2002 Consolidated Emissions Reporting Rule

On-Road Mobile Source Emissions Inventory

August 2004 Update

Colllin	Hunt
Dallas	Johnson
Denton	Kaufman
Ellis	Parker
Henderson	Rockwall
Hood	Tarrant

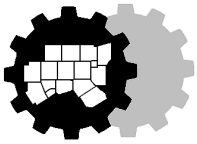
North Central Texas Council of Governments
Transportation Department

What is NCTCOG?

The North Central Texas Council of Governments is a voluntary association of cities, counties, school districts, and special districts which was established in January 1966 to assist local governments in **planning** for common needs, **cooperating** for mutual benefit, and **coordinating** for sound regional development.

It serves a 16-county metropolitan region centered around the two urban centers of Dallas and Fort Worth. Currently the Council has **231 members**, including 16 counties, 164 cities, 23 independent school districts, and 28 special districts. The area of the region is approximately **12,800 square miles**, which is larger than nine states, and the population of the region is over **5.5 million**, which is larger than 30 states.

NCTCOG's structure is relatively simple; each member government appoints a voting representative from the governing body. These voting representatives make up the **General Assembly** which annually elects a 15-member Executive Board. The **Executive Board** is supported by policy development, technical advisory, and study committees, as well as a professional staff of 208.



NCTCOG's offices are located in Arlington in the Centerpoint Two Building at 616 Six Flags Drive (approximately one-half mile south of the main entrance to Six Flags Over Texas).

North Central Texas Council of Governments
P. O. Box 5888
Arlington, Texas 76005-5888
(817) 640-3300

NCTCOG's Department of Transportation

Since 1974 NCTCOG has served as the Metropolitan Planning Organization (MPO) for transportation for the Dallas-Fort Worth area. NCTCOG's Department of Transportation is responsible for the regional planning process for all modes of transportation. The department provides technical support and staff assistance to the Regional Transportation Council and its technical committees, which compose the MPO policy-making structure. In addition, the department provides technical assistance to the local governments of North Central Texas in planning, coordinating, and implementing transportation decisions.

Prepared in cooperation with the Texas Department of Transportation and the U. S. Department of Transportation, Federal Highway Administration, and Federal Transit Administration.

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Transportation Director, NCTCOG

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ABSTRACT

TITLE: 2002 Consolidated Emissions Reporting Rule On-Road Mobile Source Emissions Inventory

DATE: February 2004 (August 2004 Update)

AUTHORS: David Jodray
Principal Transportation Planner

Chad Edwards
Senior Transportation Planner

Dawn Dalrymple
Transportation Planner II

SUBJECT: Consolidated Emissions Reporting Rule emissions inventory development of methodologies for on-road sources of ozone-producing emissions, particulate matter and other criteria pollutants.

SOURCE OF COPIES: Transportation Department
North Central Texas Council of Governments
P. O. Box 5888
Arlington, Texas 76005-5888
(817) 695-9240

NUMBER OF PAGES: 41

ABSTRACT: The purpose of this document is to report methodologies and results of the on-road source emissions inventory for 2002. The sources of emissions contained in this report include mobile sources such as cars and trucks. Results are given for emissions for an average summer weekday total and annual total.

ACKNOWLEDGMENTS

The North Central Texas Council of Governments would like to thank the following individuals for their invaluable assistance in preparing this report.

Michael Morris, P.E.
Director of Transportation

Dan Kessler
Assistant Director of Transportation

Vickie Alexander
Administrative Assistant II

Shahram Bohluli
Transportation Planner II

Ruth Boward
Senior Transportation Planner

Ken Cervenka
Senior Program Manager

Christopher W. Klaus
Senior Program Manager

Arash Mirzaei
Principal Transportation Planner

Vercie Pruitt-Jenkins
Administrative Assistant I

Vijaya Pusuluri
Transportation Planner II

Carrie Reese
Urban Planner II

Mark Sattler
Senior GIS Analyst

Francisco Torres
Principal Transportation Planner

Barbara Walsh
Administrative Secretary II

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GLOSSARY OF ABBREVIATIONS

AADT	-	Annual Average Daily Traffic
AAWT	-	Average Annual Weekday Traffic
ATP	-	Anti-Tampering Program
ATR	-	Automatic Traffic Recorder
CD	-	Compact Disc
CERR	-	Consolidated Emissions Reporting Rule
CO	-	Carbon Monoxide
DFW	-	Dallas-Fort Worth
DFWRTM	-	Dallas-Fort Worth Regional Travel Model
EPA	-	Environmental Protection Agency
HOV	-	High Occupancy Vehicle
HPMS	-	Highway Performance Monitoring System
I/M	-	Inspection & Maintenance Program
MPO	-	Metropolitan Planning Organization
NAAQS	-	National Ambient Air Quality Standards
NCTCOG	-	North Central Texas Council of Governments
NEI	-	National Emission Inventory
NIF	-	NEI Input Format
NH_3	-	Ammonia
NOx	-	Nitrogen Oxides
NTI	-	National Toxics Inventory
PEI	-	Periodic Emission Inventory
PM-2.5	-	Particulate Matter 2.5 microns
PM-10	-	Particulate Matter 10 microns
RIFCREC	-	Roadway Inventory Functional Class Records
SO_2	-	Sulfur Dioxide
TAP	-	Transportation Analysis Process
TCEQ	-	Texas Commission on Environmental Quality
TSZ	-	Traffic Survey Zone
TTI	-	Texas Transportation Institute
TxDOT	-	Texas Department of Transportation
V/C (ratio)	-	Volume/Capacity Ratio
VHT	-	Vehicle Hours of Travel
VMT	-	Vehicle Miles of Travel
VOC	-	Volatile Organic Compounds

I. INTRODUCTION

PURPOSE OF UPDATE

In August 2004 this document was updated to improve results through better modeling assumptions. A correction to the vehicle miles of travel mix, the removal of the Low Emission Diesel Nitrogen Oxide emission adjustment and inclusion of Environmental Speed Limits were necessary to improve annual and daily emission estimates.

PURPOSE OF ANALYSIS

The Texas Commission on Environmental Quality (TCEQ), the Texas Transportation Institute (TTI), and the North Central Texas Council of Governments (NCTCOG) have worked together to provide this 2002 Consolidated Emissions Reporting Rule (CERR) On-Road Mobile Source Emissions Inventory of air quality pollutants. Accurate emissions inventories are critical if State, local, and federal agencies are to attain and then maintain the National Ambient Air Quality Standards (NAAQS) that the U.S. Environmental Protection Agency (EPA) has established for criteria pollutants such as ozone, particulate matter, and carbon monoxide. EPA combined the Periodic Emission Inventory (PEI), National Emission Inventory (NEI), and the National Toxics Inventory (NTI) requirements into a single emission inventory requirement called the CERR that was detailed in the Federal Register on Monday, June 10, 2002 (FR Volume 67, Number 111, pp 39602-39616). Consolidation of reporting requirements enables State and local agencies to clarify to the public and others in the air quality field, the necessity for a dependable inventory program, and to provide more consistent and uniform data. States are required to prepare a comprehensive statewide inventory every three years starting with the year 2002. This report does not provide data for the air toxics portion of the CERR, formerly known as National Toxics Inventory. This portion of the inventory was not included in the Work Order developed in conjunction with TCEQ and NCTCOG. The list of pollutants included in the CERR are volatile

organic compounds, nitrogen oxides, carbon monoxide, sulfur dioxide, ammonia, and particulate matter in two sizes, 2.5 and 10 microns.

