors, and can achieve a 98% reduction in hydrocarbon emissions once they are put into use. The vapors are captured by a vapor return hose, which is connected to the storage tank and

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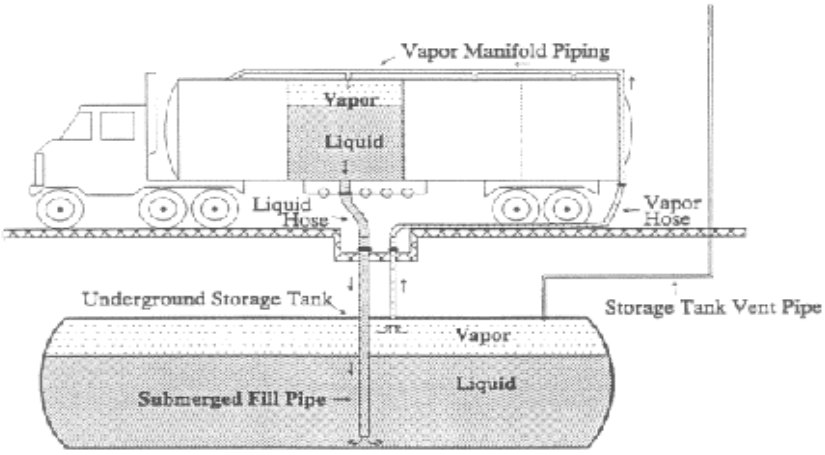
the gasoline delivery truck. Once captured, the vapors are stored in a vapor cargo department in the gasoline delivery trucks and transported to the refinery for recovery or incineration. Figure L-1 illustrates a typical stage one recovery system.

Figure L-1. Stage I Vapor Recovery System



(A) Loading of Service Station Underground Storage Tank With Vapor Balance System (Stage I Controls).

There are two types of Stage I vapor recovery systems, the dual point system and the coaxial system. The dual point system has two parts, a drop tube and a vapor recovery tube equipped with a spring-loaded valve. The valve prevents vapors from escaping. Dual point systems also consist of two separate tank openings, one for delivery of the product and the other for the release of vapors. The following figures illustrate a top filling dual point system, and a bottom filling dual point system.

Figure L-2. Dual Point Top Filling System

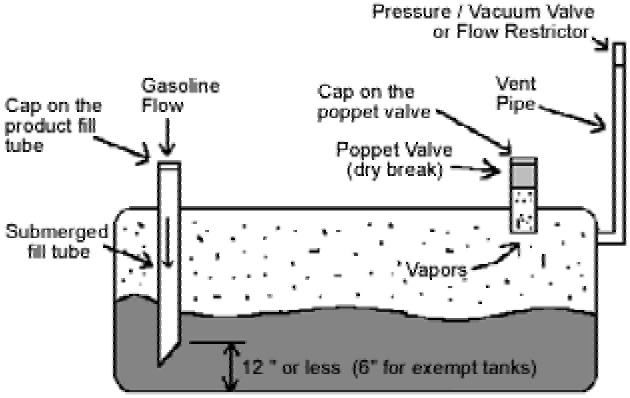


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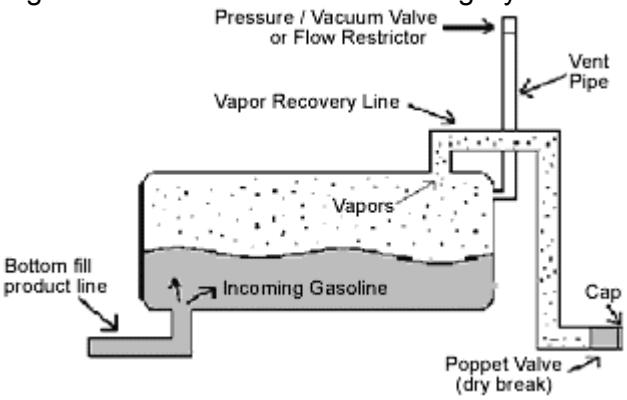
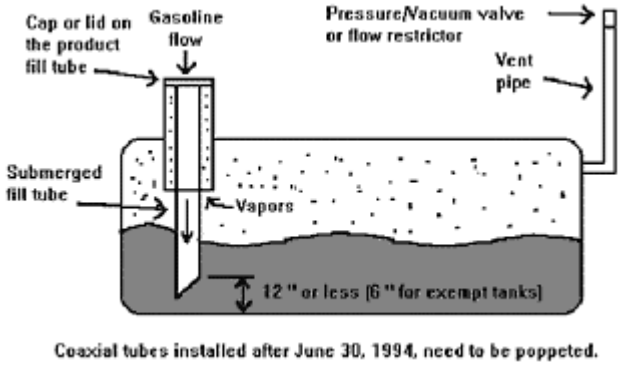
Figure L-3. Dual Point Bottom Filling System



The coaxial system is comprised of a tube within a tube. A coaxial spring allows the drop tube to depress during the filling of the tank and then retract upon disconnection of the fill hose to create a tight seal. This tight seal prevents vapors from escaping. The coaxial system only has one tank opening. The opening usually has a four- inch diameter product fill tube inserted into the tank opening. Gasoline flows through the inner tube and the vapors are displaced through the space in between the inner and outer tubes. The following figure provides an illustration of the coaxial system.

Figure L-4. Coaxial System



Currently, Stage I systems are required in the San Antonio EAC Region for facilities that dispense 125,000 or more gallons/month of gasoline are required by Control of Air Pollution From Volatile Organic Compounds §115.229. The effectiveness of the Stage I vapor recovery system strategy was approximated by calculating the current release of hydrocarbon emissions due to tank unloading for the San Antonio EAC Region. These emissions would be eliminated if all of the gasoline stations in the region were required to have Stage I vapor recovery system. Table L-9 lists the 2007 emissions and table L-10 lists the 2012 emissions from the tanker unloading category in the SAER counties.

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Table L-9. 2007 Emissions from Tanker Unloading in San Antonio EAC Region (AACOG, 2001)

County	VOC tons/day
Bexar	8.81
Comal	0.47
Guadalupe	0.52
Wilson	0.19
Total SA MSA	9.99

Table L-10. 2012 Emissions from Tanker Unloading in San Antonio EAC Region

County	VOC tons/day
Bexar	9.08
Comal	0.48
Guadalupe	0.53
Wilson	0.19
Total SA MSA	10.28

The effectiveness of the Stage I vapor recovery system strategy was measured by calculating the current release of hydrocarbon emissions due to tanker truck unloading for the San Antonio EAC Region. Of the 9.99 tons/day for 2007 and the 10.28 tons/day VOC emissions presented in tables L-8 and L-9 respectively, seventy percent of those emissions totals was included in the 2007 and 2012 EIs. This adjustment was performed based on data analysis in a TCEQ study for 95 counties east of I-35 (TCEQ 1999). The results of this study are displayed in table L-11.

Table L-11. Emission Reduction Due to Stage I Implementation in the 95-county Region

Gasoline Throughput Gallons/Month	Number of Gas Stations	% of Total Stations	VOC Reductions Tons/Year	% of Total VOC Reductions
Less than 10,000	1,607	18.6	0	0.0
10,000 – 25,000	2,436	28.3	1,210	11.8
25,000 – 50,000	2,287	26.5	2,480	24.1
50,000 – 125,000	1,599	18.6	3,510	34.1
Greater than 125,000	691	8.0	3,090	30.0
Total	8,620	100.0	10,290	100.0

Source: Texas Commission on Environmental Quality, (TCEQ 1999)

As displayed in tables L-12 and L-13, use of Stage I technology by facilities that have 125,000+ gallons per month throughput can reduce VOC emissions by 30%. Removing this amount of reduction from the total projected amount of VOC emissions in the SAER from tanker truck unloading results in reducing the 2007 projected emissions to 7.0 tons per day and 2012 projected estimates to 7.19 tons per day.

The following table indicates the exact reduction/adjustment values for VOC emissions for each county in San Antonio region.

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Table L-12. Stage I Emission Reductions (>125,000 gal) for the SAER Counties, 2007

County	Percent Reduction	Tons per Day Reduction
Bexar	30%	2.64
Comal	30%	0.14
Guadalupe	30%	0.15
Wilson	30%	0.06
Total	-	2.99

Table L-13. Stage I Emission Reductions (>125,000 gal) for the SAER Counties, 2012

County	Percent Reduction	Tons per Day Reduction
Bexar	30%	2.72
Comal	30%	0.14
Guadalupe	30%	0.16
Wilson	30%	0.06
Total	-	3.08

Regulation V Rules Affecting Area Source

The only category affected by the Regulation V Rules in the AACOG 2012 Projected Emissions Inventory is Factory Finished Wood, under the subtitle of Surface Coatings. This category has a 99% Rule Effectiveness (RE), thus emissions are reduced by 99%. This gives Factory Finished Wood, SCC 2401015000, a control factor of 0.01. (Mark, 2001)

Emissions Projections with Population Estimates

The EGAS model supplied growth factors were used to project of all area source emissions except Architectural Surface Coatings, SCC: 2401001000, and Consumer/Commercial Solvents which include:

SCC: 2465100000 - Personal Care Products
SCC: 2465200000 - Household Products
SCC: 2465400000 - Automotive After-market Products
SCC: 2440020000 - Adhesives and Sealants
SCC: 2465600000 - FIFRA Regulated Products
SCC: 2460520000 - Coatings and related products
SCC: 2460900000 - Miscellaneous Products

Instead, the emissions from these emission categories were projected using population estimates. Some of the categories also had emission control factors applied to reflect future controls that would reduce product emissions, such as Rate of Progress factors for Consumer /Commercial Solvents.

Rate of Progress Control Factors

In addition to projection factors, Rate of Progress (ROP) control factors were also used on several categories, as directed by TCEQ (Environ, 2001). Table L-14 shows applicable ROP control factors for the AACOG 2007 and 2012 emission inventories. These control factors account for the amount of emission reductions due to use of improved techniques and/or implementation of new regulations.

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Table L-14. Rate of Progress Control Factors

Category	SCC	Control Factor
Leaking Underground Storage Tanks	2660000000	0.0
Architectural Coatings	2401001000	0.8
Traffic Markings	2401008000	0.8
High-Performance Maintenance	2401100000	0.8
Other Specific Purpose Coatings	2401200000	0.8
All Solvent Types	2465000000	0.8
Personal Care Solvents	2465100000	0.8
Household Solvents	2465200000	0.8
TSDF's	2640000000	0.07
Automotive Aftermarket Coatings	2465400000	0.8
Adhesives & Sealants	2465600000	0.8

To forecast the amount of emission for each area source category, the emission amount for each category in 1999 EI was enlarged by the given 2007 and a 2012 projection factors. The results were then factored by the ROP factors to account for improvements in applications techniques and changes in regulations. To give a demonstration of this procedure, the following table, which is prepared for the 2007 Bexar County, is presented in this appendix. The last column in this table indicates the net amount of change between before and after application of ROP factors.

Table L-15. 2007 Bexar County Area Source Emissions impacted by ROP

Emission Inventory Category	Uncontrolled 2007 Tons/Day	Controlled 2007 Tons/Day	Reduction Tons/Day
Architectural Coatings	9.73	7.78	1.95
Traffic Markings	0.02	0.02	0.00
High-Performance Maintenance	3.14	2.51	0.63
Other Spec. Purpose Coatings	2.41	1.93	0.48
Personal Care Solvents	3.84	3.07	0.77
Household Solvents	2.54	2.03	0.51
Automotive Solvents	1.64	1.31	0.33
Leaking Underground Tanks	0.19	0.00	0.19

The above procedure was repeated for each county in the SAER region. A summary of the results of these factoring is shown in the table L-16. The values in this table are in fact the reduction amounts that are resulted after the application of ROP factors.

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Table L-16. 2007 & 2012 ROP Emission Reductions

Emission Inventory Category	Bexar County		Comal County		Guadalupe County		Wilson County	
	2007	2012	2007	2012	2007	2012	2007	2012
Leaking Underground Storage Tanks	0.194	0.215	0.004	0.005	0.030	0.034	0.003	0.003
Architectural Coatings	1.946	1.916	0.109	0.122	0.120	0.122	0.045	0.043
Traffic Markings	0.004	0.004	0.001	0.001	0.001	0.002	0.000	0.000
High-Performance Maintenance	0.628	0.714	0.033	0.038	0.037	0.042	0.013	0.015
Other Specified Purpose Coatings	0.482	0.500	0.026	0.027	0.028	0.029	0.010	0.011
Personal Care Solvents	0.767	0.850	0.045	0.054	0.047	0.054	0.018	0.019
Household Solvents	0.508	0.563	0.030	0.036	0.031	0.036	0.012	0.013
Automotive Solvents	0.328	0.364	0.019	0.023	0.020	0.023	0.008	0.008
Total	4.856	5.126	0.266	0.304	0.316	0.341	0.109	0.112

Biogenic Source Emissions

Biogenic data for the 2007 and 2012 projected emission inventory remained unchanged from the 1999 base case emissions in accordance with EPA recommendations. Table L-17 details the biogenic emissions for the SAER.

Table L-17. Biogenic Emissions for the San Antonio EAC Region

County	1996		1999		2007		2012	
	VOC	NOx	VOC	NOx	VOC	NOx	VOC	NOx
Bexar	60.1	5.0	60.1	5.0	60.1	5.0	60.1	5.0
Comal	56.5	1.5	56.5	1.5	56.5	1.5	56.5	1.5
Guadalupe	83.6	7.5	83.6	7.5	83.6	7.5	83.6	7.5
Wilson	62.8	6.5	62.8	6.5	62.8	6.5	62.8	6.5
Total	**263.0**	**20.6**	**263.0**	**20.6**	**263.0**	**20.6**	**263.0**	**20.6**

Point Source Emissions

Point source emissions were gathered from a variety of sources. City Public Service (CPS) provided the 2007 and 2012 emission figures for the CPS power plants. Also accounted for were the new Tessman Road Landfill Gas Power Station, Guadalupe Power Plants, and Toyota Manufacturing plant. The emission estimates for these additional sources are detailed in the following tables.

Tessman Road Landfill Gas Power Station

The proposed Tessman Road power station is located in Bexar County near Converse, TX. The station will feature six Deutz TBG 620 V16 engines, producing electricity from

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methane and other landfill gases. This plant will emit 0.179 ton of NOx and 0.049 ton of VOC in both 2007 and 2012.

Guadalupe County Power Plants
Two natural gas powered electrical generating facilities are slated for completion and operation prior to 2007. Table L-18 details the projected emissions from the point source for 2007 and 2012.

Table L-18. Projected 2007 and 2012 Emissions for the Natural Gas Power Plant in Guadalupe County

Facility ID	SIC	Stack ID	Stack Height (Meters)	Projected Emissions (tons/day)	
				NOx	VOC
Guadalupe Power Partners 1000	4911	100	39.6	0.948	0.060
		300	39.6	0.948	0.060
		400	39.6	0.948	0.060
		500	39.6	0.948	0.060
Rio Nogales Power Projects LP 1001	4911	100	39.6	1.249	0.064
		200	39.6	1.249	0.064
		300	39.6	1.249	0.064

Toyota Manufacturing Plant
Toyota Motor Manufacturer North America (TMMNA) is currently negotiating the building of an auto-production assembly plant in south Bexar County. Toyota provided emissions estimates of the anticipated pollutants produced by this plant at the start of production and are described in the following paragraphs. Table L-19 lists the emission estimates for 2007 and 2012.

The plant is to be built in 2 phases.

Phase 1: Phase 1 operation has a Start of Production (SOP) date of 2006. Emissions for 2007 are projected at 5.00 tons/day of VOC and 0.34 tons/day of NOx.

Phase 2: Phase 2 operation has a SOP date of 2008-2010. Emissions estimates in 2012 include both phases of production. Phase 1 and 2 combined is projected to emit 10.00 tons/day of VOC and 0.68 tons/day of NOx.

VOC emissions will be mainly from painting cleaning, sealers, adhesives, & natural gas combustion. NOx emissions will be mainly from natural gas boilers, space heaters, miscellaneous process heating.

Table L-19. Point Source Emissions from Toyota Plant, Bexar County 2007 & 2012

Year & Phase	VOC (tpd)	NOx (tpd)
2007 Emissions, Phase 1	5.00	0.34
2012 Emissions, Phase 1 and 2	10.00	0.68

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Electric Generating Units (EGU) and Non-electric Generating Units (NEGU)
TCEQ provided AACOG with electric generating unit (EGU) and non-electric generating unit (NEGU) files for 2007. These emissions were left unchanged 2012. (Thomas, 2003), (TCEQ, 2003). The emission estimates are from the 2007 TEXAQS 2000 projection, which was used in the photochemical model. The estimates do not reflect growth or additional controls between 2007 and 2012. These files, used in the Houston SIP, were updated with local data when available. Table L-20 lists NEGU, non-CPS EGU point, and minor point source emissions source emissions.

Table L-20. Non-CPS EGU and NEGU emissions for 2007 and 2012

County	1999		2007		2012	
	NOx	VOC	NOx	VOC	NOx	VOC
Bexar	16.86	4.55	17.89	5.99	17.89	5.99
Comal	12.16	0.34	13.77	0.52	13.77	0.52
Guadalupe	0.51	0.45	8.07	1.10	8.07	1.10
Wilson	0.00	0.07	0.00	0.07	0.00	0.07

City Public Service
City Public Service provided projected emissions for 2007 and 2012 for the CPS power plants in the area. (Fulton, 2003) The emissions reflect average ozone season days in September. These emissions include a new coal fired power plant scheduled to go on-line in 2009. Table L-21 gives the predicted weekday emissions per power plant for 2007 and 2012.

Table L-21. Projected CPS Emissions from 2007 to 2012

CPS Plant	2007		2012	
	VOC	NOx	VOC	NOx
CPS - O.W. Sommers (OWS) - Total	0.27	6.28	0.00	0.00
CPS - J.T. Deely (JTD) - Total	0.34	15.62	0.67	10.03
CPS - J.K. Spruce (JKS) - Total	0.05	10.85	0.15	12.89
CPs - V.H. Braunig (VHB) - Total	0.05	1.04	0.09	0.00
CPS - A.Von Rosenberg Unit 1 (VHB 4A)	0.07	1.05	0.14	1.32
TOTAL	0.78	34.84	1.01	24.24

Legislative Actions
In 1999, the Texas Legislature passed two laws governing emissions for point sources in Texas. The 2012 emission inventory from City Public Service accounts for Senate Bill 7, which limits NO_x emissions from grand-fathered electric generating facilities in central and eastern Texas and Senate Bill 766, which increases emissions fees on grand-fathered non-electric generating facilities. (TCEQ, 2004)

<u>Senate Bill 7</u>
The electric utility deregulation bill requires reductions in emissions levels of nitrogen oxides and sulfur dioxide from grandfathered electric utility units. The NOx rate, in pounds of NOx per MM Btu (lbs. NOx/MM Btu) is specified by SB 7 and is based on the

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location of the EGF. This applies only to grand-fathered EGFs and is blank for permitted EGFs.