This inventory requires incorporation of recently collected data and use of the newest EPA on-road emission factor model, MOBILE6.2. NCTCOG conducted this analysis on the 12-county North Central Texas Region that includes Collin, Dallas, Denton, Ellis, Henderson, Hood, Hunt, Johnson, Kaufman, Parker, Rockwall and Tarrant Counties. TTI conducted the analysis for the 242 remaining Texas counties. Exhibit I-1 shows graphically where the counties are located in North Central Texas and their relation to each other. Also identified on this map are the counties that are designated under the 1-Hour NAAQS for nonattainment for ozone.

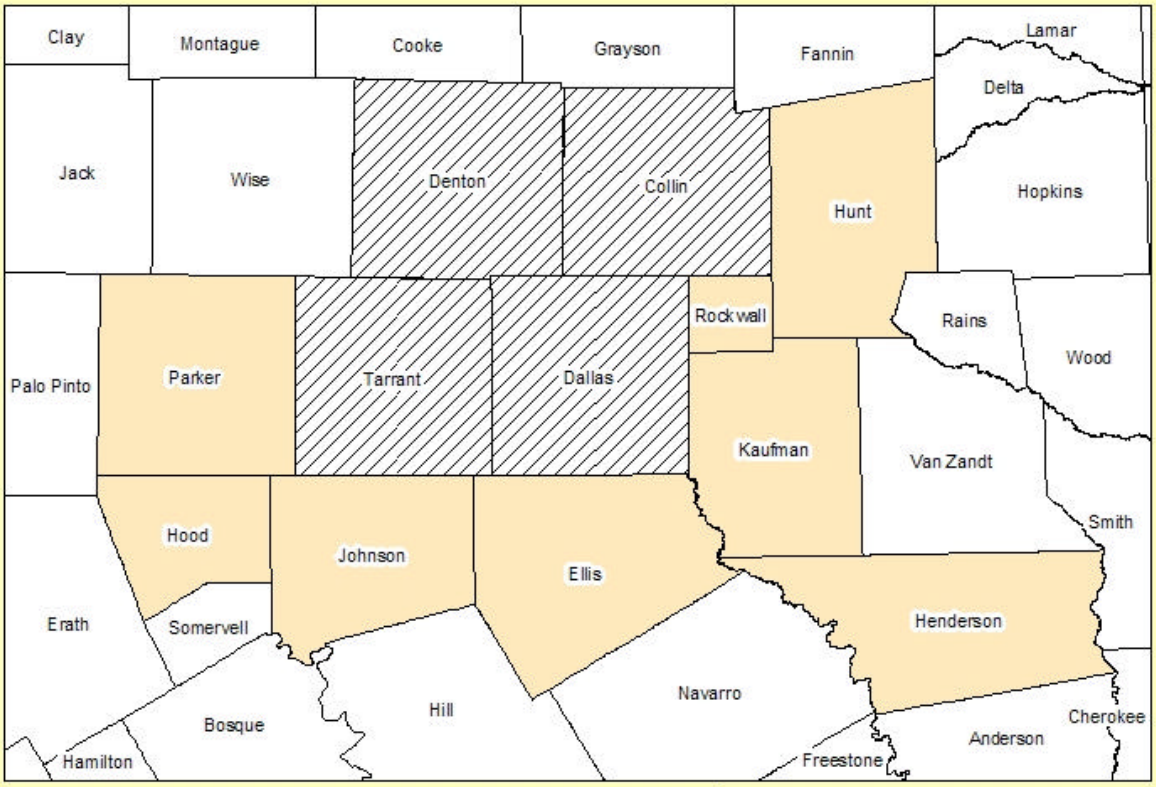
The purpose of this document is to provide a summary of methodology of on-road mobile source 2002 evaluation year emissions inventory needed for the State of Texas under the CERR. To be consistent with the other 242 Texas counties previously inventoried by TTI, NCTCOG agreed to use similar methodologies as that of TTI. Vehicle activity collected through TransCAD and Texas Department of Transportation (TxDOT), development of daily and seasonal emission factors and finally the calculation of emissions are similar to the process used for the rest of the State. The following pages will detail the methodologies used and the resulting emissions.

DELIVERABLES

The deliverables identified include this document outlining methodologies and electronic data used to develop and analyze the results of the 2002 CERR. This document will be submitted in five hard copies; one loose-bound and four bound copies. This document and supporting data will also be submitted electronically on five sets of six compact discs. The resulting electronic data created will be identified in Appendix A.

EXHIBIT I-1

DALLAS-FORT WORTH
NATIONAL AMBIENT AIR QUALITY STANDARDS
1-HOUR OZONE NONATTAINMENT AREA



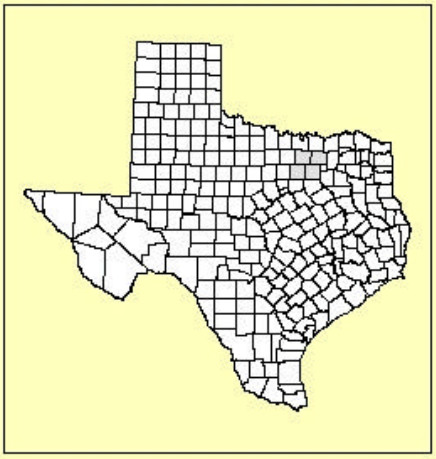
Legend

Nonattainment Counties

- Collin
- Denton
- Dallas
- Tarrant
- Other Counties in Analysis Area

0 5 10 20 30 40 Miles

N W E S



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II. ESTIMATION OF VEHICLE MILES OF TRAVEL

For emissions to be calculated properly, a key component to the equation is vehicle activity. This activity can be developed or collected in many ways. The process that NCTCOG follows is outlined for all counties in the following text.

DFWRTM COUNTIES

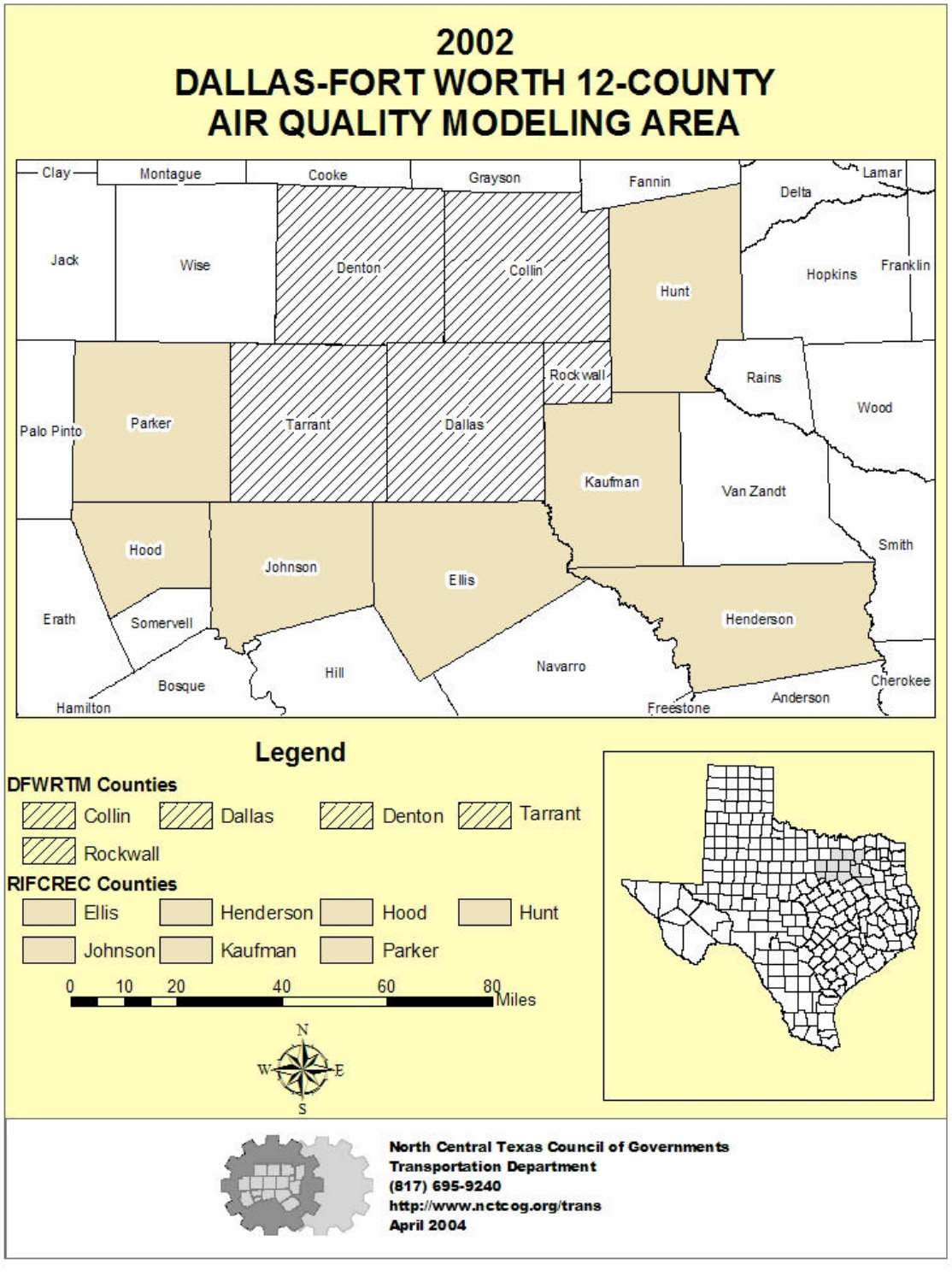
Dallas-Fort Worth Regional Travel Model

The source of vehicle miles of travel (VMT) estimates for the 2002 CERR On-Road Mobile Source Emissions Inventory for the Dallas-Fort Worth Regional Travel Model (DFWRTM) counties are network-based DFWRTM executed by NCTCOG's Transportation Department. The DFWRTM counties include Collin, Dallas, Denton, Rockwall, and Tarrant. The DFWRTM supports federally required regional transportation planning efforts for all modes of transportation in the Dallas-Fort Worth (DFW) region.

Multimodal Transportation Analysis Process

The forecasting technique of the DFWRTM is based on a four-step sequential process designed to model human travel behavior and predict travel demand at regional, subarea, or corridor levels. For the 2002 CERR emissions inventory, VMT was estimated on a roadway network or link-by-link basis for each of the DFWRTM counties. The VMT estimates were established using an analysis year 2002 TransCAD-based regional travel model transportation network. TransCAD is a personal computer Microsoft Windows-based commercial travel demand software package that NCTCOG uses for long-range network performance evaluations. Exhibit II-1 shows NCTCOG's modeling area in which transportation planning efforts are concentrated on the counties covered by the DFWRTM and defines the geographical area used in this analysis.

EXHIBIT II-1


2002
DALLAS-FORT WORTH 12-COUNTY
AIR QUALITY MODELING AREA
Clay
Montague
Cooke
Grayson
Fannin
Lamar
Delta
Jack
Wise
Denton
Collin
Hunt
Hopkins
Franklin
Rockwall
Rains
Wood
Palo Pinto
Parker
Tarrant
Dallas
Kaufman
Van Zandt
Smith
Hood
Johnson
Ellis
Erath
Somervell
Henderson
Hill
Navarro
Bosque
Cherokee
Hamilton
Freestone
Anderson
Legend
DFWRTM Counties
Collin
Dallas
Denton
Tarrant
Rockwall
RIFCREC Counties
Ellis
Henderson
Hood
Hunt
Johnson
Kaufman
Parker
0 10 20 40 60 80
Miles
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April 2004

The roadway networks developed for the 2002 CERR On-Road Mobile Source Emissions Inventory contain over 25,000 unique segments designed to replicate the actual roadway transportation system. Each link in the network has the following attributes:

- Network node numbers (defining the beginning and end of each link)
- Functional classification
- Number of intervening controls along the link
- Jurisdiction number
- Number of operational lanes in the A.M. and P.M. Peak periods
- Speed limit
- City code
- Tolls
- Free-flow speeds
- Traffic direction (one-way or two-way)
- Divided/undivided roadway code
- Type of traffic control at each end of the link
- Length of link
- Number of operational lanes in the Off-Peak period
- Traffic survey zone
- Area type
- Hourly capacities
- Estimated loaded speeds

In many cases these attributes are dependent on the roadway functional classification. These classifications include zone centroid connector, freeway, principal arterial, minor arterial, collector, local street, ramp, frontage road, and high occupancy vehicle lane (HOV). Each roadway segment is categorized into one of these functional classifications depending on the type of facility (regional vs. local) and its design specifications.

Trip purposes in the DFWRTM are defined in one of four ways: home-based work, which includes trips from home to work or work to home; home-based non-work, which includes non-work trips beginning or ending at home; non-home based, which includes trips where home is neither the origin nor the destination; and Other trips, which include all truck trips as well as all external-internal, internal-external, and external-external vehicle trips. Trucks are identified as a vehicle with three or more axles.

The model process begins with an estimate of the socioeconomic variables for each zone. The data is organized by traffic survey zone (TSZ), the smallest zone size available. There are 6,249 TSZs in the modeling area. The data for each TSZ includes zone centroid; median household income; number of households; population; basic, retail, and service employment; and total land area. The information is aggregated to 4,874 Transportation Analysis Process (TAP) Model Zones (4,813 internal zones plus 61 External Station Zones), which is the level of detail retained in all modeling steps. The Trip Generation Model generates the number of weekday person trips sent to and from each zone. The Trip Distribution Model determines the interaction between each zone and the rest of the zones in the modeling area. The mode of travel is determined by the Mode Choice Model, which calculates the zone-to-zone automobile occupancy and allocates the person trips into transit passenger trips and automobile vehicle trips. The Roadway Assignment loads the roadway trips onto the roadway network, and the Transit Assignment loads the transit passenger trips onto the transit network.