Senate Bill 766

Senate Bill 766 has two major parts. The first part redefines the current permitting hierarchy according to the significance of emissions into De Minimis, Exemptions, Permits by Rule, Standard Permits and regular permits. The second part created three new types of permits: Voluntary Emission Reduction Permit (VERP), Multiplant Permit, and Grandfather Utility Permit. Senate Bill 7 provides additional guidance to the TCEQ regarding the issuance of Grandfathered Utility Permits and allowances as stipulated in General Air Quality Rules §101.333.

On Road Source Emissions

On road emissions were provided by the Texas Transportation Institute (TTI). The emissions are average weekday emissions with no adjustments and are from the modeling inventory.

The emission estimates in 1996 includes the 1995 on road estimates updated with MOBILE6, version 2. There were no Mobile6 emission estimates for 1996 so the closest year was used.

TREND ANALYSIS

As mentioned in previous sections, due to the federal, state, and local emission control policies, the downward trend of emissions will be sustained until the year 2012, despite predicted growth in population size and economic activities. The following figure, which was generated based on the available and forecasted data, depicts this trend. The anthropogenic emissions are caused by human's activities and are separated from those occurring naturally.

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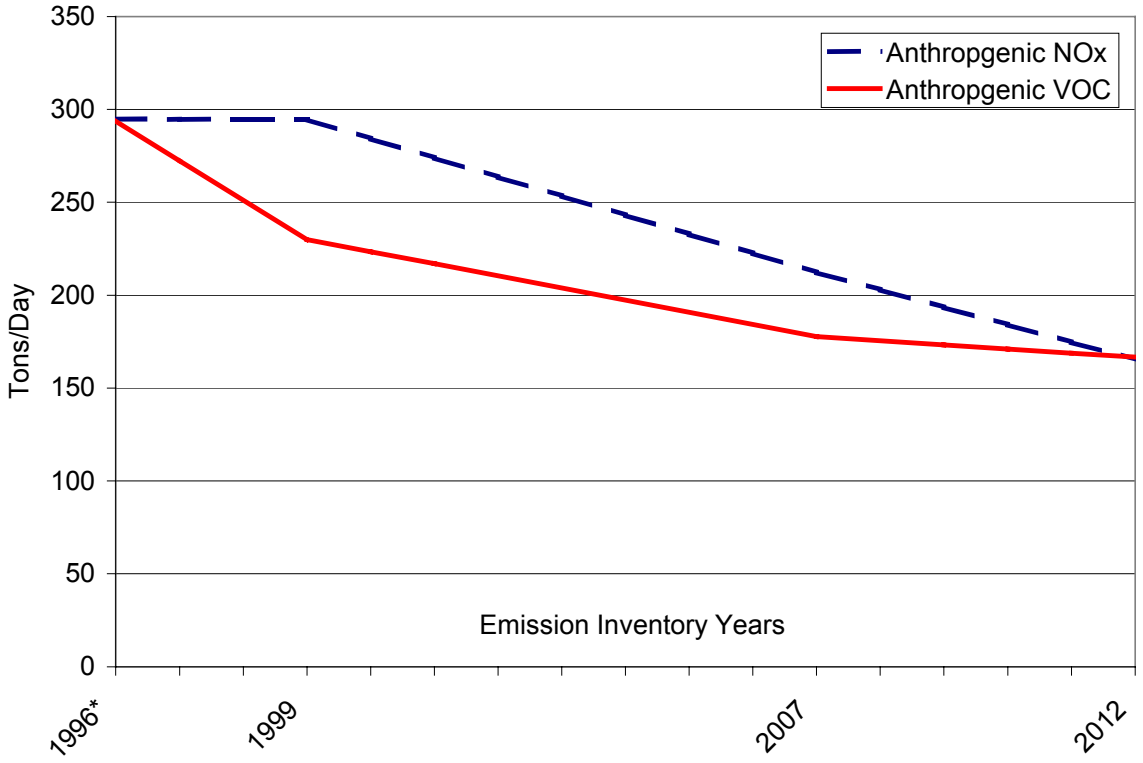
Figure L-5. Trend Line Analysis of VOC and NOx Emissions in the SAER, 1996, 1999, 2007, 2012



*note 1996 estimates included using version two of the 1995 Mobile6 inventory

As indicated in figure L-5, the tonnage of VOC and NOx emissions is projected to decrease from 1996 to 2012. Between 1999 and 2007, an overall reduction of 28% of NOx emissions and 23% reduction in VOC emissions are predicted. Between 2007 and 2012, additional reductions of 22% in NOx emissions and 7% in VOC emissions can be expected. The reductions are as a result of control strategies enforced by the USEPA and TCEQ and provides improved air quality is in the future of the San Antonio EAC region.

Table L-23 details and compares emission totals for the four EAC counties in all emission source categories. These estimates are slight different then the photochemical modeling inventory because the model is based on day specific inventories. The inventory used in the Trend Line analysis is for and average ozone season day. Also, certain emission categories may be affected by seasonal adjustments. For example, there are no fertilizer emissions in the model, while these tables do include fertilizer emissions. Fertilizer is not applied during September in the SAER.

The total emissions in the SAER indicate a decrease in emissions for VOCs in area sources, NOx emissions in point sources, and both ozone precursor emissions in mobile sources and non-road sources. These observable trends of increasing emissions in some sources and the decreasing of emissions in other sources counterbalance each other and indicate that the SAER is projected to remain in attainment in 2012. The

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following subsections describe the individual emission source categories and their emission trends.

Area Sources
Area source emissions in 2012 are lower than 1999 area source emissions. This is indicative of the effects federal and state measures have on the San Antonio's regional air quality. However, trends within individual counties in the SAER demonstrate peculiar activity.

For Bexar, Comal, and Guadalupe counties, area source VOC emissions decrease from 1999 to 2007 but then increase from 2007 to 2012. In 2007, larger decreases of VOC emissions from state and federal strategy implementation are anticipated than the total projected VOC increase due to population and source growth. In 2012, larger increases in VOC emissions than strategy induced VOC reduction is expected.

Originally, the projected 2007 VOC emission estimate for Bexar County was 83.4 tons per day. After taking into account state and federal regulations such as Stage I vapor recovery at stations that throughput 125,000 gallons/month, onboard refueling vapor recovery, and state mandated degreasing controls, total VOC emissions for Bexar County is 69.2 tons per day.

For 2012, area VOC emissions are projected to increase 7 tons. Therefore, before taking into account additional emission reductions due to strategy implementation in 2012, 2012, area sources were projected at 76.2 tons per day (69.2 tons + 7 tons). An emission reduction of 4.8 tons per day due to implemented control measures was then applied thus reducing emissions to 71.4 tons per day (76.2 tons - 4.8 tons).

The same occurrences can be noted in Comal and Guadalupe area source emissions. The reductions were not large enough to offset the projected increases in 2012. Emissions in Wilson County reflected no activity and remained constant.

Point Sources
In Bexar County, point source VOC emissions are expected to nearly triple from 1999 to 2012 due to emergence of additional point sources within the county, such as the Toyota Manufacturing Plant and the Tessman Landfill Gas Power Plant. NOx emissions, however, decrease from 1999 to 2012, which would be reflective of updated emission controls on local point sources. VOC emissions remained constant in Comal County while NOx emissions slightly increased. Guadalupe County VOC and NOx emissions increased due to the development of a new power plant within the county. Wilson County VOC emissions increased slightly but their NOx emissions did not significantly change.

On Road Sources
Both VOC and NOx emissions decrease from 1999 to 2012 in all SAER counties.

Non Road Sources
Reductions in VOC and NOx emissions can be noted in all SAER counties. These reductions can be attributed to improved emission control technologies as required by various federal standards. These emissions also reflect airport and military emissions in the SAER.

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The resulting emission estimates displayed on table L-22 indicate that the San Antonio EAC Region is projected to maintain the 8-hour ozone NAAQS five years beyond the 2007 attainment date. It is important to note that these emission estimates do not reflect the additional emission reduction resulting from the implementation of the locally selected clean air measures submitted as part of San Antonio's Clean Air Plan.

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Table L-22. Anthropogenic Emission Trend within the San Antonio Early Action Compact Region

San Antonio Early Action Compact Region		Tons per Day Emission							
		1996		1999		2007		2012	
		VOC	NOx	VOC	NOx	VOC	NOx	VOC	NOx
Area Sources	Bexar	78.3	2.4	73.4	4.7	69.2	5.0	71.4	5.2
	Comal	4.4	0.1	3.7	0.3	3.4	0.5	3.6	0.5
	Guadalupe	6.1	0.3	5.4	0.9	5.2	1.7	5.4	1.8
	Wilson	2.6	0.4	2.7	0.9	2.7	1.8	2.7	2.0
	Total	91.4	3.3	85.2	6.8	80.5	9.0	83.1	9.5
Point Sources	Bexar	7.0	64.3	6.3	83.9	11.8	53.2	17.0	43.0
	Comal	0.4	8.2	0.5	12.2	0.5	13.8	0.5	13.8
	Guadalupe	0.4	0.3	0.5	0.5	1.1	8.1	1.1	8.1
	Wilson	0.0	0.0	0.01	0.004	0.1	0.004	0.1	0.004
	Total	7.8	72.8	7.3	96.6	13.5	75.1	18.7	64.9
On Road Sources	Bexar	106.6	122.39	82.1	121.87	45.5	69.1	33.7	41.4
	Comal	6.8	10.4	6.2	11.7	3.9	7.1	3	4.3
	Guadalupe	6.6	10	5.6	10.5	3.4	6.5	2.6	3.9
	Wilson	1.9	1.9	1.6	1.9	1	1.3	0.8	0.8
	Total	121.9	144.69	95.5	145.97	53.8	84	40.1	50.4
Non Road Sources	Bexar	54.3	55.2	36.3	36.4	25.6	36.3	21.0	32.9
	Comal	9.8	3.5	3.4	2.6	2.1	3.4	1.8	3.3
	Guadalupe	4.3	4.4	4.1	2.3	1.7	3.3	1.4	3.3
	Wilson	1.4	4.1	1.0	0.7	0.6	1.0	0.5	0.9
	Total	69.9	67.2	45.7	42.0	30.0	44.0	24.7	40.4

CONCLUSION

Developing the 2012 projections for various emission sources required the use of various methods and models. Emissions for sources such as non-road and on road source needed to reflect the implementation of various control measures aimed at reducing ozone precursors. When developing the Maintenance Year Emission Inventory, incorporating projected emissions from future sources such as the automobile manufacturing plants or new power plants is important. Taking into account these variables enables air quality planners to confidently develop air quality plans aimed at reducing emissions.

The Clean Air Plan for the SAER is directed to achieve the 8-hour standard by December 2007. Maintaining the 8-hour standard five years beyond the attainment date will be achieved through an annual review of growth as required in the EAC protocol.

As discussed in the Executive Summary, the Maintenance for Growth analysis performed by AACOG has several stages or components.

- Current Analysis: This Maintenance for Growth analysis is an updated and expanded Trend Analysis, first published September 30, 2003 as an EAC milestone. This appendix analyzes the emissions inventories from 1996 and 1999 and projects emissions to 2007 and 2012. These future year projections encompass all relevant changes affecting future emissions, including revised or new federal, state, and local rules and any new practices that would result in changes to future year emissions inventories. As a separate document, the Trend Analysis itself is updated once more, and is due as an updated milestone / deliverable in the EAC by September 30, 2005.
- Continuing Planning Process: The assumptions underlying this analysis will be reviewed annually throughout the term of the EAC (through 2007). Changes in assumptions will be incorporated annually into an updated Maintenance for Growth analysis and reported as a component of the Semi-Annual Updates. The current analysis will next be updated and reported in the December 2004 Semi-Annual Update.
- New Strategy Requirements: In the event the annual analysis of emission trends and control strategies fails to maintain attainment standards, appropriate planning and implementation of additional clean air measures will result.

Current Analysis

The bulk of this Appendix is devoted to the Current Analysis outlined above, according to which our present projections suggest continued attainment of the 8-hour average ozone NAAQS through 2012. This is based on the most-currently available data as of March 2004.

Continuing Planning Process

Various stages of planning and verification must be performed on a continual basis to ensure timely emission reductions for the region to maintain air quality standards. The impacts of new point source related emissions, economic and population growth, and the implementation of new control strategies are evaluated during the air quality modeling process. Analyzing their effect on ambient ozone levels will be essential in ensuring the maintenance of attainment.

AACOG staff will analyze air quality and related data and perform necessary modeling updates and modeling assumption verification annually. In the event that updated emission inventories, updates in any photochemical model inputs, or corrections to

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earlier modeling assumptions are created and available, the modeling scenarios used to demonstrate attainment for the SAER will be brought up to date. Modeling updates will be performed in accordance with state and federal guidelines.

Ongoing Updates

Gathering, updating, and verifying data is part of an ongoing process between the Texas Commission on Environmental Quality, the US Environmental Protection Agency, and the Alamo Area Council of Governments. The updating and verification process will continue to occur in the context of the Joint Near Nonattainment Area meetings held by air quality planning technical staff representing TCEQ, and the San Antonio, Victoria, Corpus Christi, Austin and the Tyler-Longview areas, or other appropriate venue (technical meetings with TCEQ and / or EPA, etc.). Joint Near Nonattainment Area meetings are held at least as often as every three months. They were established as a forum for discussion of new technology, new program and planning requirements under state programs, progress on and cooperation in attainment of air quality goals, as well as discussion of updates to modeling input and modeling technique. AACOG frequently attends other technical modeling meetings hosted by the TCEQ, EPA and other agencies, which provides greater opportunity for information update exchanges. In addition, AACOG staff attends regularly scheduled monthly technical meetings of the local San Antonio / Bexar County Metropolitan Planning Organization (MPO), allowing AACOG staff the most recent transportation planning information. AACOG provides all air quality analysis for the local MPO transportation projects. All local transportation planning updates to the modeling inputs will be incorporated as they occur, and their impacts analyzed.

Reporting of modeling updates and modeling assumption verification will be reported in the Semi-Annual Reports written by the AACOG. These reports are due on an ongoing six-month cycle ending December 31 and June 30 of each year of the Early Action Compact, ending December 31, 2007. These reports will specifically address, at a minimum,

- all relevant actual new point sources;
- impacts from potential new source growth; and
- future transportation patterns and their impact on air quality in a manner that is consistent with the most current adopted Long Term Transportation Plan and most current trend and projections of local motor vehicle emissions.

Throughout the continuing planning process, the air quality impact on the region's ozone levels imposed by transportation patterns will be evaluated and assessed by technical staff of various local, regional, state, and federal offices. The ongoing technical collaboration between AACOG and the local MPO is the central conduit such that updated transportation planning becomes integrated in air quality planning. These cooperative relations will assist in maintaining the 8-hour ozone standard by the technical assistance provided by each agency and in the event additional planning is necessary.

New Strategy Requirements

The annual reviews of growth, including the updates and the continuing planning processes reported in the Semi-Annual Updates will provide air quality planners the insight necessary to ensure attainment of the 8-hour standard up to 2012. The extensive clean air strategy modeling performed by AACOG staff will facilitate the

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planning if the continuous review process indicates additional measures should be considered.

If at any time the review of growth demonstrates that adopted control measures are inadequate to address growth in emissions, additional measures will be added to the plan. If additional control measures for 2007 attainment are suggested as being necessary through a review of growth, they will be verified using the current attainment demonstration photochemical model and adopted according to the public review process overseen by the Air Improvement Resources Committee. If additional control measures for 2012 attainment are suggested as being necessary through a review of growth, AACOG staff will work with the TCEQ and EPA to analyze control strategies based on then-currently available photochemical models. Appropriate control strategies will be adopted according to the public review process overseen by the Air Improvement Resources Committee.

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APPENDIX M

IMPACT OF TRANSPORT

SAN ANTONIO EAC REGION ATTAINMENT DEMONSTRATION

MARCH 2004

Appendix M

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Transport into the San Antonio Region: Introduction
Wind allows for transport of air pollution over great distances. Through this pollution transport, even areas that do not generate significant air pollution can be affected by air from other areas of high pollution production. Evidence for transport and its effects on the local San Antonio area are based on two sources: archived meteorological and special event data (which may be local, state, national or international in scope, and is limited in time only by the availability of data archives) and local photochemical modeling analysis (and so is restricted to the time and domain of the specific modeling episode).

An analysis of regional and national patterns helps provide an understanding of events which may affect local ozone levels. Such patterns include meteorological patterns, reoccurring regional or distant events, and/or pollution patterns due to placement and impact of regional pollutant generators. Historical meteorological data in the San Antonio area, information on transport, wind speed and direction, air movement identified through HYSPLIT back trajectories, and other important meteorological variables affecting ozone concentrations in the San Antonio region are discussed in detail in Appendix A. Some of these materials will be used in the current appendix in order to characterize the relationship between pollution transport into the San Antonio region and high ozone readings locally.

The other source of analysis for this topic rests with the 1999 CAMx photochemical model used for the attainment demonstration in this document set. While this data set is more limited in spatial extent and time period, hence with restraints in generalizability, it provides a far richer context because of the analytical tools available within the CAMx modeling tool chest.

Analysis of Meteorological Data: Regional Haze/Smoke Events
Significant regional haze/smoke events may affect the ozone levels in San Antonio from time to time. In instances such as these, fine particulate matter (PM 2.5) is transported into the area. Transported PM 2.5 may impact local ozone readings, even if PM concentrations are well below the NAAQS for fine particulate matter. The Naval Research Laboratory's NAAPS (Navy Aerosol Analysis and Prediction System) has archived model results for several pollutants (figures 1, 3, & 4), displaying smoke, dust, PM 2.5, and sulfate patterns across North America, aiding in pattern recognition. (NAAPS, 2003)

San Antonio experienced high levels of ozone at the same time that heavy smoke was present during the May 1998 Mexico/Central America smoke event. This case has been well documented as a transport incident and will be discussed for the sake of comparison to a haze event in September 2002, during which high levels of ozone were generated locally also. During both events, San Antonio experienced high levels of PM 2.5 and had several ozone exceedances. During yet another smoke episode in May 2002, lighter PM and smoke were accompanied by moderate ozone readings.