In addition to the detail provided by the model through the number of TSZs, time is also subdivided to provide greater model detail. The 24 hours in one day are aggregated into three time periods; AM Peak is 6:30 a.m. – 9:00 a.m., PM Peak is 3:00 p.m. – 6:30 p.m., and Off-Peak consists of the remaining hours of the day.

Speed Estimation Procedure

The speed estimation procedures of the DFWRTM are carried out within a post-processing program that first converts the three time-of-day Roadway Assignment link volumes into 26 time periods (22 one-hour periods and four 30-minute periods). The model-calculated free-flow speed, the link length, the time period traffic volume, and the time period Level-of-Service "E" capacity are input to volume-delay equations to calculate the final time-period-specific average loaded speeds for each of the 25,000+ links in the 2002 roadway network. The VMT and vehicle hours of travel

(VHT) for different time periods can be added to obtain an overall average speed (VMT/VHT) for any desired length of time.

The free-flow (uncongested) speed is defined as the speed limit minus the travel time delay caused by intersection controls. For the freeway and principal arterial functional classes, the posted speed limit is increased by 10 percent to account for observed travel behavior in which average speeds during uncongested periods exceed the posted speed limit. Free-flow speeds are determined for each link based on the speed limit, degree of signalization, roadway functional classification, and the area type in which the roadway segment is located. In general, the functional classification and area type determine the delay associated with various traffic controls. Free-flow speeds are carried on the network file and used in the Roadway Assignment model for calculation of congested (loaded) speeds.

In order to calculate final loaded speeds, the reduction in speed caused by traffic congestion delay is subtracted from the uncongested free-flow speed. Congestion delay is a function of the traffic volume assigned to a particular roadway segment and the carrying capacity of that segment. The congestion delay for each roadway segment is calculated from the following volume-delay equation:

$$Delay = Min\left[Ae^{B(\frac{V}{C})}, C \right]$$

where:

Delay	= congestion delay (minutes/mile);
A and B	= volume/delay equation coefficients;
C	= maximum minutes of delay per mile; and
$\frac{V}{C}$	= time-of-day directional $\frac{V}{C}$ $\left(\frac{Volume}{Capacity}\right)$ ratio.

The A, B, and C parameters are based on traditional volume-delay curves. Exhibit II-2 shows the parameters for freeway and non-freeway facilities.

EXHIBIT II-2

Dallas-Fort Worth Regional Travel Model Parameters			
	A	**B**	**C**
Freeway Facilities	0.015	4.200	5.000
Non-freeway Facilities	0.050	3.900	6.000

The volume-delay curves were developed from observed speed-volume relationships and calibrated from observed travel time data collected by TTI. Finally, the congestion travel-time delay is added to the uncongested travel time (based on the free-flow speeds) to produce total travel time on each roadway segment. To verify past assumptions, average freeway speeds from the 1999 model validation run were found to be consistent with average speeds derived from the 1999 low level aerial photo survey conducted by NCTCOG.

Local Street Speeds

The roadway networks of the DFWRTM do not contain the details of local (residential) streets. However, a VMT estimate calculation is based on data provided by the travel model. Local street VMT is calculated for each county by multiplying the number of intrazonal trips by the intrazonal trip length and then adding the VMT from the zone centroid connectors. The temporal distribution is assumed to be the same as for non-local streets. Local street speeds vary by county as shown in Exhibit II-3.

EXHIBIT II-3

Average Loaded Speeds For Local Streets	
County	**Daily Speeds (mph)**
Collin	25.11
Dallas	22.06
Denton	27.09
Rockwall	29.49
Tarrant	23.33

RIFCREC COUNTIES

Roadway Inventory Functional Class Records

County level vehicle miles of travel, centerline mile and lane mile data was collected from TxDOT for 2002. The 2002 data was obtained from the Roadway Inventory Functional Class Records (RIFCREC) database TxDOT keeps. This data is identical to Highway Performance Monitoring System (HPMS) data the Federal Highway Administration requires to validate the travel demand model.

Speed Estimation Procedure

RIFCREC county speeds were estimated using the volume-delay equation in a manner similar to the estimation of speeds for DFWRTM counties. VMT, centerline mile, and lane mile data for each county were obtained from TxDOT 2002 RIFCREC data. Hourly VMT was divided by centerline miles, yielding hourly volumes for each time period. Lane miles were divided by centerline miles to generate the number of lanes. The number of lanes was then multiplied by hourly lane capacities to determine the hourly capacities specific to each county. This process

was conducted for each functional class and for each time of day. From this, estimated delay is produced using the following equation:

$$Delay = Min\left[Ae^{B(\frac{V}{C})}, C \right]$$

where:

Delay	= congestion delay (minutes/mile);
A and B	= volume/delay equation coefficients;
C	= maximum minutes of delay per mile; and
$\frac{V}{C}$	= time-of-day directional $\frac{V}{C}\left(\frac{Volume}{Capacity}\right)$ ratio.

The A, B, and C volume-delay equation parameters are regionally specific values applied in the Dallas-Fort Worth Regional Travel Model. Volume-delay equation parameters are divided into two groups, freeway and non-freeway, to better calculate different facility speeds. Interstate and urban freeways are grouped together for use with freeway parameters. Principal arterial, minor arterial, major collector, minor collector and locals are grouped together for use with non-freeway parameters. The same parameters were used for RIFCREC counties as for DFWRTM counties. Exhibit II-2 shows the parameters used.

Given the hourly lane capacity and the speed limit, shown in Exhibit II-4, congested speed can be calculated as:

$$CongestedSpeed = \frac{60}{\frac{60}{FreeflowSpeed} + Delay}$$

EXHIBIT II-4

Estimated Capacity Delay and Speed Limits for the RIFCREC Counties							
	Interstate	**Freeway**	**Principal Arterial**	**Minor Arterial**	**Major Collector**	**Minor Collector**	**Local**
Hourly Lane Capacities (Vehicles per Hour per Lane)	2,300	2,300	1,025	975	600	600	600
Speed Limits (Miles per Hour)	70	65	55	50	40	35	20

This model was applied to each functional class for each time period of day. Speed estimates were performed for each of the RIFCREC counties individually. However, as the speed estimates showed minimal variance across each time of day and across each of the counties, the results were averaged to obtain one set of data to be used for all RIFCREC counties. Interstate speeds were reduced to 65 miles per hour, from the calculated 66 mph, to accommodate the maximum speed value allowable in MOBILE6. The resulting RIFCREC county speeds are listed in Exhibit II-5.

EXHIBIT II-5

RIFCREC County Congested Speeds (Miles per Hour)						
Interstate	**Freeway**	**Principal Arterial**	**Minor Arterial**	**Major Collector**	**Minor Collector**	**Local**
65	62	49	47	38	34	20

ADJUSTMENTS

Seasonal and Hourly Adjustments

The vehicle activity data used for this analysis is representative of August 2002. This section outlines the process used to convert the DFWRTM November weekday activity and the Average Annual Daily Traffic (AADT)/RIFCREC data to represent this episode period.

The Automatic Traffic Recorder (ATR) data for 2002, collected by TXDOT, is used to calculate the necessary conversions. Exhibit II-6 lists the stations used in this analysis.

EXHIBIT II-6

2002 Selected Automatic Traffic Recording Stations

Station	Name	Road	County	Location
1	A301 ARLINGTON	U.S. 80	Tarrant	DFWRTM
2	S016 JACKSBORO	U.S. 281	Jack	RIFCREC
3	S017 DALLAS	U.S. 175	Dallas	DFWRTM
4	S027 DENTON	F.M. 428 S	Denton	DFWRTM
5	S040 CORSICANA	I.H. 45	Navarro	RIFCREC
6	S126 DALLAS	I.H. 35E	Dallas	DFWRTM
7	S130 FT. WORTH	I.H. 30	Tarrant	DFWRTM
8	S145 TERRELL	I.H. 20	Kaufman	RIFCREC
9	S171 DALLAS	I.H. 635	Dallas	DFWRTM
10	S192 ARLINGTON	I.H. 30	Tarrant	DFWRTM
11	S193 FT. WORTH	I.H. 820	Tarrant	DFWRTM
12	S220 DALLAS	I.H. 45	Dallas	DFWRTM
13	S221 DALLAS	I.H. 30	Dallas	DFWRTM

DFWRTM county location ATR stations are used for conversion of the DFWRTM data, and RIFRCEC county location ATR stations are used for conversion of RIFCREC data.

DFWRTM Counties Seasonal Adjustments

ATR data for August 2002 is organized into five day types: Sunday, Monday, Midweek (Tuesday, Wednesday, and Thursday), Friday, and Saturday. For this analysis the Midweek day type was used. To adjust the representative November weekday data from the DFWRTM to the specified day type in the August episode period, a ratio of November to August ATR volumes is calculated. The November part of the ratio computes average daily traffic volumes for midweek days in the first three weeks of November. The counts for the last week of November are not included because of possible unusual travel behaviors during the Thanksgiving Holiday. The seasonal adjustment for DFWRTM counties is 1.107.

RIFCREC Counties Seasonal and Daily Adjustments

To adjust the representative AADT reported in RIFCREC to the specified episode period in August, a ratio of August to average daily traffic is calculated. The August portion of the ratio includes traffic volumes recorded between August 15 and August 24, 2002. All reported days are used for calculation of the average daily traffic component, representing an average for the year. The seasonal adjustment for RIFCREC counties is 0.889.

Hourly Adjustments

Daily volumes recorded for the midweek day type described previously are aggregated by hour to determine the percent of daily traffic occurring during each hour, representing hourly vehicle activity estimates. The DFWRTM county midweek is further detailed by utilizing a time period volume for aggregation. These time periods correspond to the time periods utilized in the DFWRTM, where AM Peak is 6:30 a.m. to 8:59 a.m., PM Peak is 3:00 p.m. to 6:29 p.m., and Off-Peak represents all other hours of the day (12:00 a.m. to 6:29 a.m., 9:00 a.m. to 2:59 p.m., and 6:30 p.m. to 11:59 p.m.). Time periods split by mid-hour times utilize an equal division of

traffic recorded during the hour. Exhibits II-7 identify the hourly adjustments for DFWRTM and RIFCREC counties.

EXHIBIT II-7

Midweek Hourly Model Adjustments for the Dallas-Fort Worth Regional Travel Model				
	Period	DFWRTM County	Period	RIFCREC County
12:00 a.m. – 12:59 a.m.	Off Peak	0.0172	24 Hours	0.016
1:00 a.m. – 1:59 a.m.		0.0113		0.0128
2:00 a.m. – 2:59 a.m.		0.0103		0.0121
3:00 a.m. – 3:59 a.m.		0.0095		0.0124
4:00 a.m. – 4:59 a.m.		0.0148		0.0158
5:00 a.m. – 5:59 a.m.		0.0437		0.0289
6:00 a.m. – 6:29 a.m.		0.0477		0.0209
6:30 a.m. – 6:59 a.m.	AM Peak	0.1681		0.0209
7:00 a.m. – 7:59 a.m.		0.4441		0.0506
8:00 a.m. – 8:59 a.m.		0.3879		0.0465
9:00 a.m. – 9:59 a.m.		0.0857		0.0497
10:00 a.m. – 10:59 a.m.	Off Peak	0.0804		0.0537
11:00 a.m. – 11:59 a.m.		0.0852		0.0546
12:00 p.m. – 12:59 p.m.		0.089		0.0543
1:00 p.m. – 1:59 p.m.		0.091		0.0575
2:00 p.m. – 2:59 p.m.		0.0967		0.0623
3:00 p.m. – 3:59 p.m.	PM Peak	0.2611		0.066
4:00 p.m. – 4:59 p.m.		0.2949		0.0682
5:00 p.m. – 5:59 p.m.		0.3175		0.0697
6:00 p.m. – 6:29 p.m.		0.1265		0.0284
6:30 p.m. – 6:59 p.m.		0.0536		0.0284
7:00 p.m. – 7:59 p.m.	Off Peak	0.0761		0.0469
8:00 p.m. – 8:59 p.m.		0.0619		0.0403
9:00 p.m. – 9:59 p.m.		0.0546		0.0341
10:00 p.m. – 10:59 p.m.		0.0422		0.0275
11:00 p.m. – 11:59 p.m.		0.0291		0.0215

Model Adjustment

Historically, the DFW Metropolitan Planning Organization (MPO) has used Highway Performance Monitoring System (HPMS) data to adjust modeled VMT to recorded traffic counts. Through Texas Department of Transportation's (TxDOT) direction, RIFCREC data was determined to be a direct subset of HPMS. RIFCREC consists of local and non-local roadways and toll roads that are currently on-ground.

To develop an adjustment factor, RIFCREC VMT was collected for 1999 representing the AADT. Similar VMT estimates were generated from the DFWRTM representing average weekday school season traffic. The modeled estimates were converted into average annual weekday traffic (AAWT) for comparison with RIFCREC VMT. Exhibit II-8 shows RIFCREC data broken into local and non-local VMT compared to the DFWRTM VMT for local and non-local facilities. Exhibit II-8 also shows the comparison of non-local VMT for RIFCREC and DFWRTM. The resulting ratio of 1.017 between the two data sets is the model adjustment factor for the DFWRTM. This ratio was applied to all links, local and non-local, in the DFWRTM. The DFWRTM shows nine percent of VMT is accounted for on the local street system. The Institute of Transportation Engineers offers a guideline in their Transportation and Traffic Engineering Handbook (1976, p541) that an urban area like Dallas-Fort Worth, with a population of roughly 4.5 million people, should have a local VMT of approximately 10 percent of their total VMT, as portrayed in Exhibit II-9.