In May 1998, a large mass of smoke from agriculture fires in Mexico and Central America traveled across the state of Texas and as far north as the Dakotas. EPA received requests from nine states to exclude certain days of ozone data during this episode from compliance calculations. EPA reviewed the various requests in consultation with experts outside of the EPA, including those from the National Oceanic and Atmospheric Administration and the National Aeronautics and Space Administration. The EPA did concur with most of the requests from those nine states. (Seitz, 2000)

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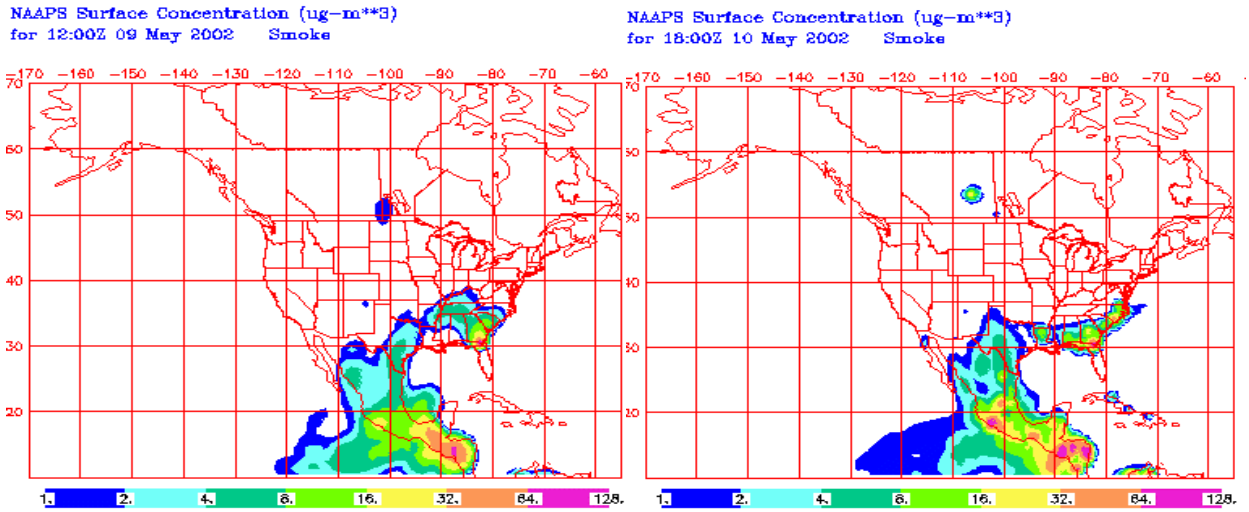
Every year the potential exists for San Antonio to experience similar air quality events due to agricultural burning. In May of 2002, smoke traveled from agricultural fires into Texas. Figure M-1 shows the concentration of smoke during the May 2002 event. On May 9, Continuous Air Monitoring Station (CAMS) 678 in eastern San Antonio recorded levels of PM 2.5 at 34.62μg/m³ and an ozone 8-hour maximum of 46 ppb, neither of which are considered high values.

Figure M-1: Surface Smoke Concentration Levels for May 9 & 10, 2002
Source: The Naval Research Laboratory's NAAPS, Navy Aerosol Analysis and Prediction System.



The September 2002 haze event was caused by sulfates transported from the Midwest (Ohio & Mississippi Valleys). (TCEQ, 2003) The San Antonio region experienced elevated peak 8-hr average ozone levels of 111, 97, and 92 ppb on September 12th, 13th, and 14th respectively. In addition, the regional background levels of ozone were also elevated during these days. The TCEQ described the area's lowest peak eight-hour measurement of 75 ppb as a "conservative estimate of the regional ozone background levels," based on the September 12, 2002, CAMS 503 (Bulverde, Texas) readings. (TCEQ, 2003b) The highest ozone reading on September 12 was 111 ppb in San Antonio, measured at CAMS 23, and was the highest eight-hour ozone average for the region in 2002. According to TCEQ, the "difference of 36 ppb between the measured eight-hour area maximum of 111 ppb and the estimated regional background level of 75 ppb was likely caused by local air pollution sources in the San Antonio area. The estimated 36 ppb local contribution was 32 percent of the 111 ppb area eight-hour peak." (TCEQ, 2003) Figure M-3 and Figure M-4, which follow, show the ground level sulfate concentrations for this event.

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Figure M-2: Hourly PM 2.5 and 8-hr Average Ozone for San Antonio, 2002 Ozone Season

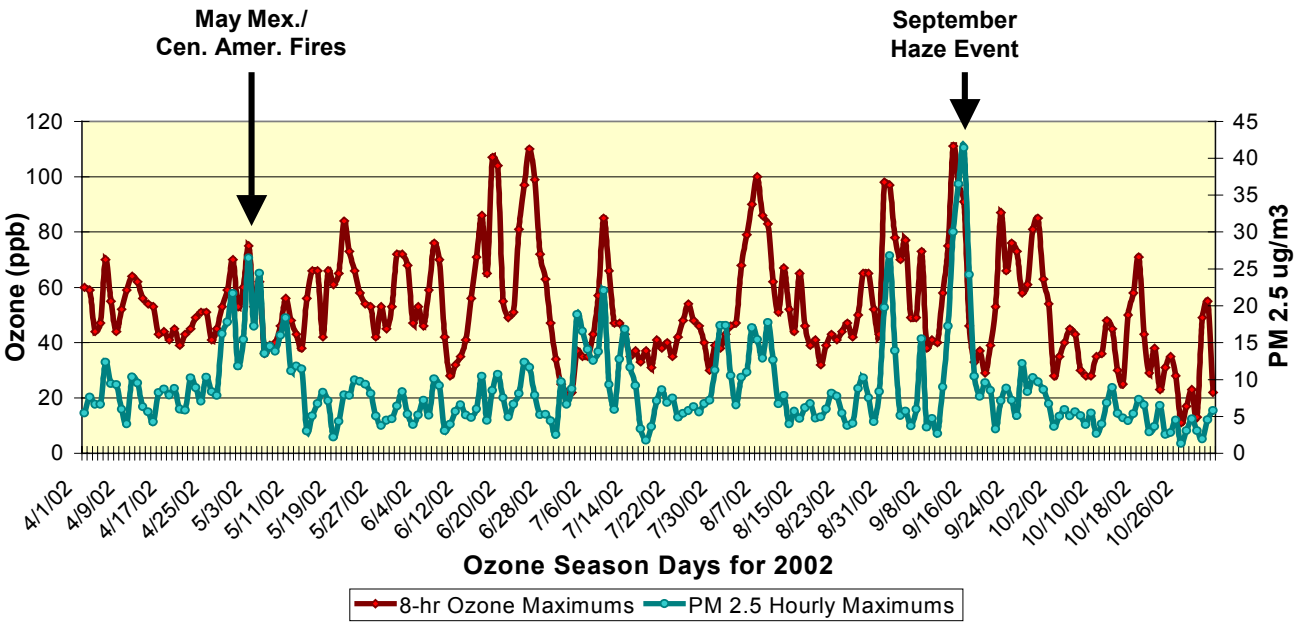

Figure M-2 displays a comparison between PM 2.5 and ozone readings for the 2002 ozone season. The May Mexico/Central America smoke and September Ohio Valley haze periods are marked for reference. The highest eight-hour average ozone reading for 2002 was recorded at CAMS 23 on September 12, coincident with high PM 2.5 and sulfate readings. The second, third and fourth highest 2002 readings at CAMS 23 occurred between June 17-24, when PM 2.5 readings were markedly lower.

Figure M-3. Ground Level Sulfate Concentrations on September 11 & 12, 2002
Source: The Naval Research Laboratory's NAAPS, Navy Aerosol Analysis and Prediction System.

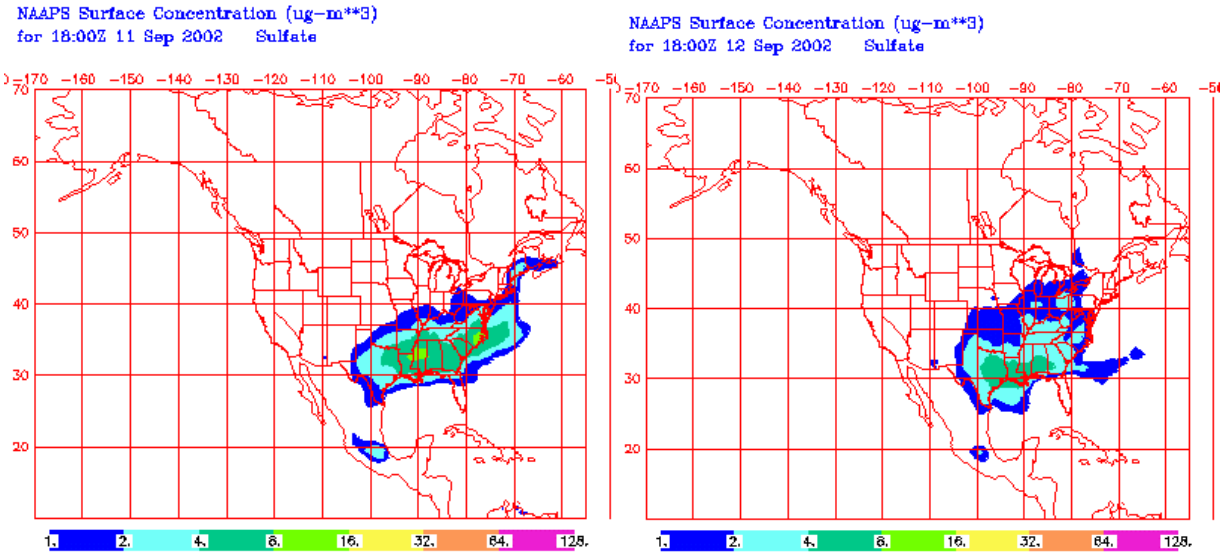

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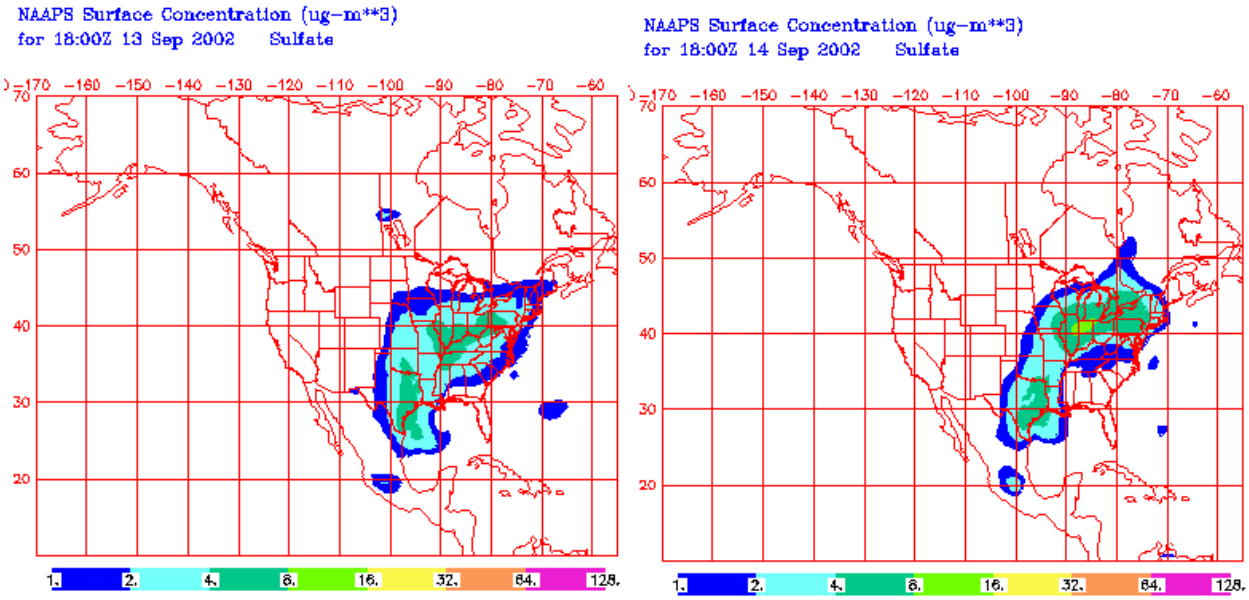
Figure M-4. Ground Level Sulfate Concentrations on September 13 & 14, 2002
Source: The Naval Research Laboratory's NAAPS, Navy Aerosol Analysis and Prediction System.



The transport of sulfates from the Ohio Valley to Texas can be traced by following the weather patterns at that time. In the Northern Hemisphere, winds move in a clockwise rotation around high-pressure areas; thus, the position of the high effects wind direction. The arrows show the approximate direction of the winds with respect to the high-pressure cell in Figure M-5. (TCEQ, 2003c) The presence of this cell moving across the country from west to east, driven by the jet stream, is the most likely cause of the pollutant migration. Figure M-6, displays a progression of high ground-level ozone mass from the Midwest down into Texas during the same episode. (EPA, 2003)

Figure M-5. High Pressure Cell on Sept. 7, 2002 and Same Cell on Sept. 12, 2002

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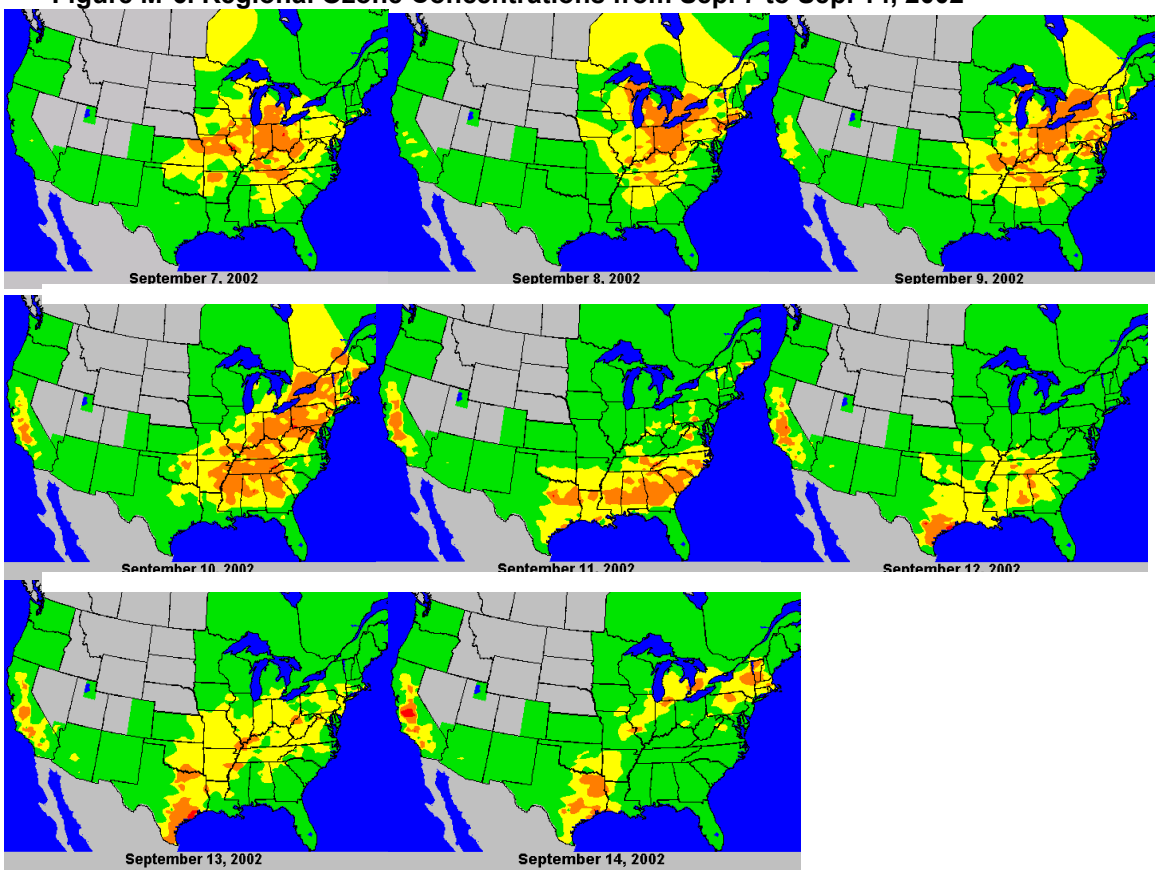
Figure M-6. Regional Ozone Concentrations from Sep. 7 to Sep. 14, 2002



Air Parcels Paths: HYSPLIT model

The HYSPLIT[1] model provided an approximate path of the air coming into San Antonio for the September 2002 haze event as shown in figures M-7 through M-9. Each back trajectory[2] path was computed for a 144 hour (6 day) period.

[1] The HYSPLIT model runs described here are based on historical meteorological data sets archived by the National Centers for Environmental Prediction within the National Oceanic and Atmospheric Administration. The HYSPLIT model allows the user to access this archived data as model input specific to place and time.