EXHIBIT II-8

DALLAS-FORT WORTH NONATTAINMENT AREA
Dallas-Fort Worth Regional Travel Model (DFWRTM) and Highway Performance Monitoring System Data (RIFCREC) Analysis
AVERAGE ANNUAL DAILY TRAFFIC
(Thousands)

	1999 RIFCREC	1999 DFWRTM (TransCAD)	RIFCREC/ DFWRTM Ratio	DFWRTM – (Adjustment)	RIFCREC/ DFWRTM (Adjusted) Ratio
LOCAL	16,247	10,629	not calculated	not calculated	not calculated
NON-	108,965	107,104	1.017	108,925	1.000
TOTAL	125,212	117,734	not calculated	not calculated	not calculated
% LOCALS	12.98	9.03	N/A	N/A	N/A

EXHIBIT II-9

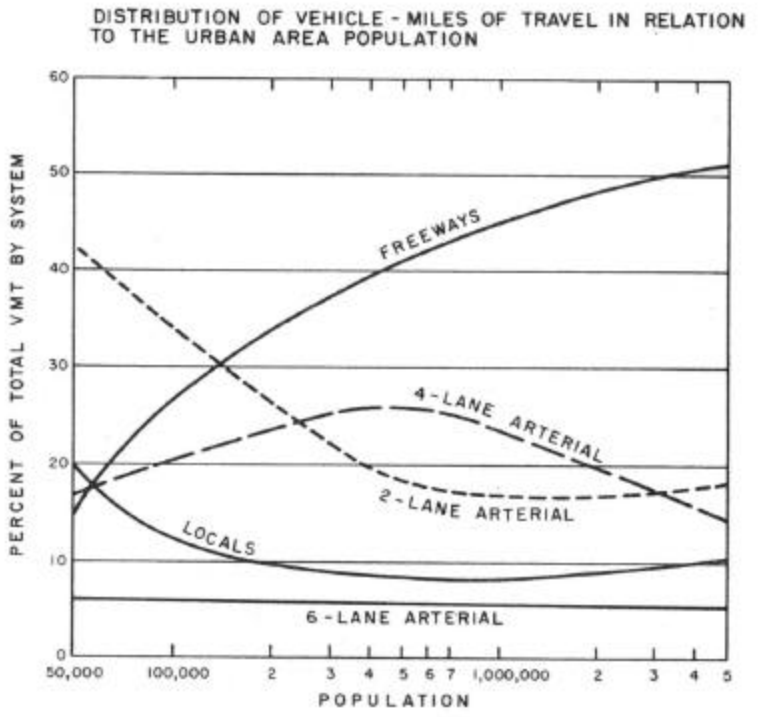

Figure 12.15. The distribution of vehicle miles of travel varies by system according to area population. [Source: *System Considerations for Arterial Streets* (Washington, D.C.: Institute of Traffic Engineers, 1969), p. 23.]

Non-Recurring Congestion

According to a paper published in the January 1987 ITE Journal by Jeffrey A. Lindley entitled Urban Freeway Congestion: Quantification of the Problem and Effectiveness of Potential Solutions, congestion due to traffic incidents accounts for twice as much as congestion from bottleneck situations. Congestion due to incidents, or nonrecurring congestion, causes emissions not represented in the VMT-based calculations of the base emissions. In order to include these effects, the delay caused by nonrecurring congestion is added to freeway travel times and congestion delay due to bottlenecks to obtain an increased freeway travel time. This translates into a reduced speed on freeway facilities. Reducing the freeway speeds increases Volatile Organic Compounds (VOC) and Nitrogen Oxides (NOx) emissions. Arterial street emissions are not significantly affected by incidents because alternate routes on the arterial system are generally available.

VMT Estimates

The final 2002 VMT Estimates are located in Exhibit II-10 for all counties. VMT is summarized by DFWRTM and RIFCREC counties and by functional class.

EXHIBIT II-10

2002 Annual Vehicle Miles of Travel									
DFWRTM Counties[1]									
County	**Freeways**	**Principal Arterials**	**Minor Arterials**	**Collectors**	**Ramps**	**Frontage Roads**	**HOV Lanes**	**Locals**	**Total**
Collin	1,020,151,895	880,783,612	1,491,100,564	392,633,375	70,724,005	277,772,938	-	508,565,885	4,641,732,273
Dallas	10,170,617,274	3,220,177,932	4,765,930,007	1,854,494,868	700,678,954	931,065,252	112,867,433	1,503,988,613	23,259,820,332
Denton	1,302,365,817	640,496,509	1,103,272,324	383,554,766	67,438,103	298,216,917	208,139	520,601,051	4,316,153,627
Rockwall	277,707,136	120,638,513	76,749,438	31,681,260	7,341,417	2,601,126	-	64,802,553	581,521,442
Tarrant	6,548,231,466	1,900,196,973	2,318,743,370	1,293,824,213	551,092,055	568,520,070	-	1,113,184,488	14,293,792,636
RIFCREC Counties[2]									
County	**Interstates**	**Urban Freeways**	**Other Principal Arterials**	**Minor Arterials**	**Major Collectors**	**Minor Collectors**	**Locals**	**Total**	
Ellis	589,546,644	40,904,148	196,575,415	82,844,298	268,034,510	18,235,810	77,467,515	1,273,608,340	
Henderson	-	-	247,305,900	74,707,818	184,445,310	28,520,338	53,914,562	588,893,927	
Hood	-	-	130,814,701	-	121,260,269	23,828,931	27,846,555	303,750,457	
Hunt	279,354,103	-	162,366,933	86,294,869	184,307,388	40,852,331	73,971,873	827,147,498	
Johnson	225,687,614	14,571,118	257,115,990	125,524,448	224,208,326	36,673,656	87,007,850	970,789,002	
Kaufman	274,652,942	27,766,725	417,330,626	118,956,403	170,932,099	65,277,941	49,747,308	1,124,664,044	
Parker	352,998,046	-	114,434,740	124,500,415	205,714,559	26,053,933	81,123,812	904,825,505	

1 – DFWRTM = Dallas-Fort Worth Regional Travel Model, data provided by North Central Texas Council of Governments
2 – RIFCREC = Roadway Inventory Functional Class Records, data provided by Texas Department of Transportation

III. ESTIMATION OF EMISSION FACTORS

Emission factors are one component in the equation to determine annual and daily emission estimates from the region's on-road vehicles. To maintain consistency with the other counties in the state, the following methodologies and process was required. Two sets of emission factor input files were developed for this analysis; one for the summer (ozone) season, and one for the winter (non-ozone) season. The resulting emission factors are further adjusted to create appropriate emission factors to use in calculation of daily and annual emissions.

SEASONAL EMISSION FACTORS

MOBILE6 Input Parameters

The U.S. EPA's MOBILE6.2 Mobile Source Emission Factor Model is used in the first step to develop 2002 vehicle emission factors for this analysis. MOBILE6.2 parameters included in creation of summer and winter season emission factors are listed in Exhibits III-1 through III-7. Information listed applies to all counties unless otherwise specified. Referenced files identifying specific local data and MOBILE technical reports are included in Appendices B and C respectively. MOBILE input files utilizing these parameters and data for each county are included in Appendix D.

EXHIBIT III-1

MOBILE6 MODELED POLLUTANTS			
Command	**Input Parameter Values**		**Description**
	Summer Season	**Winter Season**	
POLLUTANT	Run1) HC CO NOX Run2) (None)	Run1) HC CO NOX Run2) (None)	Hydrocarbons, Carbon Monoxide, Nitrogen Oxide
PARTICULATES	Run1) SO_2, NH_3, SO4, OCARBON, ECARBON, GASPM, LEAD, BRAKE, TIRE Run2) SO_4, OCARBON, ECARBON, GASPM, LEAD, BRAKE, TIRE	Run1) SO_2, NH_3, SO_4, OCARBON, ECARBON, GASPM, LEAD, BRAKE, TIRE Run2) SO_4, OCARBON, ECARBON, GASPM, LEAD, BRAKE, TIRE	Sulfur Dioxide, Ammonia, Sulfate portion of exhaust particulate, Organic Carbon portion of diesel exhaust particulate, Elemental Carbon portion of diesel exhaust particulate, Total Carbon portion of gasoline exhaust particulate, Lead, Brake wear particulate, Tire wear particulate
PARTICLE SIZE	Run1) 10.0 Run2) 2.5	Run1) 10.0 Run2) 2.5	
PARTICULATE EF	PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV	PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV	Required if PARTICULATES command is used

EXHIBIT III-2

MOBILE6 EXTERNAL CONDITIONS			
Command	**Input Parameter Values**		**Description**
	Summer Season	**Winter Season**	
CALENDAR YEAR	2002	2002	Base case; Required
EVALUATION MONTH	7	7	July, representing summer ozone season; applied also for the winter season to maintain appropriate vehicle fleet turnover
MINIMUM/MAXIMUM TEMPERATURE	N/A	N/A	See Hourly Temperatures
HOURLY TEMPERATURES	2002 Three-Year Cycle Emissions Inventory Methodology for 216 Counties in Texas, TTI 2003 per TCEQ request	2002 Three-Year Cycle Emissions Inventory Methodology for 216 Counties in Texas, TTI 2003 per TCEQ request	County-specific, provided by TCEQ
ALTITUDE	1	1	Low altitude; EPA default
RELATIVE HUMIDITY	2002 Three-Year Cycle Emissions Inventory Methodology for 216 Counties in Texas, TTI 2003 per TCEQ request	2002 Three-Year Cycle Emissions Inventory Methodology for 216 Counties in Texas, TTI 2003 per TCEQ request	County-specific, provided by TCEQ
BAROMETRIC PRESSURE	29.4	29.5	County-specific, provided by TCEQ
Environmental Effects on Air Conditioning: Commands used by MOBILE6 to model the extent of vehicle air-conditioning usage.			
CLOUD COVER	0%	0%	EPA default
PEAK SUN	10 a.m./4 p.m.	10 a.m./4 p.m.	EPA default

EXHIBIT III-3

MOBILE6 VEHICLE FLEET CHARACTERISTICS			
Command	**Input Parameter Values**		**Description**
	Summer Season	**Winter Season**	
REGISTRATION DISTRIBUTION	See external files: reg02.*	See external files: reg02.*	County specific LDV and area specific HDV from TxDOT 2002 Vehicle Registration data. LDVs in Collin, Dallas, Denton, and Tarrant Counties are weighted by County-to-County Worker Flow data from the 2000 census.
DIESEL FRACTIONS	See 02diesel fractions.txt	See 02diesel fractions.txt	2002 EPA defaults applied for light-duty categories and HDBS. Area specific 2002 TxDOT registration data used for HDV classes.
MILEAGE ACCUMULATION RATES	See technical report: M6FLT.007	See technical report: M6FLT.007	EPA default; annual mileage accumulation rates by vehicle type and age.
NGV FRACTION	0	0	EPA default.
NGV EMISSION FACTORS	None	None	EPA default; alternate NGV emissions factors for each of the 28 vehicle types, for running and start emissions.

EXHIBIT III-4

MOBILE6 ACTIVITY			
Command	**Input Parameter Values**		**Description**
	Summer Season	**Winter Season**	
VMT FRACTIONS	N/A	N/A	POST-PROCESSED. VMT mix fractions are applied to link VMT using IMPSUM6 utility from TTI; see Chapter IV for more information.
VMT BY FACILITY	See technical report: M6.SPD.003	See technical report: M6.SPD.003	EPA default; VMT fractions by MOBILE6 road types are used to combine the four individual road type emissions factors into the "all road types" emissions factors. Data has no impact for this analysis.
VMT BY HOUR	See external files: hrvmt_wk.*	See external files: hrvmt_wk.*	Regionally specific, derived from 2002 ATR data.
SPEED VMT	N/A	N/A	Generated by POLFAC62 utility; No input required.
AVERAGE SPEED	N/A	N/A	Allows a single average speed for combined freeways and arterials for the entire day.
STARTS PER DAY	See technical report: M6.FLT.003	See technical report: M6.FLT.003	EPA default; Specifies average number of engine starts per vehicle per day by vehicle types for weekend days and weekdays.
START DISTRIBUTION	See technical report: M6.FLT.003	See technical report: M6.FLT.003	EPA default; allocates engine starts by hour of the day for weekend days and weekdays.
SOAK DISTRIBUTION	See technical reports: M6.FLT.003 and M6.FLT.004	See technical reports: M6.FLT.003 and M6.FLT.004	EPA default; alternate vehicle soak duration distributions for weekend days and weekdays.
HOT SOAK ACTIVITY	See technical reports: M6.FLT.003 and M6.FLT.004	See technical reports: M6.FLT.003 and M6.FLT.004	EPA default; specifies a hot soak duration distribution for each of 14 daily time periods for weekend days and weekdays.
DIURNAL SOAK ACTIVITY	See technical report: M6.FLT.006	See technical report: M6.FLT.006	EPA default; identifies diurnal soak time distributions for each of 18 daily time periods.
WEEKDAY TRIP LENGTH DISTRIBUTION	See external files: 02wdtrip.*	See external files: 02wdtrip.*	Regional data derived from the TransCAD Regional Travel Model, distributions applied for AM peak (6:00-9:00), PM peak (3:00-6:00), and Off-peak.
WEEKEND TRIP LENGTH DISTRIBUTION	N/A	N/A	Weekend inventory is not included in this analysis
WEEKEND VEHICLE USAGE	N/A	N/A	Weekend inventory is not included in this analysis