[2] Given a geographic destination for an air parcel, back trajectories show the path followed by the parcel before reaching the destination

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Figure M-7. Back Trajectories: Sept. 12, 2002

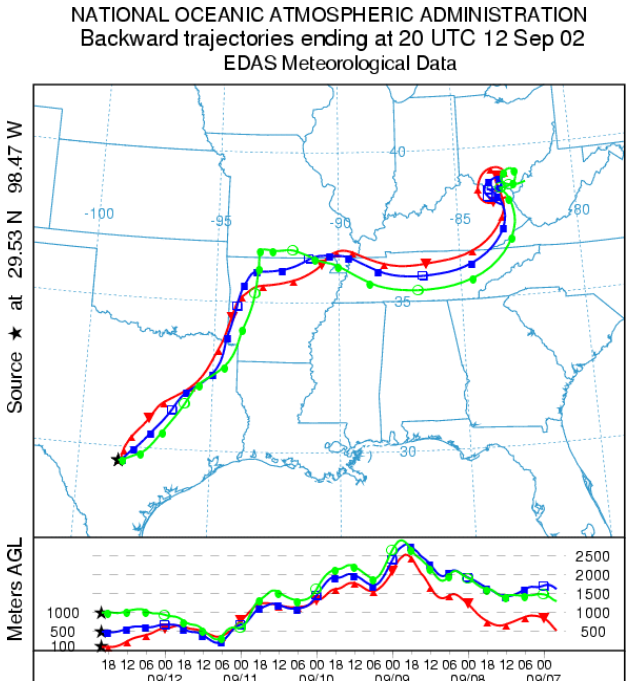


Figure M-8. Back Trajectories: Sept. 13, 2002

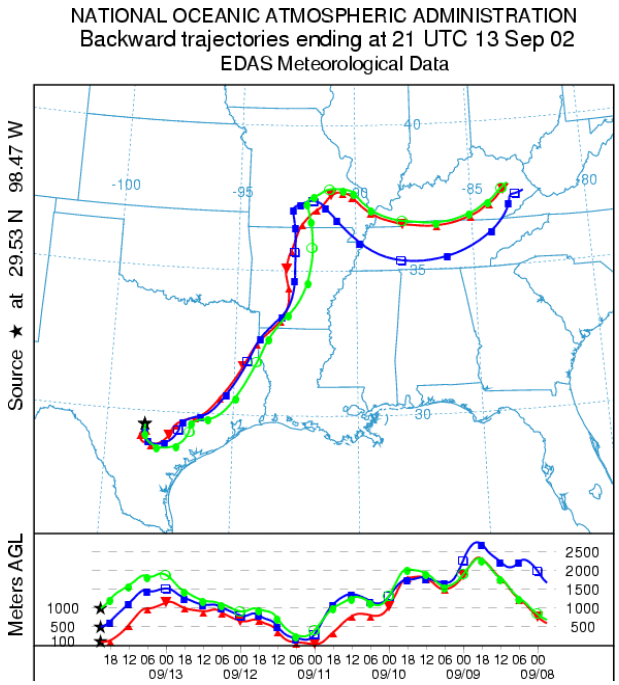
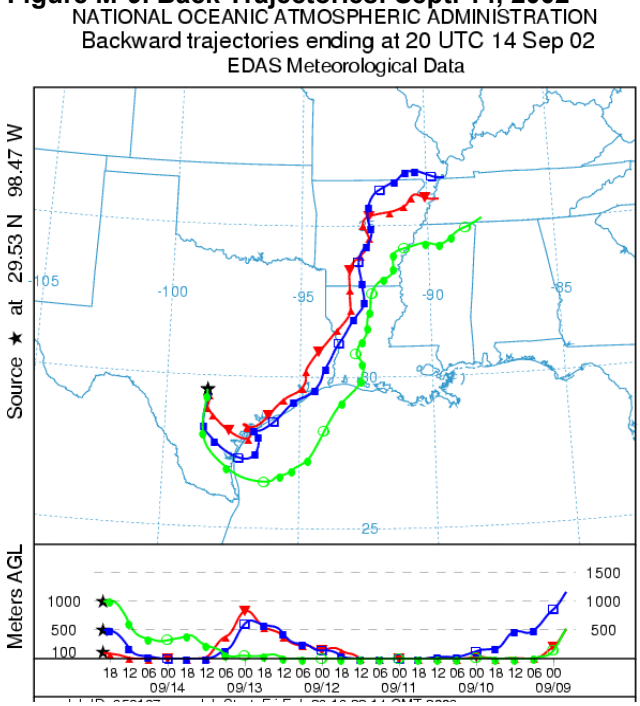


Figure M-9. Back Trajectories: Sept. 14, 2002



In conclusion, the ozone levels recorded in San Antonio during mid-September 2002 coincided with high PM levels. There is strong evidence that both the ozone and PM measured across the local area were part of a wide pattern of transport across the entire eastern half of the United States. The May 1998 Mexican smoke event was considered

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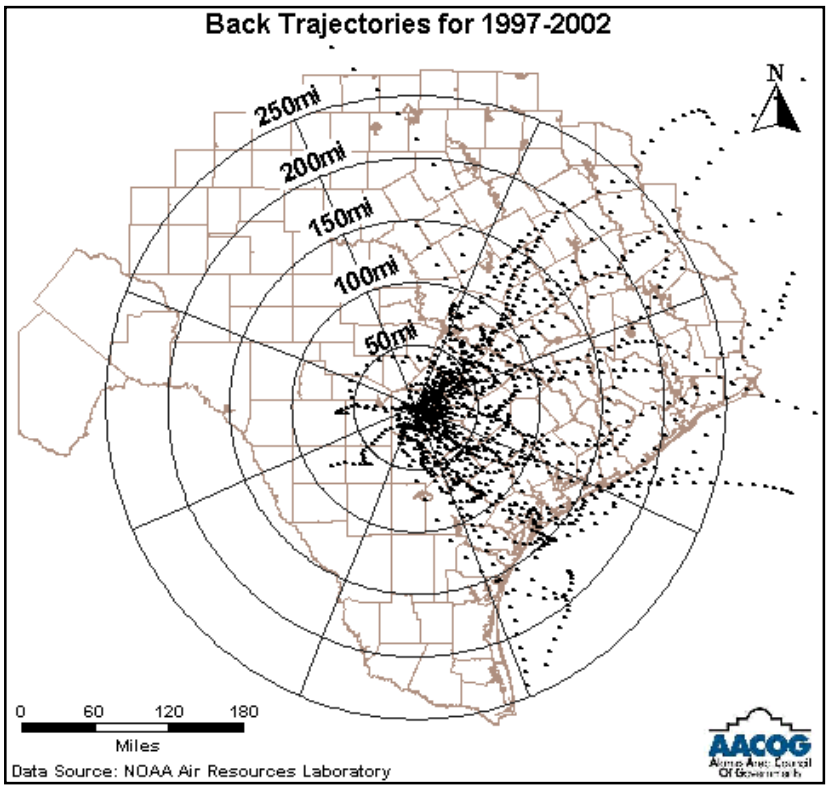
an exceptional event such that the EPA excused local area ozone levels from consideration for regulatory purposes, and by definition was due to transport. There is strong coincidence of HYSPLIT wind patterns, appearance of shifting elevated ozone concentrations archived by EPA, sulfate concentrations archived by NAAPS, and wind patterns documented by TCEQ during the September 2002 event. Evidence of transport during the September 2002 event, including an analysis concluding that background levels in San Antonio reached as high as 75 ppb, has been presented here.

Analysis of Local Ozone Levels and Selected Regional Precursor Sources
The HYSPLIT model was also used to estimate air parcel paths typical to ozone exceedance days in the San Antonio region[3] over a 1997-2002 period. By running back trajectories for the forty-two exceedance days in the San Antonio region that occurred from 1997 to 2003, AACOG staff identified ***wind patterns*** for exceedance days.

Figure M-10[4] shows the pattern of air parcels positions on their path to the San Antonio International Airport. A total of 33 hours for each exceedance day have been backtracked in order to cover the regional air quality modeling area. Figure M-10 shows that, on high ozone days, it is rare that air arriving in San Antonio will have traveled west, northwest, south or the southwest over the six-year period investigated.

Figure M-10. 1997-2002 Pattern of Air Parcels Paths Arriving in San Antonio



[3] The HYSPLIT model is used in development of the Conceptual Model; see Appendix A.
[4] Because the HYSPLIT model outputs both graphical and ASCII-text latitude/longitude/altitude coordinate sets by hour, the output is both display-ready and suitable for further analysis, as performed to typify wind patterns associated with high ozone days.

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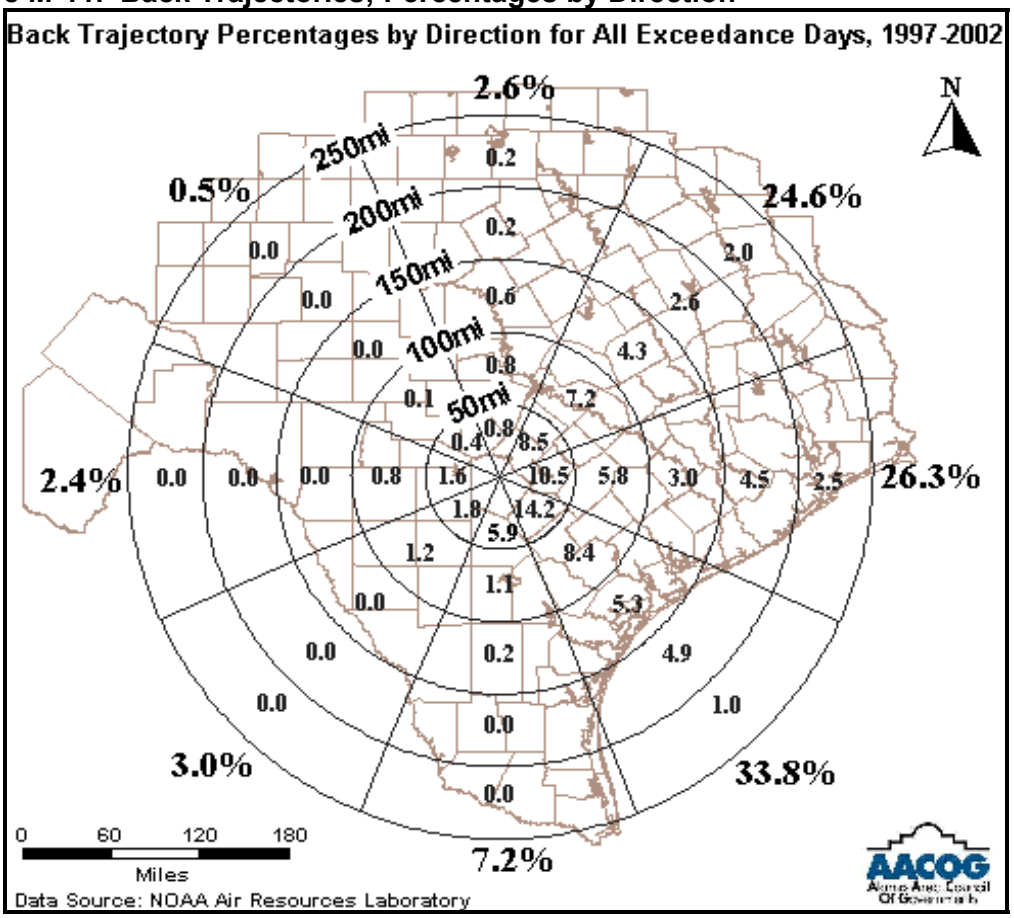
As mentioned, the HYSPLIT model back trajectory output provides hourly latitude / longitude / altitude locations of air parcels. These individual data points are plotted in figure M-10. Figure M-11 provides the percentage of air parcels allocated within each region on the map. The total for each octant is located just outside the 250-mile circle.

Figure M-11. Back Trajectories; Percentages by Direction



The image shows that within 50 miles of the destination of the air parcels in the back trajectories, the San Antonio International Airport (SAIA), 8.5 % of the air parcels swept through the northeast, 18.5% of the air parcels came from the east, and 14.2 % came from the southeast direction. It is worth noting that the entire San Antonio Early Action Compact region, i.e., Bexar, Comal, Guadalupe and Wilson Counties, lies within the 50-mile radius shown.

Between 50 and 100 miles of SAIA, 0.8% of the air parcel came from the west. On the east of SAIA, outside the 250-mile boundary, the figure in bold indicates that altogether, 26.3% of all air parcels came from the east of SAIA within the eastern octant, where the Houston/Galveston area is located.

Use of back trajectories to identify wind patterns coincident with high local ozone levels is typically a technique used by modelers to select new modeling episodes, as discussed in Appendix A. These calculations show the frequency with which air parcels pass through a given region before coming into San Antonio on a high ozone day. This, in

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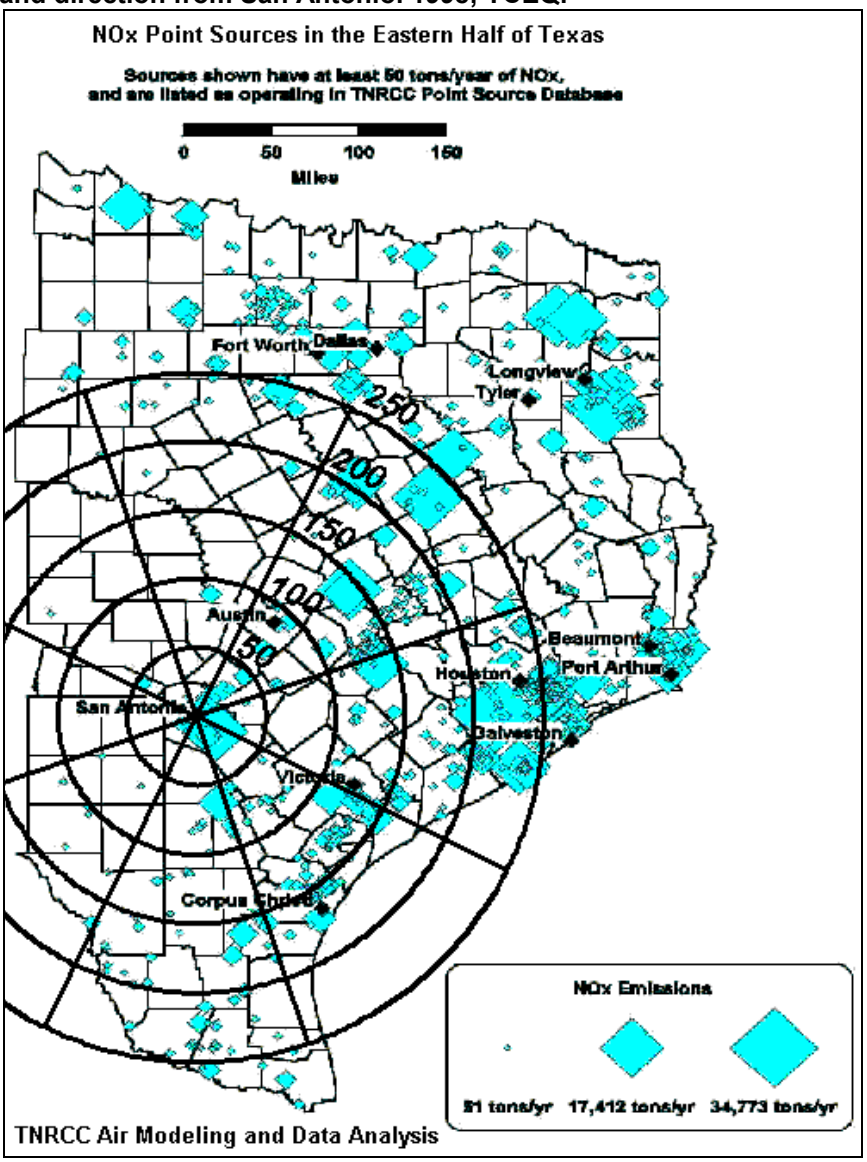
turn, is important in discussing the influence of ozone precursor sources along the back trajectories on ozone levels in the San Antonio region.

Major Point Sources along Back Trajectories on days of High Ozone
Figure M-12 shows the location of major point sources in Texas, identified by distance and direction from San Antonio in the same manner as the back trajectory air patterns. Given the predominant wind patterns for air arriving in San Antonio on high ozone days and the location of important point sources, it is clear that air typically passes over many of these point sources prior to arriving in San Antonio, where high ozone levels are then recorded. In conclusion, there is a strong correlation between the location of point sources in Texas and air pathways associated with historical high ozone readings in San Antonio. This correlation is supported by further analysis using the photochemical model, as now follows.

Figure M-12. NOx Point Sources in the Eastern Half of Texas by their distance, magnitude and direction from San Antonio. 1998; TCEQ.



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Modeling: Removing Anthropogenic pollution from the Emission Inventory
The evidence for transport can be further demonstrated by conducting a series of modeling runs in which all of the anthropogenic emissions from the adjacent metropolitan areas are removed from the CAMx emission inventory for the modeled episode. Sensitivity runs were employed to determine the impact of transport on ozone concentrations in the San Antonio region during the 1999 episode. These runs required the application of a masking program to the model to "zero out" the anthropogenic VOC, NOx, and CO emissions for three urban Texas areas: Austin, Corpus Christi, and Houston. Transported emissions from each of these areas can impact ozone concentrations in the San Antonio area.

PAVE Graphics
After removing anthropogenic emissions generated by Austin, Corpus Christi, and Houston from the 1999 base case model, the modeling output was processed through a graphics software program (PAVE) to provide visual depictions of the resulting impact on regional ozone concentrations. The following series of figures compare, day by day for September 15-20, 1999, the changes in ozone predicted by the precursor reductions in each of these three urban areas.

Different colors in the plots distinguish variations in the amount of ozone. The red and orange areas indicate higher levels of increased ozone levels while blue and green areas indicate levels of ozone reductions from the transport of air mass. The predicted increases in ozone concentrations (red and yellow shading) within some areas of the 4-km subdomain are noteworthy. This is particularly evident in the zero out Corpus Christi runs, although the zero out Austin runs for September 15-17th also depict relatively small areas of yellow shading.

In general, according to these graphics, removing Houston anthropogenic emissions impacted ozone concentrations in all SAER counties and east Texas. When Houston's emissions are removed, a blue plume usually appears which indicates an area of maximum reduced ozone levels stretching a considerable distance downwind of Houston. Removing Austin anthropogenic emissions typically impacted ozone concentrations in the northern SAER region. Removing emissions from Corpus Christi is least likely to impact the four SAER counties.

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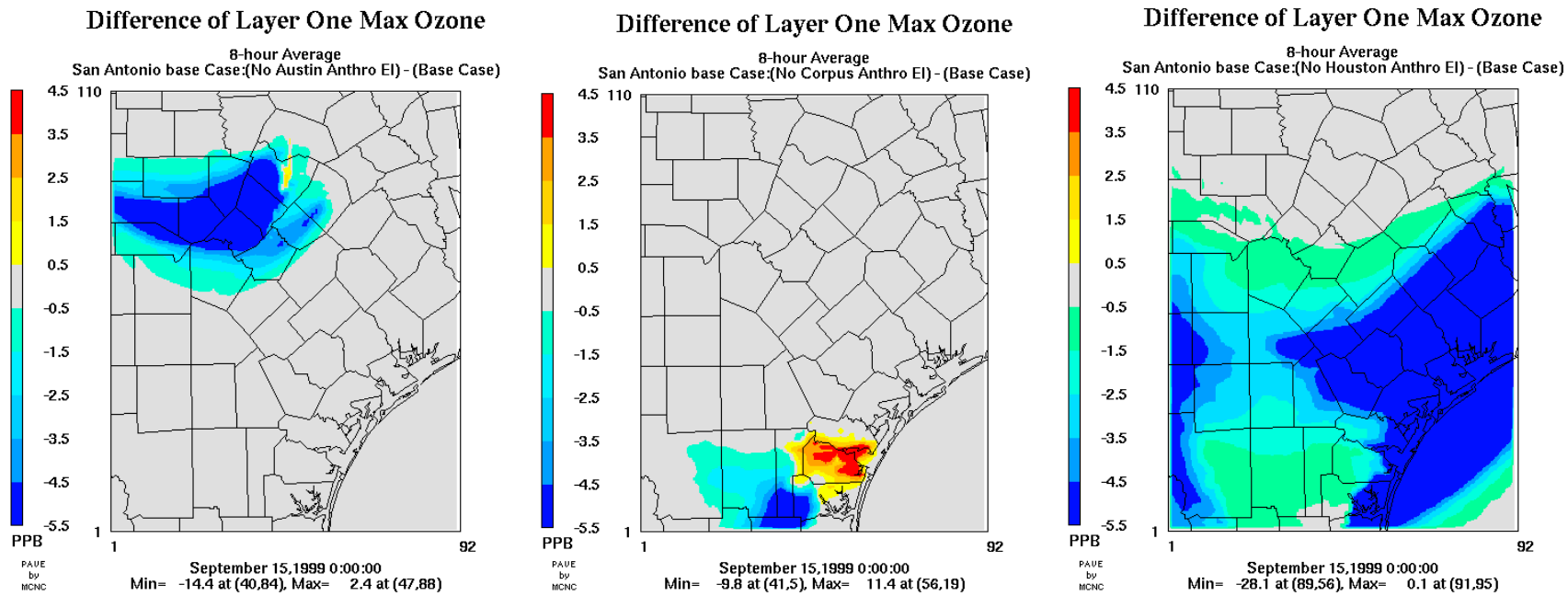
Figure M-13. Results of "zero out" model runs for Wednesday, September 15, 1999.



Zero out Austin Anthropogenic Emissions

Zero out Corpus Christi Anthropogenic Emissions

Zero out Houston Anthropogenic Emissions

As shown, removing Austin and Houston anthropogenic precursor emissions reduced modeled ozone concentrations in each SAER county (or a portion of a county) on September 15th. However, removing Corpus Christi anthropogenic emissions had no projected impact on SAER ozone concentrations on the same day. The red and orange areas near and in the Corpus Christi metropolitan area indicate increased ozone levels due to the reduced scavenging. The blue and green areas indicate ozone reductions from the transport of air mass.

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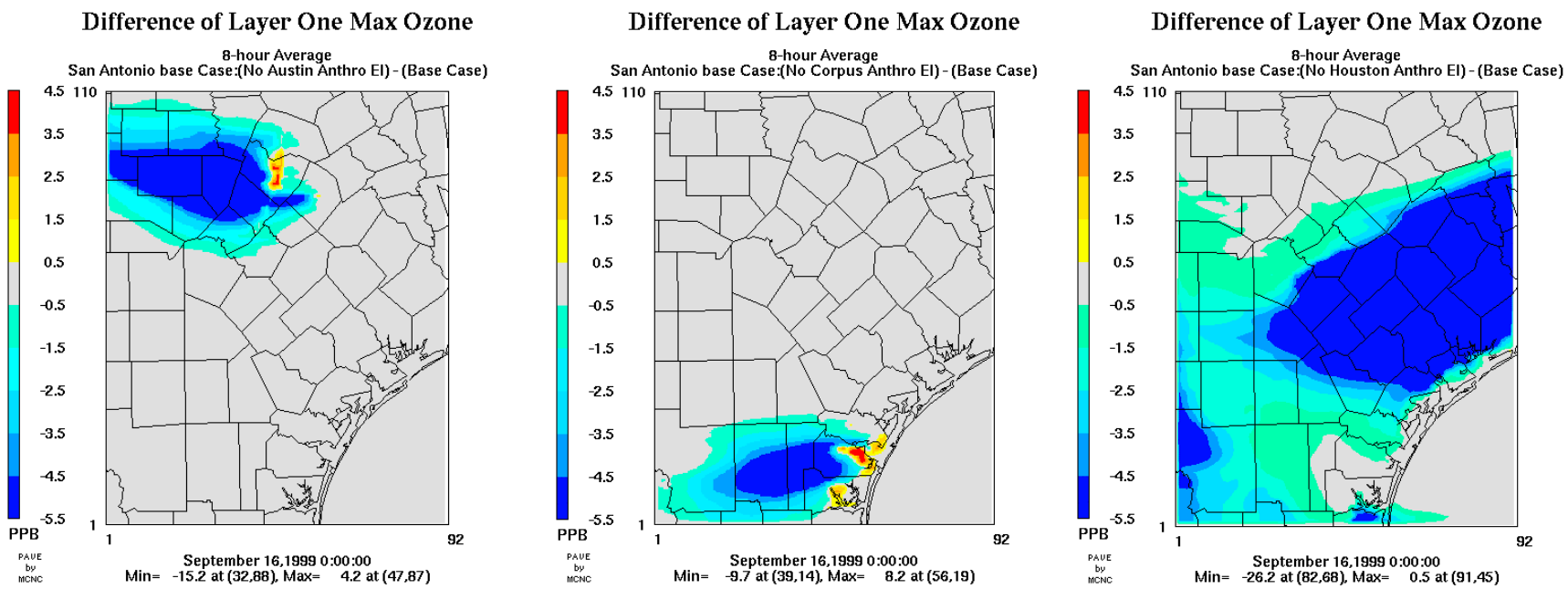
Figure M-14. Results of "zero out" model runs for Wednesday, September 16, 1999.



Zero out Austin Anthropogenic Emissions

Zero out Corpus Christi Anthropogenic Emissions

Zero out Houston Anthropogenic Emissions

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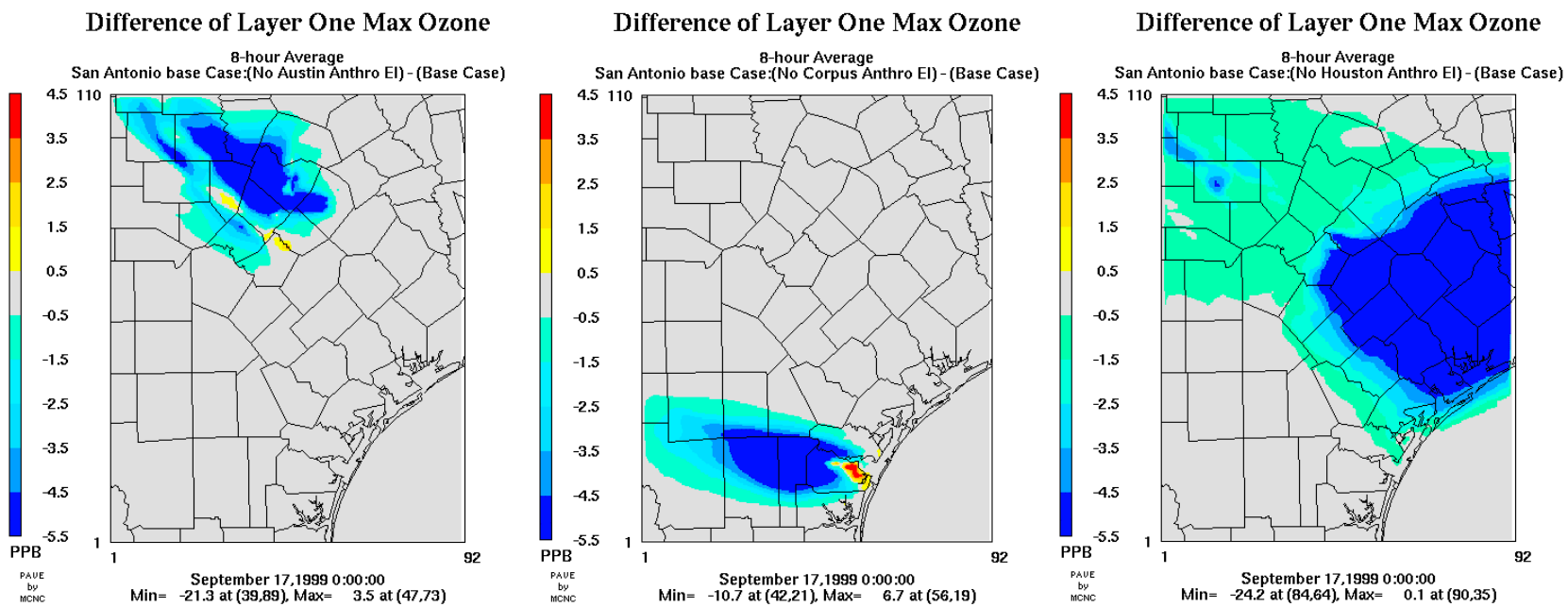
Figure M-15. Results of "zero out" model runs for Wednesday, September 17, 1999.



Zero out Austin Anthropogenic Emissions

Zero out Corpus Christi Anthropogenic Emissions

Zero out Houston Anthropogenic Emissions

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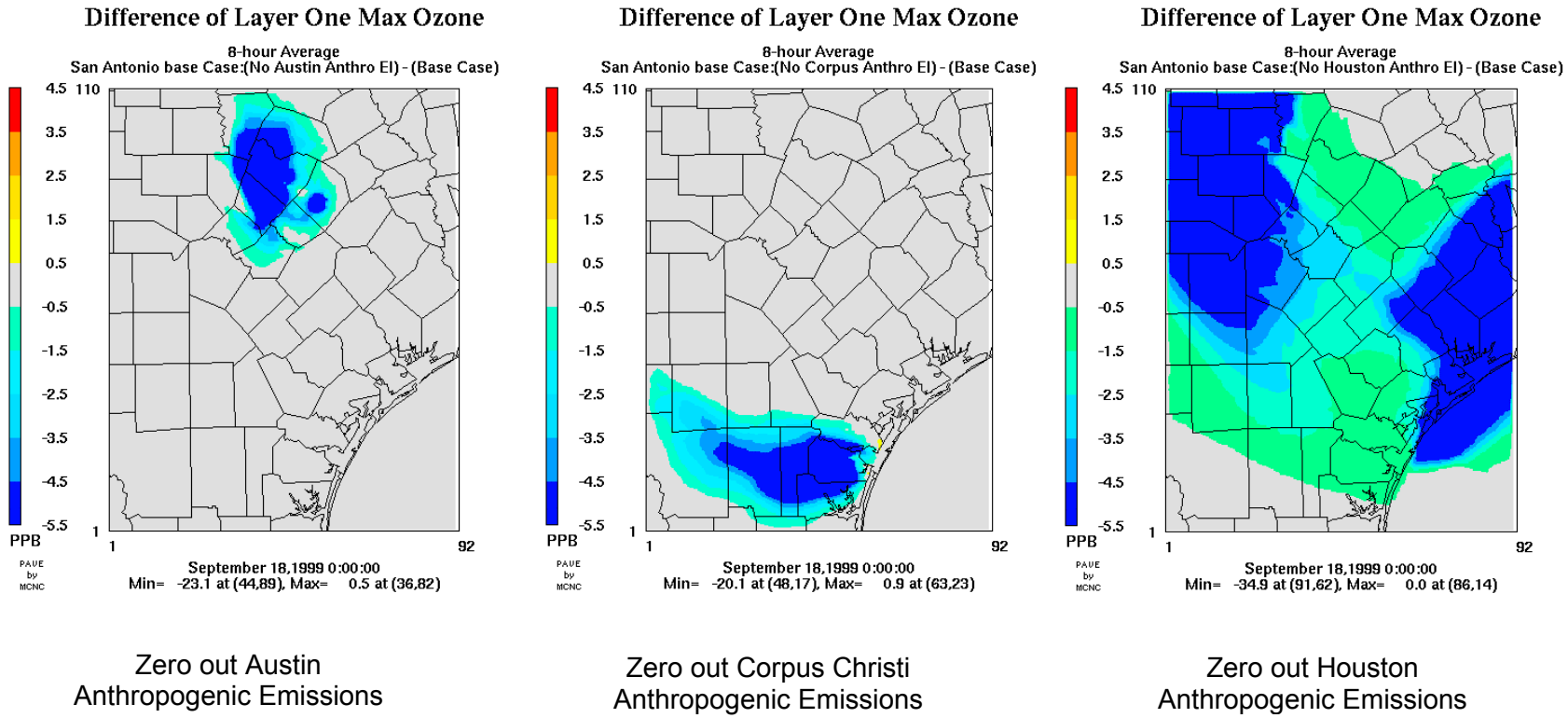
Figure M-16. Results of "zero out" model runs for Wednesday, September 18, 1999.



Zero out Austin Anthropogenic Emissions

Zero out Corpus Christi Anthropogenic Emissions

Zero out Houston Anthropogenic Emissions

As noted earlier, when emissions are removed and a blue plume appears, the plume indicates an area of reduced ozone. Here, in Corpus Christi's case, the plume stretches a considerable distance downwind of this area. The downwind plume is very evident on September 18, 1999, with less evidence of NOx scavenging than on most other days for this region.

The plot for Houston clearly shows the effect of the reduction for two days, given by the two large distinct blue lobes.

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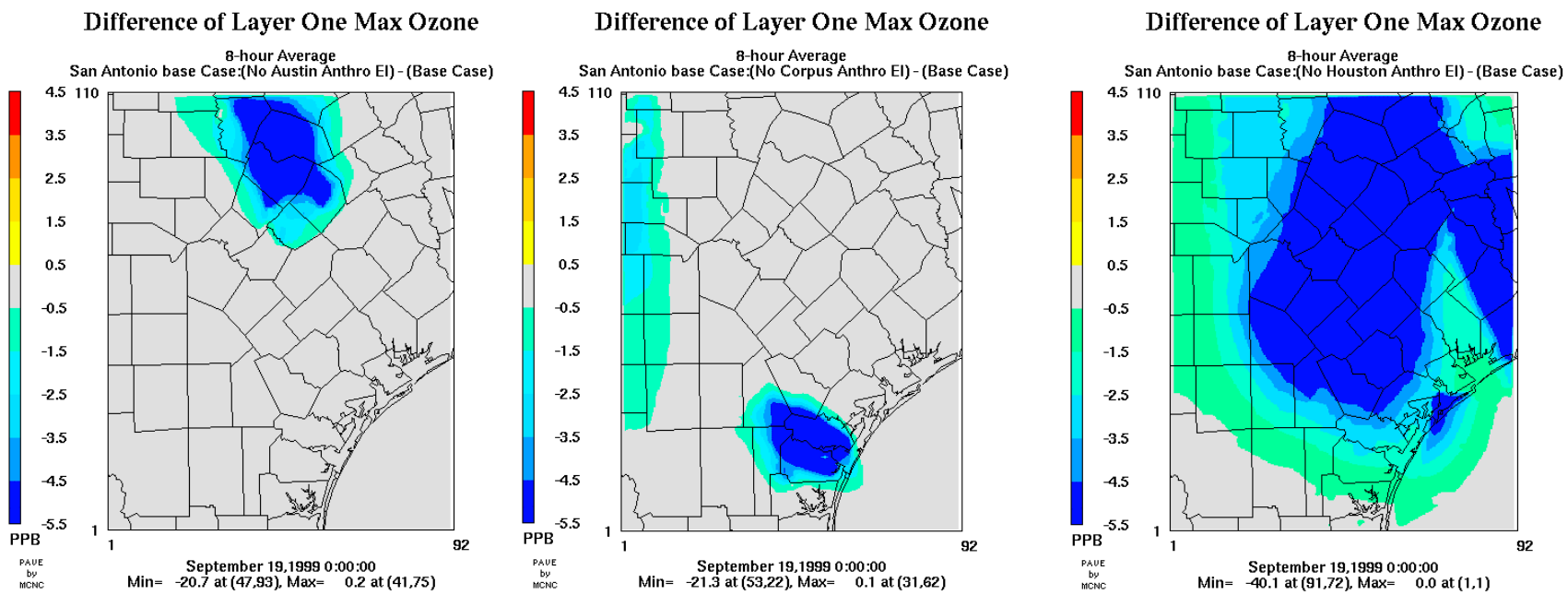
Figure M-17. Results of "zero out" model runs for Wednesday, September 19, 1999.



Zero out Austin Anthropogenic Emissions

Zero out Corpus Christi Anthropogenic Emissions

Zero out Houston Anthropogenic Emissions

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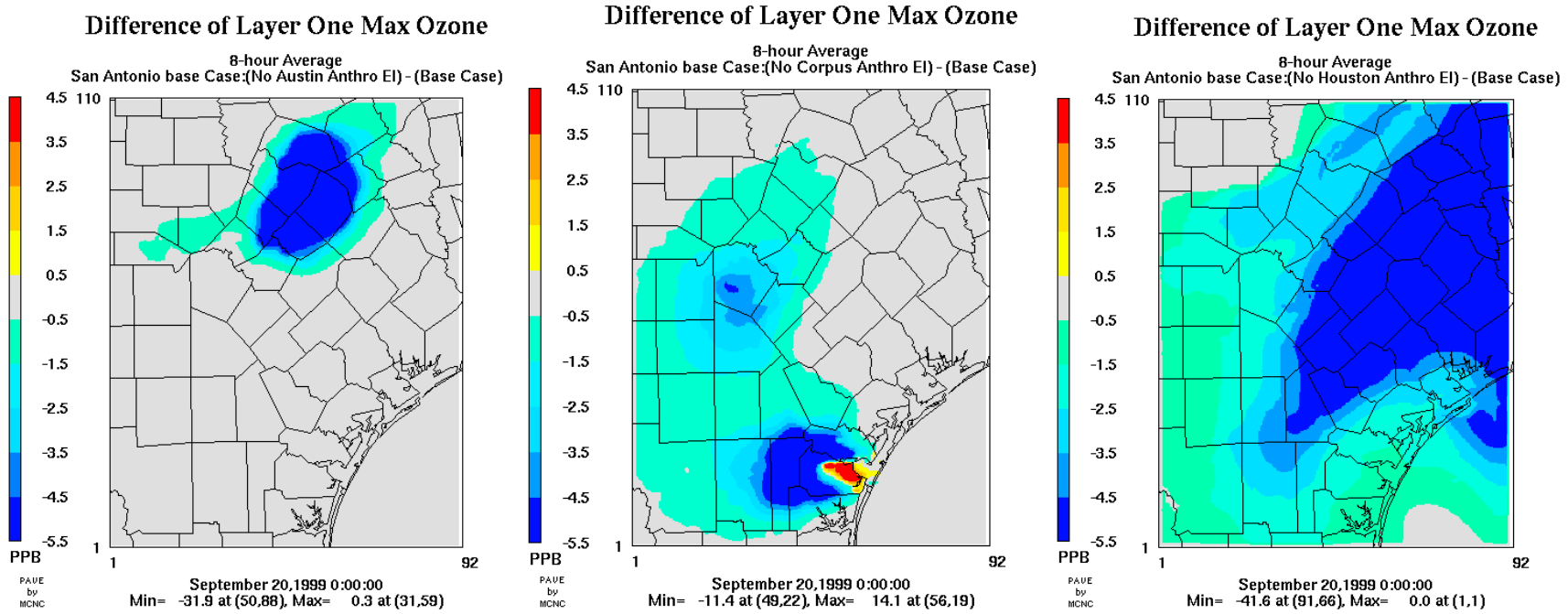
Figure M-18. Results of "zero out" model runs for Monday, September 20, 1999.



Zero out Austin Anthropogenic Emissions

Zero out Corpus Christi Anthropogenic Emissions

Zero out Houston Anthropogenic Emissions

Graphical Display of Data

The preceding graphical representations of the change in ozone due to reductions in anthropogenic regional emissions are based on photochemical modeling output data. Predicted effects of these reductions at various CAMS in the San Antonio region were analyzed numerically as well. The following graphs specifically show these impacts on the design value. The calculation of design value, which is an off-model procedure, was based on instructions received from the EPA and TCEQ. The procedure averages the ozone levels for each day of the episode run with reduces precursor levels and compares this average with the design value for the episode. In this way, the impact on the design value of any precursor reduction scenario can be estimated.

As figure M-19 indicates, removing the Houston/Galveston area anthropogenic emissions lowers the CAMS 58 design value by about 2.60 parts per billion. This impact is considerably greater than the impacts which are estimated by removing Austin and Corpus Christi area anthropogenic emissions. In figure M-20 removing the Houston/Galveston area emissions shows a reduction of 2.72 ppb at CAMS 23, which is also considerably higher than readings due to removing Austin and Corpus Christi area anthropogenic emissions. Figures M-19 and M-20 reflect averages over the 5-day modeling period of the peak 8-hour ozone averages predicted by the model.

Figure M-19. Design Value Reduction due to the Removal of Houston, Austin, and Corpus Christi Anthropogenic Emissions, CAMS 58, Sept. 1999

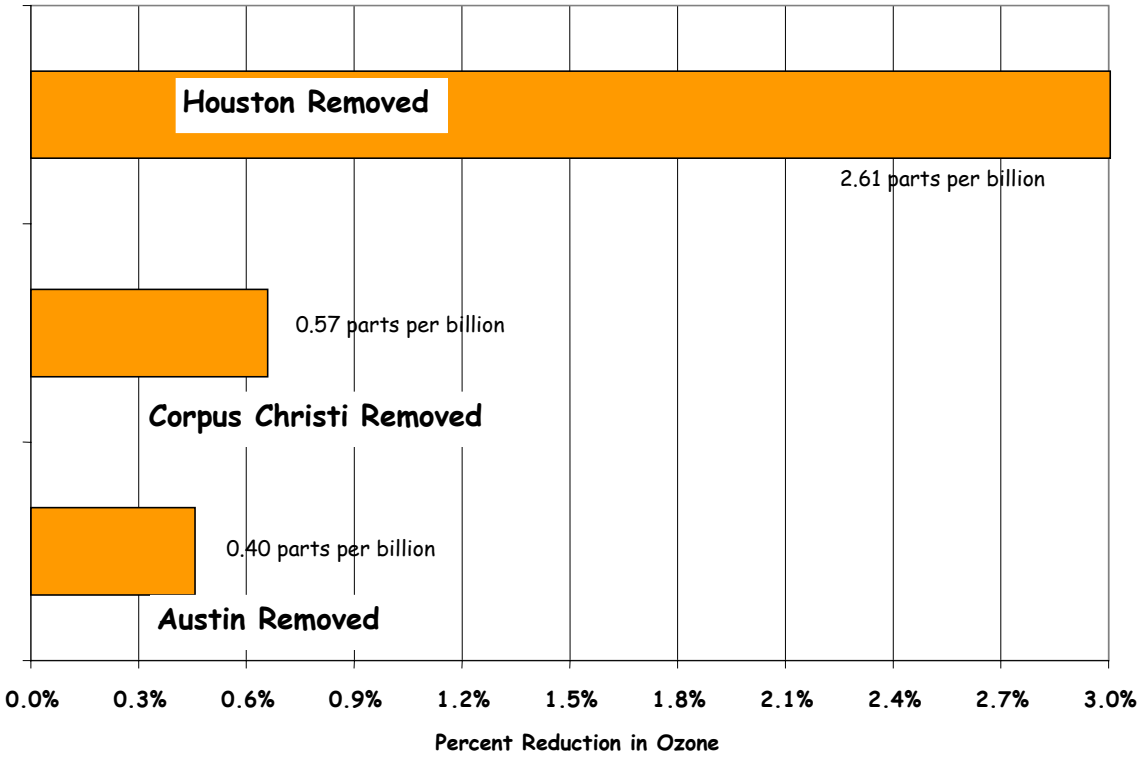


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Figure M-20. Design Value Reduction due to the Removal of Houston, Austin, and Corpus Christi Anthropogenic Emissions, CAMS 23, Sept. 1999

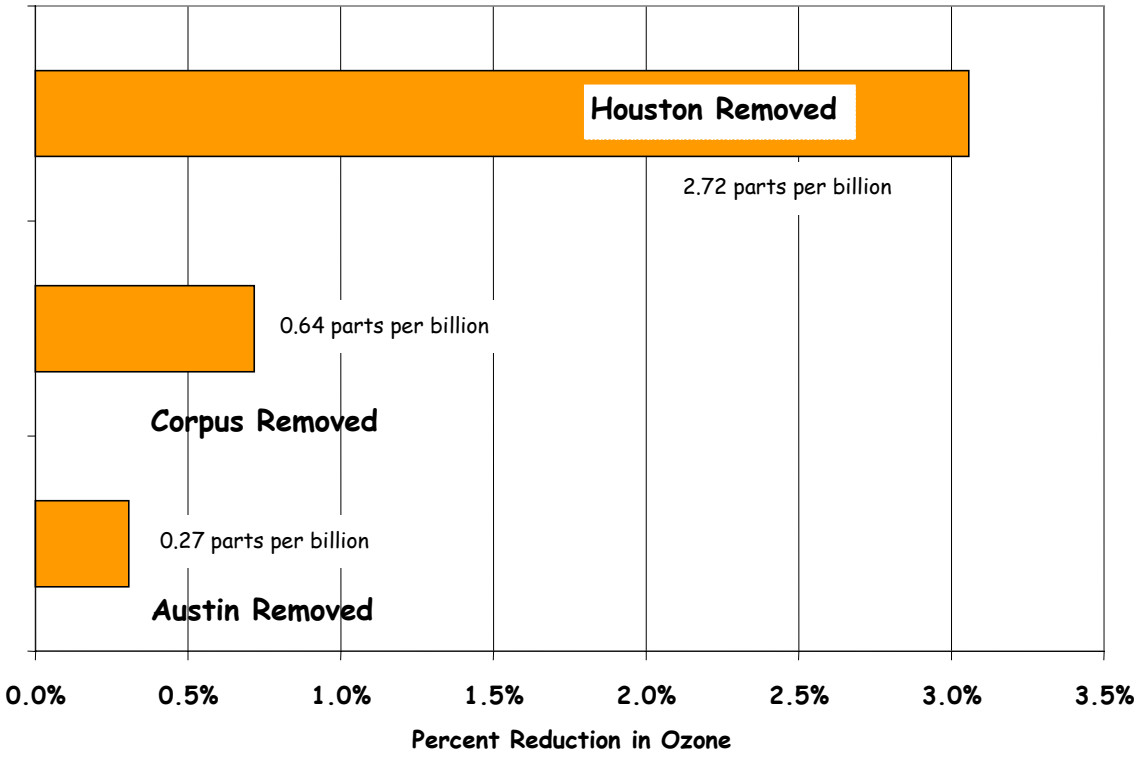
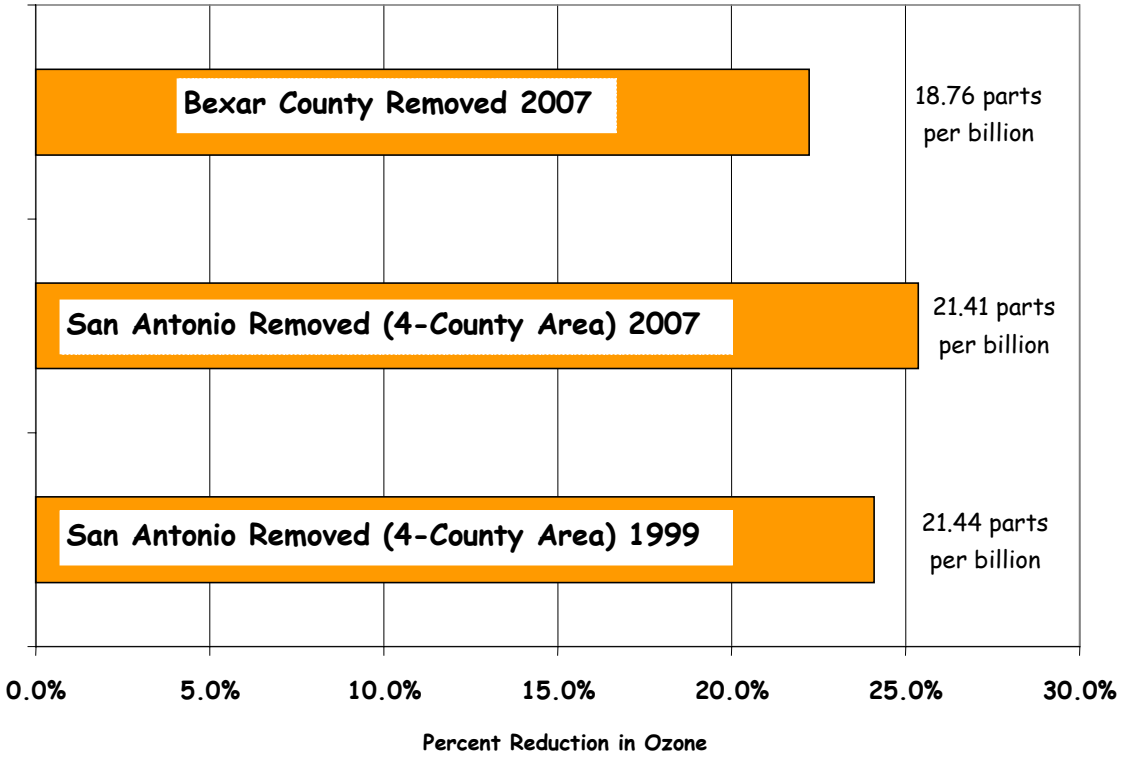


Figure M-21. Design Value Reduction due to the Removal of Bexar County and San Antonio Region Anthropogenic Emissions, CAMS 23, Sept. 1999 and 2007



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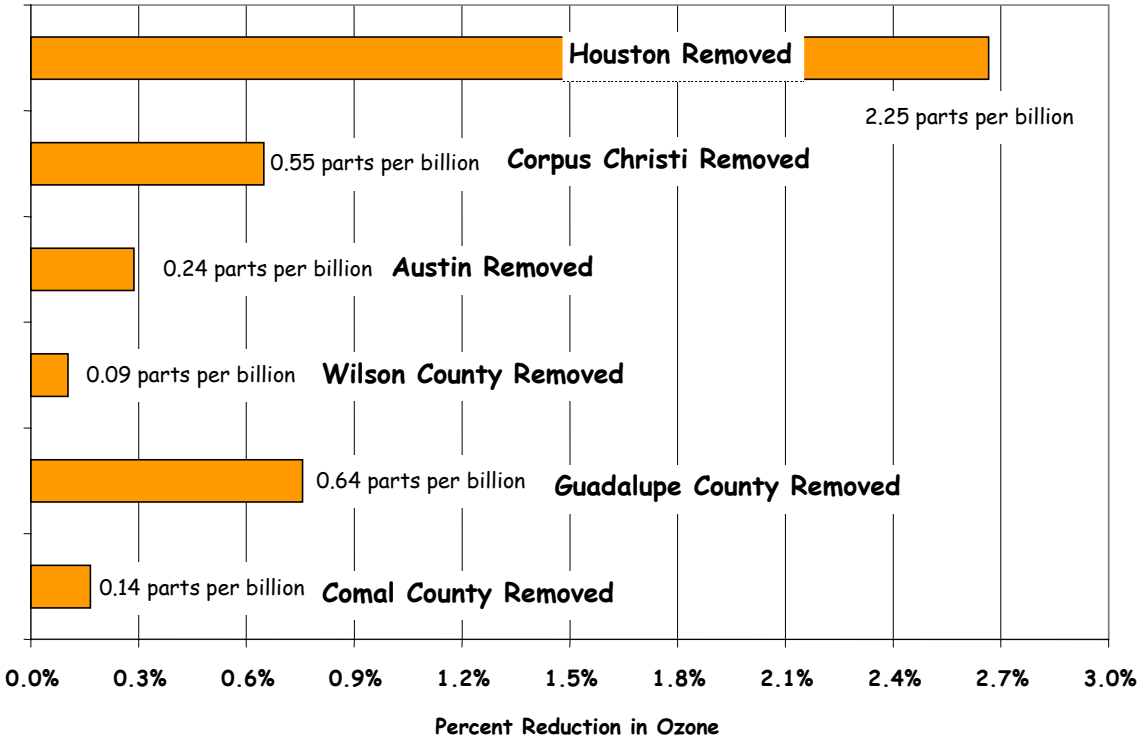
Further analysis of the emission inventory for the Sept. 1999 episode revealed that removal of *local* (i.e., Bexar, Comal, Guadalupe and Wilson Counties) anthropogenic emissions cause an average reduction of about 25% of the peak ozone predicted around CAMS 23 during this episode. Figure M-21 shows the results of this additional analysis. The figure indicates that the proportion of emissions attributed to and originating in the local San Antonio region is predicted to increase from 1999 to 2007. Hence, the region's contribution to the design value for the Sept. 1999 episode was around 24.09% of the total design value, or 21.44 parts per billion of ozone; the estimated 2007 contribution is around 25.36%, or 21.41 ppb.

In addition, the analysis further indicates that, due to the implementation of air quality control strategies in the Houston/Galveston area by the year 2007, the amount of pollution transport from this area will noticeably decrease. However, this region still remains the largest emissions contributor to San Antonio as compared to the other contributing regions in Texas. This can be seen in Figure M-22. Contributions from other regions affecting the air quality in San Antonio region are also shown for comparison purposes.

Figure M-22. Design Value Reduction due to the Removal of Emissions from Various Contributing Areas at CAMS 23, Sept. 2007



Comparing the results of zero out runs for Austin, Corpus Christi, Houston and San Antonio, it is predicted that removing the SAER anthropogenic emissions has, by far, the greatest impact on local ozone concentrations. Therefore, it is clear the San Antonio region contributes to its own air quality problem. The 1999 base simulation predicts that without the SAER anthropogenic precursor emissions, ozone concentrations within the San Antonio region would be reduced by as much as ~24%. Although this provides an indication of the significance of SAER-generated anthropogenic emissions, it also indicates that approximately three-quarters of the ground-level ozone in the SAER is a

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product of natural and transported emission sources – emissions over which the SAER has no control.

Removing Houston's anthropogenic emissions had the greatest impact on San Antonio area ozone levels. Without the reductions credited to the Houston area for 2007 (attributed to reductions achieved through the Houston SIP), for example, the San Antonio region would likely fail to show attainment as it currently does.

Tables M-1 through M-3 provide the projected reduction in ozone concentrations (percent difference between Base Case F and the sensitivity run) within the 7x7 grids surrounding three San Antonio monitors after removing anthropogenic emissions for Austin, Corpus Christi, or Houston. For comparison purposes, anthropogenic VOC, NOx, and CO emissions generated in the 4-county San Antonio region were also removed from the model during one of the sensitivity runs. Results of removing or zeroing out precursor emissions are provided for both the base year and attainment year simulations.

The highest predicted ozone concentrations, in parts per billion, for each day of the September 13 – 20 episode were averaged for the areas near the three monitors listed in the columns labeled "Predicted Average O_3" in the tables below. These modeled results indicate that, under the meteorological conditions experienced during the September 1999 episode, removing the anthropogenic emissions from Houston had the greatest impact on SAER ozone concentrations when compared to other sources of transport.

The most significant reductions in predicted ozone concentrations were associated with removing anthropogenic precursor emissions generated in the 4-county San Antonio region. While transport contributes to ground-level ozone buildup in Central Texas, a significant portion of the ozone problem is created locally. This is particularly evident in figure M-21 which illustrates the importance of local precursor production on local ozone concentrations.

Table M-1. CAMS 23

Sensitivity Run	Year	Design Value	% Reduction
Base Case F	1999	89.00	---
Zero Austin	1999	88.73	0.31%
Zero Corpus Christi	1999	88.36	0.72%
Zero Houston	1999	86.28	3.06%
Zero San Antonio (4-county area) 1999	1999	67.56	24.09%
Base Case F	2007	84.42	---
Zero Austin	2007	84.11	0.29%
Zero Corpus Christi	2007	83.81	0.65%
Zero Houston	2007	82.11	2.67%
Zero San Antonio (4-county area) 2007	2007	63.13	25.35%

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Table M-2. CAMS 58

Sensitivity Run	Year	Design Value	% Reduction
Base Case F	1999	87.00	---
Zero Austin	1999	86.60	0.46%
Zero Corpus Christi	1999	86.43	0.66%
Zero Houston	1999	84.39	3.00%
Zero San Antonio (4-county area) 1999	1999	67.47	22.44%
Base Case F	2007	82.04	---
Zero Austin	2007	81.68	0.46%
Zero Corpus Christi	2007	86.43	0.66%
Zero Houston	2007	84.39	3.00%
Zero San Antonio (4-county area) 2007	2007	67.47	22.44%

Table M-3. CAMS 678

Sensitivity Run	Year	Design Value	% Reduction
Base Case F	1999	77.00	---
Zero Austin	1999	76.84	0.21
Zero Corpus Christi	1999	76.23	1.00
Zero Houston	1999	73.97	3.93
Zero San Antonio (4-county area) 1999	1999	66.18	14.06
Base Case F	2007	74.61	---
Zero Austin	2007	74.27	0.33
Zero Corpus Christi	2007	73.97	0.77
Zero Houston	2007	72.31	2.95
Zero San Antonio (4-county area) 2007	2007	62.51	16.33

Ozone Source Apportionment Technology (OSAT) Analysis

Finally, the photochemical model can help demonstrate the relationship between sources of ozone precursor in the emissions inventory, their rates of precursor production, and the contribution these sources make to the total ambient ozone contribution within a given grid cell of the model. The specific limitations of this Ozone Source Apportionment Technology (OSAT) include:

1. the limits to regional source identification, which regions are distinguished by a user-designed surface area restricted to modeling grid cells as surface area units;
2. the limits to categorization of precursors, which is by the four major emission groups of Area/Non-Road, Mobile, Elevated Point, and Biogenic;
3. the limits to determination of sources or areas beyond the grid in space and time, which the model sees as Boundary Conditions and Initial Conditions, respectively, and;
4. the increased time required for pre-processing, the model OSAT runs themselves, and data post-processing and analysis.

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Nevertheless, the OSAT tech does allow a clearer determination of the sources of ambient ozone in the model. And, even given the limits listed above, the number of variables does allow for an analysis containing extensive detail and variability. This additional tool is explained as follows.

The OSAT module in the CAMx photochemical model allows for the identification of sources in specific areas and for the subsequent tracking of their impacts on different areas. This module was used to show the impact of other regions on air quality in San Antonio area for the model run referred to as “run18.sos”. The *Anthropogenic Precursor Culpability Assessment* (APCA) option within this module was used to identify ozone formation attributed to the anthropogenic NOx sources and less ozone formation attributed to biogenic sources.

The outputs from OSAT analysis, presented in the following pages, identify contributors to the peak levels of ozone recorded at CAMS 23, during the 1999 episode, by source regions, by source categories or *emission groups,* and by type of precursor (e.g., NOx).

As mentioned, the regions by which sources are identified and distinguished are limited in number. The modeler designs them; the regions are mapped according to the modeling grid domain, using grid cells as the smallest units to build the final rectangular source region or subdomain. The names of the regions for this run (Gulf of Mexico, etc.) are listed above.

The precursors are categorized as one of the four major emission groups: Area/Non-Road, Mobile, Elevated Point, or Biogenic sources. The numbers in each list above identify the Names and Precursor type in the following charts.

In reading the charts and graphs on the following pages, notice that the pie charts are labeled with a one or two digit number corresponding with the Source Area ID number (or IC or BC for Initial or Boundary Conditions). This is followed by a comma, which is followed by a three digit number corresponding to the Source Category ID number. The percentage contribution accompanies this number pair.

The tables accompanying each graph lists, in descending order by percentage contribution, the twelve greatest contributions to ozone at the "receptor," or grid cell in the model. The grid cell chosen here contains the CAMS 23 monitor, so the "receptor" designated carries that name. Notice also that each rows of the table identifies both a Source Area and an Emissions Group; the same row will have a percentage in the far right hand column. This percentage correlates the contribution to ozone at the receptor due to precursor production from that area and that source type. For example, the September 15, 1999 table lists that Austin's Mobile source NOx made up 3.6% of the ozone and Austin's Mobile source VOC contributed 0.1% of the ozone predicted by the model at the receptor cell, i.e., at CAMS 23.

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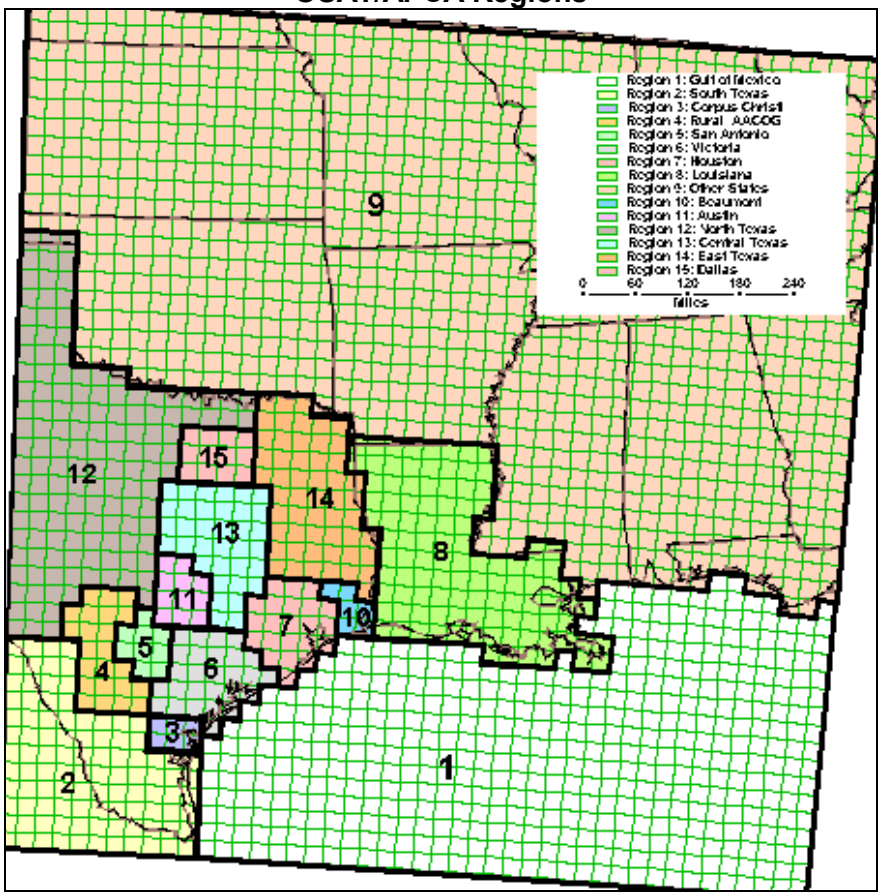
OSAT/APCA Regions



Plot Date: March 12, 2004
Compilation Date. March 3, 2004

NORTH

Source Regions used in The CAMx APCA Application	
ID	**Name**
1	Gulf of Mexico
2	South Texas
3	Corpus Christi
5	San Antonio
6	Victoria
7	Houston
8	Louisiana
9	Other States
10	Beaumont
11	Austin
12	North Texas
13	Central Texas
14	East Texas
15	Dallas
IC	Initial Conditions
BC	Boundary Conditions

Source Categories used in the CAMx APCA Application	
ID	**Category**
001	Biogenic
002	Elevated Point
003	Mobile
004	Area/Non-Road

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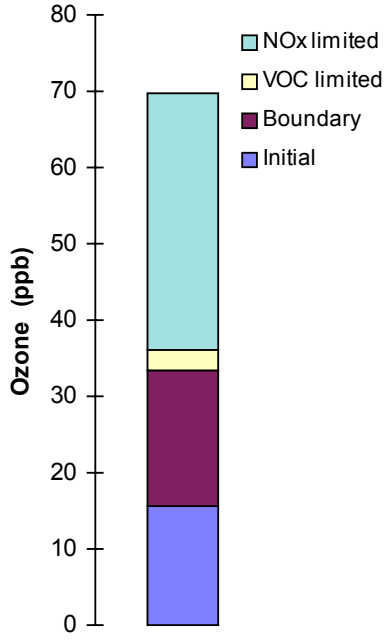
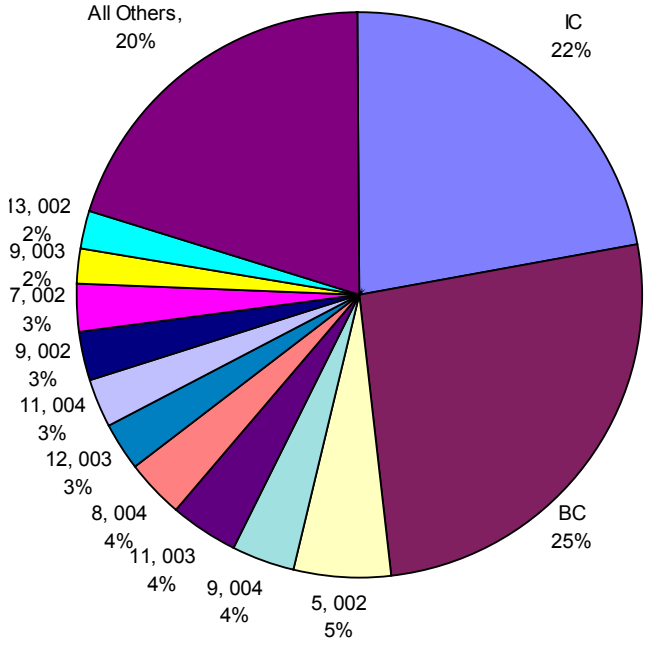
Contributions By Type



Contributions By Source Area



Receptor = San Antonio CAMS 23
Time = 13 To 14
Date = 9/15/1999
Scenario = CAMx v3.10 run18.sos.apca Sep 13-20 1999
Total Ozone = 70 ppb

Detailed Ozone Apportionment

Source Area		*Emission Group*		*Percent Ozone from*		
				NOx	*VOC*	*Total*
Initial Conditions	IC					22.3%
Boundary Conditions	BC					25.6%
San Antonio	5	Elevated Point	002	5.5%	0.0%	5.5%
Other States	9	Area/Non-Road	004	3.3%	0.5%	3.8%
Austin	11	Mobile	003	3.6%	0.1%	3.7%
Louisiana	8	Area/Non-Road	004	3.4%	0.1%	3.5%
North Texas	12	Mobile	003	2.7%	0.1%	2.8%
Austin	11	Area/Non-Road	004	2.6%	0.1%	2.7%
Other States	9	Elevated Point	002	2.7%	0.0%	2.7%
Houston	7	Elevated Point	002	2.6%	0.0%	2.7%
Other States	9	Mobile	003	1.9%	0.2%	2.2%
Central Texas	13		002	2.1%	0.0%	2.1%
All Others						20.3%
Total						100%

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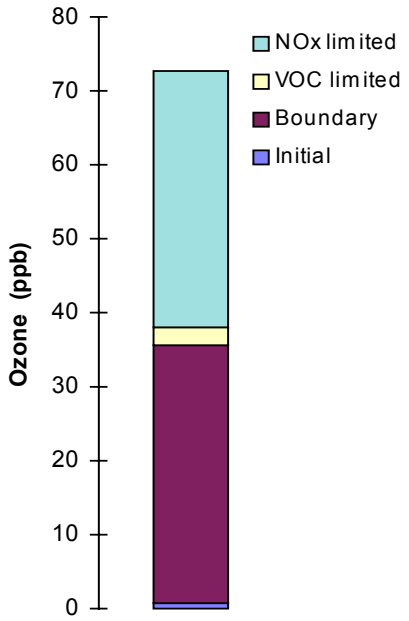
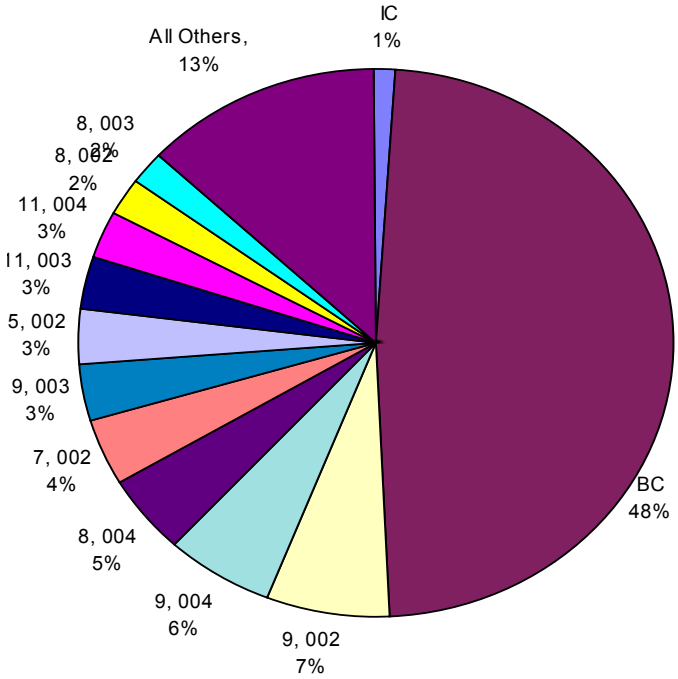
Contributions By Type



Contributions By Source Area



Receptor = San Antonio CAMS 23
Time = 12 To 13
Date = 9/16/1999
Scenario = CAMx v3.10 run18.sos.apca Sep 13-20 1999
Total Ozone = 73 ppb

Detailed Ozone Apportionment

Source Area		*Emission Group*		*Percent Ozone from*		
				NOx	*VOC*	*Total*
Initial Conditions	IC					1.2%
Boundary Conditions	BC					47.9%
Other States	9	Elevated Point	002	6.7%	0.0%	6.7%
Other States	9	Area/Non-Road	004	4.9%	0.9%	5.8%
Louisiana	8	Area/Non-Road	004	4.8%	0.1%	4.9%
Houston	7	Elevated Point	002	3.8%	0.0%	3.8%
Other States	9	Mobile	003	3.0%	0.4%	3.4%
San Antonio	5	Elevated Point	002	3.2%	0.0%	3.2%
Austin	11	Mobile	003	3.1%	0.0%	3.2%
Austin	11	Area/Non-Road	004	2.6%	0.1%	2.6%
Louisiana	8	Elevated Point	002	2.3%	0.0%	2.3%
Louisiana	8	Mobile	003	1.9%	0.0%	1.9%
All Others						13.1%
Total						100%

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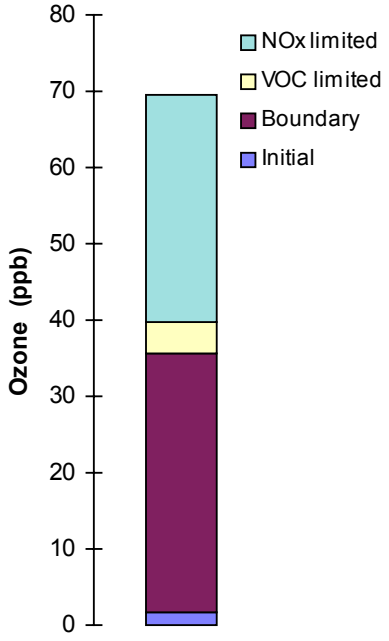
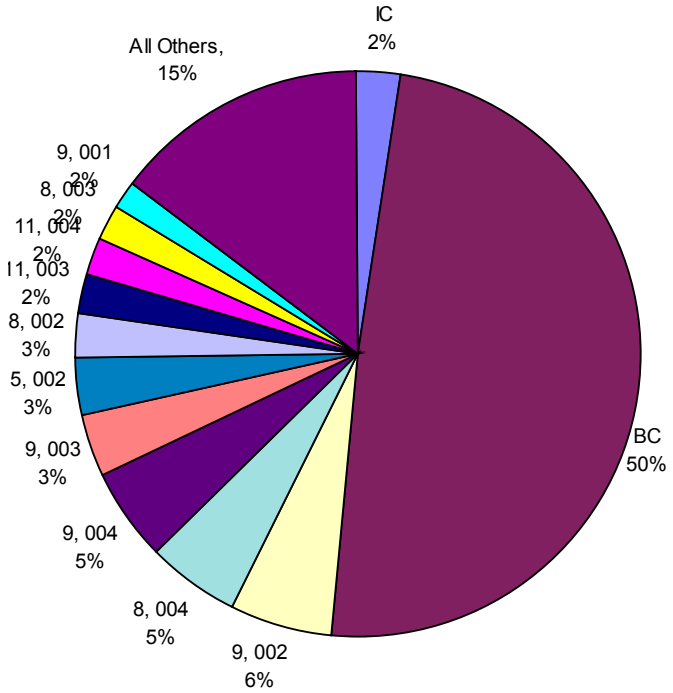
Contributions By Type



Contributions By Source Area



Receptor	**=**	**San Antonio CAMS 23**
Time	**=**	**12 to 13**
Date	**=**	**9/17/1999**
Scenario	**=**	**CAMx v3.10 run18.sos.apca Sep 13-20 1999**
Total Ozone	**=**	**70 ppb**

Detailed Ozone Apportionment

Source Area		*Emission Group*		*Percent Ozone from*		
				NOx	*VOC*	*Total*
Initial Conditions	IC					2.4%
Boundary Conditions	BC					48.9%
Other States	9	Elevated Point	002	5.7%	0.0%	5.8%
Louisiana	8	Area/Non-Road	004	5.2%	0.2%	5.4%
Other States	9	Area/Non-Road	004	4.0%	1.3%	5.3%
Other States	9	Mobile	003	2.9%	0.6%	3.5%
San Antonio	5	Elevated Point	002	3.4%	0.0%	3.4%
Louisiana	8	Elevated Point	002	2.7%	0.0%	2.7%
Austin	11	Mobile	003	2.0%	0.1%	2.1%
Austin	11	Area/Non-Road	004	1.9%	0.2%	2.1%
Louisiana	8	Mobile	003	1.8%	0.1%	1.9%
Other States	9	Biogenics	001	0.8%	0.8%	1.6%
All Others						14.8%
Total						100%

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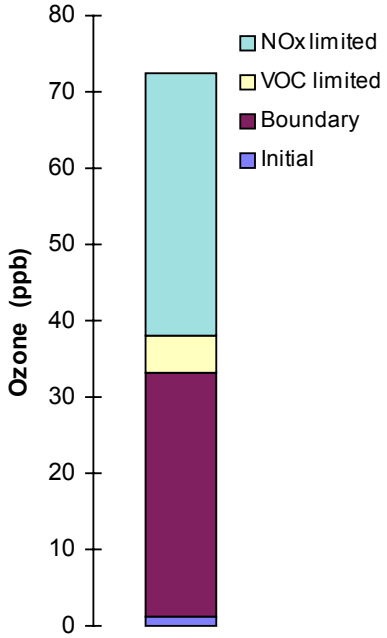
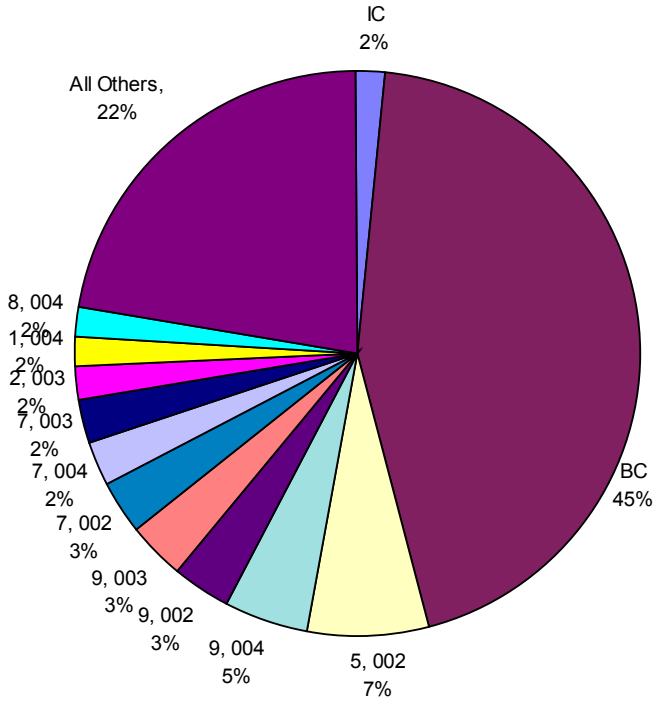
Contributions By Type



Contributions By Source Area



Receptor = San Antonio CAMS 23
Time = 13 To 14
Date = 9/18/1999
Scenario = CAMx v3.10 run18.sos.apca Sep 13-20 1999
Total Ozone = 72 ppb

Detailed Ozone Apportionment

Source Area		*Emission Group*		*Percent Ozone from*		
				NOx	*VOC*	*Total*
Initial Conditions	IC					1.8%
Boundary Conditions	BC					44.1%
San Antonio	5	Elevated Point	002	6.9%	0.0%	7.0%
Other States	9	Area/Non-Road	004	3.7%	0.9%	4.7%
Other States	9	Elevated Point	002	3.3%	0.0%	3.3%
Other States	9	Mobile	003	2.9%	0.4%	3.3%
Houston	7	Elevated Point	002	3.0%	0.1%	3.1%
Houston	7	Area/Non-Road	004	1.7%	0.7%	2.4%
Houston	7	Mobile	003	2.0%	0.3%	2.4%
North Texas	12	Mobile	003	1.9%	0.2%	2.1%
Austin	11	Area/Non-Road	004	1.6%	0.1%	1.7%
Louisiana	8	Area/Non-Road	004	1.5%	0.1%	1.7%
All Others						22.4%
Total						100%

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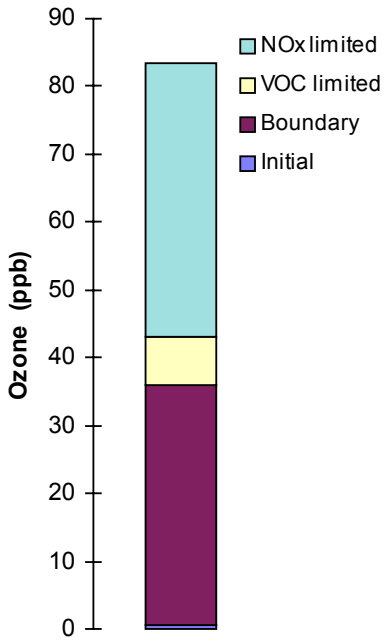
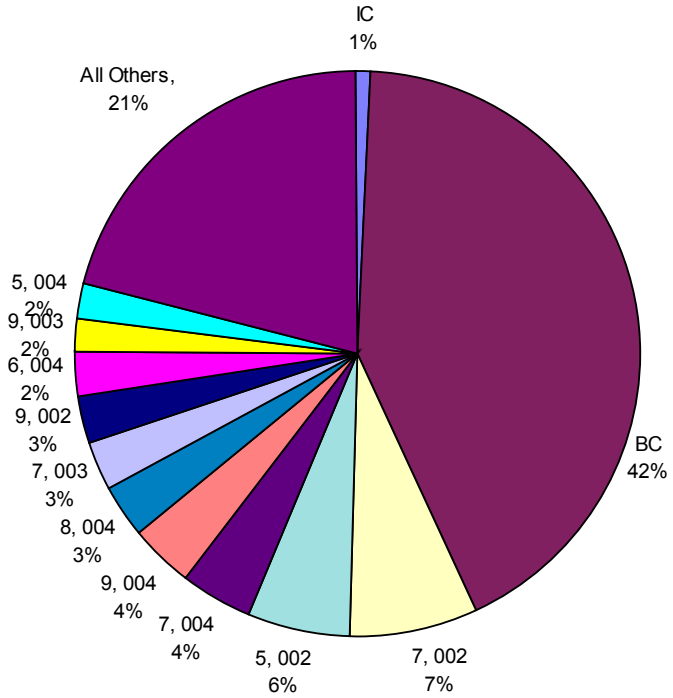
Contributions By Type



Contributions By Source Area



Receptor = San Antonio CAMS 23
Time = 13 To 14
Date = 9/19/1999
Scenario = CAMx v3.10 run18.sos.apca Sep 13-20 1999
Total Ozone = 84 ppb

Detailed Ozone Apportionment

Source Area		*Emission Group*		*Percent Ozone from*		
				NOx	*VOC*	*Total*
Initial Conditions	IC					0.7%
Boundary Conditions	BC					42.4%
Houston	7	Elevated Point	002	7.0%	0.2%	7.2%
San Antonio	5	Elevated Point	002	5.7%	0.1%	5.8%
Houston	7	Area/Non-Road	004	3.2%	1.1%	4.2%
Other States	9	Area/Non-Road	004	2.8%	0.8%	3.6%
Louisiana	8	Area/Non-Road	004	2.8%	0.3%	3.0%
Houston	7	Mobile	003	2.5%	0.3%	2.8%
Other States	9	Elevated Point	002	2.6%	0.0%	2.7%
Victoria	6	Area/Non-Road	004	1.8%	0.6%	2.4%
Other States	9	Mobile	003	1.8%	0.3%	2.1%
San Antonio	5	Area/Non-Road	004	1.3%	0.6%	1.9%
All Others						21.1%
Total						100%

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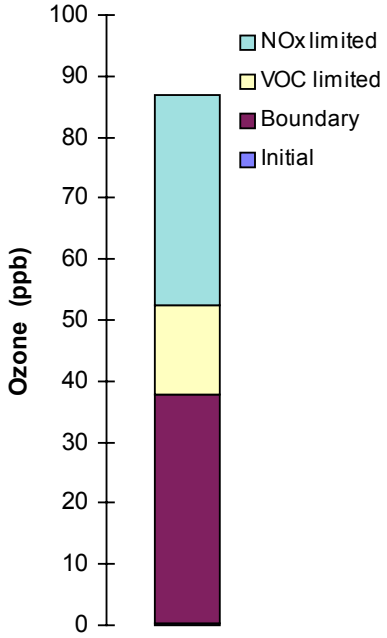
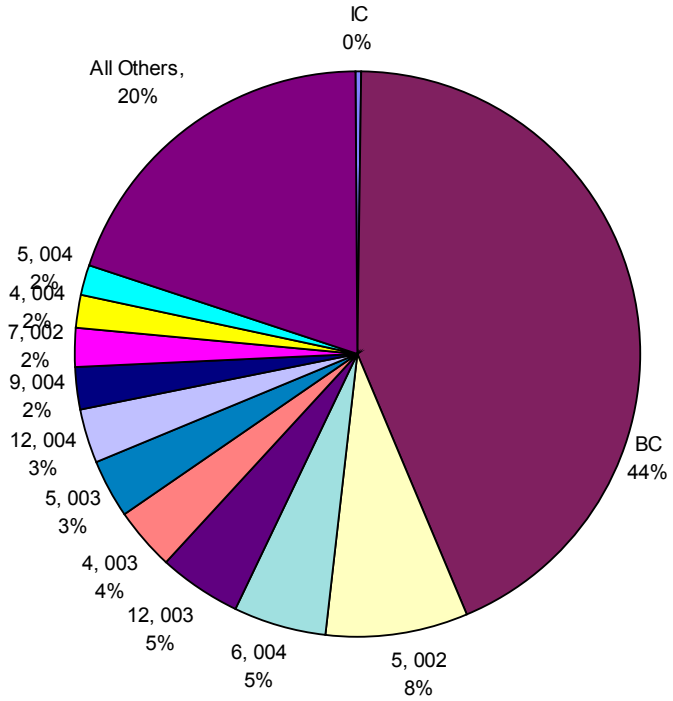
Contributions By Type



Contributions By Source Area



Receptor	**=**	**San Antonio CAMS 23**		
Time	**=**	**14**	**To**	**15**
Date	**=**	**9/20/1999**		
Scenario	**=**	**CAMx v3.10 run18.sos.apca Sep 13-20 1999**		
Total Ozone	**=**	**87**	**ppb**	

Detailed Ozone Apportionment

Source Area		*Emission Group*		*Percent Ozone from NOx*	*VOC*	*Total*
Initial Conditions	IC					0.3%
Boundary Conditions	BC					43.4%
San Antonio	5	Elevated Point	002	7.9%	0.1%	8.1%
San Antonio	4, 5	Mobile	003	4.6%	2.5%	7.1%
Victoria	6	Area/Non-Road	004	1.8%	3.2%	5.1%
North Texas	12	Mobile	003	3.1%	1.7%	4.7%
San Antonio	4, 5	Area/Non-Road	004	1.5%	2.2%	3.7%
North Texas	12	Area/Non-Road	004	1.3%	1.6%	2.9%
Other States	9	Area/Non-Road	004	1.7%	0.7%	2.4%
Houston	7	Elevated Point	002	2.2%	0.1%	2.3%
Houston	7	Area/Non-Road	004	1.1%	0.6%	1.7%
Other States	9	Elevated Point	002	1.6%	0.0%	1.6%
All Others						16.6%
Total						100%

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Note that the contributions due to the Initial Conditions drop quickly from 22% to approximately zero percent by the end of the run. This is anticipated, given the nature and definition of Initial Conditions. The Boundary Conditions quickly assume a greater importance than the 25% contribution on the first modeling day, September 15, 1999.

Note that the greatest contribution by total percentage from San Antonio sources listed for any one day is 19%, on September 20. All San Antonio anthropogenic sources appear as contributors listed in the top twelve only on September 20. Also, Elevated Point sources from San Antonio are consistently among the top twelve sources for every day of the episode. The hourly time periods for each daily analysis were chosen for their high hourly ozone values.

Both the consistent importance of the Boundary Conditions as a contribution source, as well as the low value of contribution from the San Antonio anthropogenic emissions (never greater than 20%) in this run analysis, tend to correlate with the other evidence supporting transport as an important component of readings in the local area.

To further prove this point, a ribbon graph was produced again by employing OSAT module to depict hourly ozone concentrations, contributed by San Antonio's neighboring areas, during the Sept. 1999 episode in parts per billion (ppb). For generating this graph, the CAMS 23 was specified in the coordinate of the CAMx grid as a "Point" format for the receptor definition. Concentrations at the point are determined by bi-linear interpolation of the surrounding four coarse grid surface cells as described in the ENVIRON CAMx User Guide version 3.00 pages 5-17.

In the following graph, which looks like a saw edge due to the diurnal variation of ozone during the episode, the colored strips identify the amount of ozone generated from each *source category* included in the study area. The San Antonio source category (magenta), for the exception of eighth day, appears to have contributed a small portion of the total ozone concentrations during this episode.

The first three strips at the bottom of the graph represent the impacts of initial condition (light blue), boundary condition (yellow), and biogenic sources. As the graph reveals, contributions from sources such as other state (dark blue) and Houston (red) at times exceed 18 ppb.

Maximum contribution levels for selected areas during various days of the episode are:
Other States source category 18.24 ppb on the fourth day.
Houston/ Beaumont and Port Arthur source category 19.22 ppb on the fourth day.
San Antonio source category 16.78 ppb on the eighth day.

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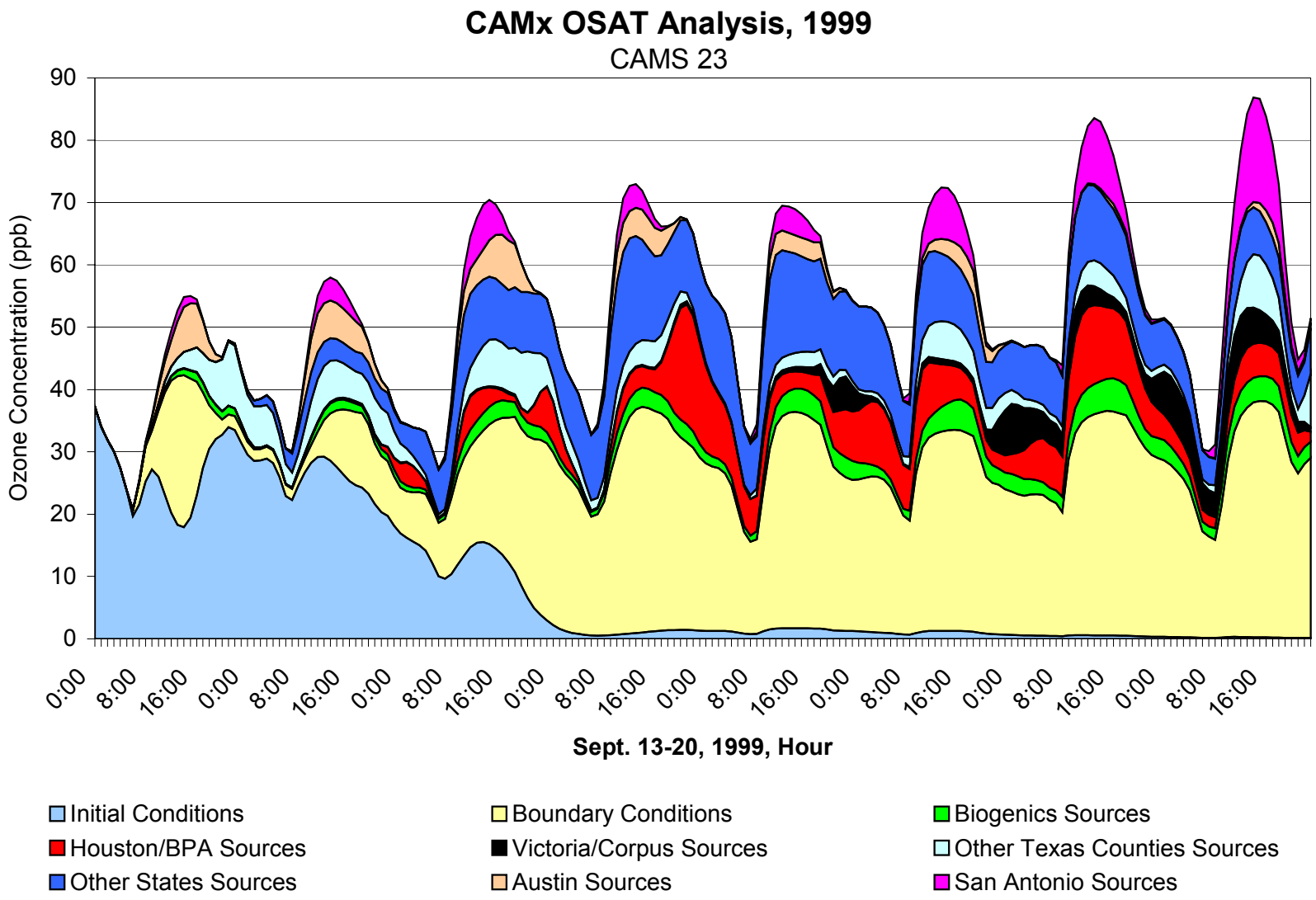

Conclusion

The effects of transport on local ozone levels have been verified across parts of the United States, notably during the May 1998 smoke episode and the September 2002 haze event. The May 1998 smoke episode verification caused EPA to exclude certain days of ozone data from compliance calculations in nine states due to these May 1998 fires. Historically, as air arrives in San Antonio during a day of local high ozone levels, the air typically flows from the east across a variety of point sources throughout the state of Texas.

An analysis of the 1999 photochemical model has been used also to demonstrate evidence of transport. It is important to keep in mind that the results from the model analysis do pertain to a single episode, and so illustrate a result specific to that particular episode. On the other hand, the September 13-20, 1999 period was chosen specifically because the wind patterns were typical of ozone episodes for the region, as documented in Appendix A. Reducing anthropogenic emissions from selected Texas cities in the 1999 photochemical model also shows the influence of transport from individual sources.

Finally, the local 2007 design value of 84.35 ppb is lowered only 21.97 ppb by removing all anthropogenic emissions in the four-county Early Action Compact region of San Antonio. This indicates that the maximum ozone reductions possible through enactment of local strategies in the San Antonio EAC region is limited; any locally enacted strategies must in fact fall short of this reduction level. Moreover, this limited depth of ozone reductions through local actions indicates the degree to which successful air quality efforts can best be achieved through state and federal efforts coupled with local actions. Success of the San Antonio Clean Air Plan relies upon the support of our local planning effort by the Texas Commission on Environmental Quality and the US Environmental Protection Agency. However, it also strongly relies on the success of TCEQ and EPA to fully enact both the State Implementation Plan revisions currently proposed by the state of Texas, notably for Houston, but on continued support for and enactment of further state and federal air quality rules.

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Addendum: the State of Texas
The State of Texas is also very active in consideration of transport issues.

The Sonoma Technology study (MacDonald et al., 1999) was supported by TCEQ and reported that, on average, 40% of San Antonio's peak ozone was locally generated. Furthermore, the study concluded that background ozone was around 70 ppb, with local sources adding approximately 45 ppb. Sonoma analysts also studied the impact of transport from two high-ozone aircraft flight days where long-range trajectories were available. They surmised that high ozone episodes were associated with local stagnation and/or recirculation during night and morning hours. During one case (August 28, 1998 flight), it was determined that material was transported from the south with background ozone at 69 ppb. During the second case (October 9, 1998 flight), material was transported from the northeast with background ozone at 78 ppb.

Other actions by the State are equally proactive. R. B. "Ralph" Marquez, TCEQ Commissioner, spoke before the US House of Representatives' Subcommittee on Energy and Air Quality on July 22, 2003. He gave the subcommittee two examples of transport as he recognized them. From his remarks:

> The first example is one of interstate transport which demonstrates a September 2002 haze episode in which haze formed in the Midwestern U.S. and moved across the eastern U.S. and into the southern states and Texas over several days. Our analysis of satellite imagery and monitor readings of ozone and particulate matter shows the impact of pollutant transport on Texas communities during the September episode. For example, 8-hour ozone values in Houston climbed from 41 ppb on September 9 to144 ppb on September 13, 2002. On those same days, particulate matter climbed from 7 micrograms/cubic meter to 56 micrograms/cubic meter. Similar increases for these pollutants occurred in other major metropolitan areas, Dallas-Fort Worth, San Antonio, and Beaumont-Port Arthur. The second case is an example of intrastate transport on a day (September 1, 2000) when the Beaumont-Port Arthur (BPA) area exceeds the one-hour ozone standard at least partially due to transport from the Houston area. In fact, when we reviewed all of the 1-hour ozone exceedances between 1998 and 2002, we found that approximately one-half of the exceedances occurred on days when there was a contribution from Houston. In addition, the highest monitored readings in BPA occurred on days when there was a contribution from Houston. 'Bump Up' (2003)

The Air Improvement Resources (AIR) Committee continues to support these findings and the dedication to find solutions to transport issues. On March 3, 2004, the AIR Executive and Advisory Committees approved the following text, which was subsequently sent in a letter to TCEQ Chairman Kathleen Hartnett White:

> Dear Chairman White,
> As you are certainly aware, transport of ozone and ozone precursors into the San Antonio region can be a significant component of our area's high ozone and high PM2.5 levels. The effects of smoke from Mexico on our local air pollution in 1998 were well documented by the US Environmental Protection Agency. Former TCEQ Chairman Huston reported to us that evidence of haze as distant as the Ohio River Valley has coincided with widespread high pollution and visibility reductions here in mid-September 2002. In a letter to AIR Committee Chairman Jay Millikin dated April 4, 2003, Chairman Huston wrote, "In every ozone exceedance recorded to date in the San Antonio area, we have measured high background levels coming into the area." While he also cautioned that "each urban area of the state, including San

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Antonio, contributes significantly to its own pollution," this fact in and of itself does not diminish the effect of transport.
The Air Improvement Resources Committee requests the Texas Commission on Environmental Quality to develop an action plan to deal with transport issues. We hope that action by the state of Texas, in coordination and collaboration with other states in this country and with our neighbors in Mexico, as well as any other sources of pollution that come to us from beyond our borders, can help us meet our air pollution challenge effectively.
We remain committed to improving local air quality through our Early Action Compact, other local endeavors undertaken by local citizens and agencies, and our continuing cooperation with the state provided by legislated aid.

The letter was signed by Chairman Jay Millikin, who is also a Commissioner of Comal County, Texas, and Vice Chairman Nelson Wolff, who is also County Judge of Bexar County, Texas.

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ftp://ftp.tnrcc.state.tx.us/pub/OEPAA/TAD/Modeling/DFWAQSE/Sci_Tech_Committees/PMTC/20030307/Regional_Haze_2002Sep-BrianFoster.pdf

'Bump-Up' Policy Under Title I of the Clean Air Act: Hearings before Subcommittee on Energy and Air Quality, of the House Committee of Energy and Commerce, 108th *Cong., 1d Sess. (2003) (testimony of TCEQ Commissioner R.B. "Ralph" Marquez). Testimony available online: http://energycommerce.house.gov/108/Hearings/07222003hearing1025/Marquez1615.htm

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