EXHIBIT III-5

MOBILE6 STATE PROGRAMS							
Command	**Input Parameter Values**						**Description**
	Summer and Winter* Seasons						
STAGE II REFUELING	N/A						Allows modeling of at-the-pump refueling emissions. Accounted for as an area source category.
Anti-Tampering Program (ATP): No Anti-Tampering in Perimeter counties in 2002							
Multiple anti-tampering programs modeled in Collin, Denton, Dallas, and Tarrant Counties to appropriately incorporate benefits. Additional information is included in the text of this chapter.							
ATP PROGRAM	ATP1			ATP2			
start year	Dallas/Tarrant: 1986 Collin/Denton: 2002			Dallas/Tarrant: 1986 Collin/Denton: 2002			
model years	1978			1984			Oldest model year covered by program; 25 year rolling window
	1983			2000			No I/M TTC credits modeled; Optional for exhaust. Do not use with evaporative.
subject vehicles	22222 22222222 2			22222 22222222 2			All gasoline vehicles tested
test only	1			1			Program definition; test and repair
frequency	1			1			Annual testing; program specifications
compliance rate	96			96			Expected compliance (%)
checks performed	21112222			22112222			
Inspection & Maintenance (I/M) Commands: No I/M in Perimeter counties in 2002							
Multiple inspection/maintenance programs modeled in Collin, Denton, Dallas, and Tarrant Counties to appropriately incorporate benefits. Additional adjustments are made to Collin and Denton Counties to account for a mid-year program start. Detailed information is included in the text of this chapter.							
I/M PROGRAM	1	2	3	4	5	6	Identifies program number when multiple programs are modeled
start year	Dallas/Tarrant: 1990 Collin/Denton: 2002	Dallas/Tarrant: 1990 Collin/Denton: 2002	Dallas/Tarrant: 1990 Collin/Denton: 2002	Dallas/Tarrant: 1996 Collin/Denton: 2000	Dallas/Tarrant: 1996 Collin/Denton: 2000	Dallas/Tarrant: 1996 Collin/Denton: 2000	Program specifications
end year	2050	2050	2050	2050	2050	2050	Program specifications
frequency	1	1	1	1	1	1	Annual testing; program specifications
type	TRC	TRC	TRC	TRC	TRC	TRC	Computerized test and repair
name	2500/IDLE	ASM 2525/5015 PHASE-IN	OBD I/M	GC	GC	EVAP OBD & GC	Exhaust and evaporative; program specifications
I/M MODEL YEARS	1978 2000	1978 1996	1996 2000	1978 2000	1978 1995	1996 2005	Program definition; 24 year rolling window, 2-year new car exemption
I/M VEHICLES	11111 22222222 2	22222 11111111 1	22222 11111111 1	11111 22222222 2	22222 11111111 1	22222 11111111 1	Program specifications
I/M STRINGENCY	20	20	20	N/A	N/A	N/A	Exhaust program only: failure rate for pre 1981 model year vehicles (%)
I/M COMPLIANCE	96	96	96	96	96	96	Expected compliance (%)
I/M WAIVER RATES	3 3	3 3	3 3	3 3	3 3	3 3	% waiver rate for pre-1981 vehicles and 1981 and later model year vehicles.
I/M EXEMPTION AGE	25	25	25	25	25	25	EPA default; age vehicle is no longer subject to mandatory I/M requirements
I/M GRACE PERIOD	2	2	2	2	2	2	Program definition; age vehicle is first subject to mandatory I/M requirements
I/M EFFECTIVENESS	1.0 1.0 1.0	1.0 1.0 1.0	1.0 1.0 1.0	1.0 1.0 1.0	1.0 1.0 1.0	1.0 1.0 1.0	Applies only to exhaust program; optional
I/M CUTPOINTS	N/A	N/A	N/A	N/A	N/A	N/A	Optional for exhaust (but required for IM240). Do not use with evaporative.
Technical Training Course (TTC) Credits	N/A	N/A	N/A	N/A	N/A	N/A	No I/M TTC credits modeled; Optional for exhaust. Do not use with evaporative.
I/M DESCRIPTIVE FILE	N/A	N/A	N/A	N/A	N/A	N/A	Optional for both exhaust and evaporative.

EXHIBIT III-6

MOBILE6 FUELS					
Command	**Input Parameter Values**				**Description**
	Summer Season		**Winter Season**		
	Core Counties	Perimeter Counties	Core Counties	Perimeter Counties	
DIESEL SULFUR	364.0	364.0	364.0	364.0	Provided by TCEQ
FUEL REID VAPOR PRESSURE (RVP)	6.8 psi	7.5 psi	11.7 psi	12.3 psi	Provided byTCEQ
FUEL PROGRAM	4	4	4	4	
GASOLINE SULFUR	150	166	246	199	Provided by TCEQ
OXYGENATED FUELS	N/A	N/A	N/A	N/A	Models effects of oxygenated gasoline on exhaust emissions for all gasoline-fueled vehicle types.
SEASON	N/A	N/A	N/A	N/A	EPA default; summer

EXHIBIT III-7

MOBILE6 ALTERNATIVE EMISSIONS REGULATIONS AND CONTROL MEASURES			
Command	**Input Parameter Values**		**Description**
	Summer Season	**Winter Season**	
NO CLEAN AIR ACT	N/A	N/A	Models vehicle emissions as if the Federal Clean Air Act Amendments of 1990 had not been implemented.
HDDV NOx Off-Cycle Emissions Effects:			
NO DEFEAT DEVICE	N/A	N/A	
NO NOx PULL AHEAD	N/A	N/A	
NO REBUILD	N/A	N/A	
REBUILD EFFECTS	1%	1%	Provided by TCEQ
Tier 2 Emission Standards and Fuel Requirements: Overrides default Tier 2 emissions standards and fuel requirements settings.			
NO TIER2	N/A	N/A	
TIER2 EXHAUST PHASE-IN	N/A	N/A	
TIER2 EVAPORATIVE PHASE-IN	N/A	N/A	
TIER2 CERTIFICATION	N/A	N/A	
94+ LDG IMPLEMENTATION	N/A	N/A	Applies alternate 1994 and later fleet penetration fractions for LDGVs under the Tier 1, NLEV (or California LEV 1), and Tier 2 emissions standard programs.
NO 2007 HDDV RULE	N/A	N/A	Disables 2007 Heavy Duty Diesel Vehicle emissions standards.

Area Specific Calculations and Procedures

Registration Distribution

Vehicle age distributions are calculated from TxDOT vehicle registration data and MOBILE6 default data. July 2002 data sets are utilized for light- and heavy-duty classes. MOBILE6.2 default values are used for bus categories. Light-duty distributions are calculated county-specific for Ellis, Henderson, Hood, Hunt, Johnson, Kaufman, Parker, and Rockwall Counties directly from the registration data. Light-duty registration data for Collin, Dallas, Denton, and Tarrant Counties are weighted for commute patterns with the County-to-County Worker Flow data from the 2000 Census. This method better reflects the true interrelation between the DFWRTM Counties. Exhibit III-8 identifies the percentages applied for this weighted adjustment. Heavy-duty vehicle data is combined for Ellis, Henderson, Hood, Hunt, Johnson, Kaufman, Parker, and Rockwall Counties for a RIFCREC county distribution applied to each county. Similarly, Collin, Dallas, Denton, and Tarrant Counties are combined for the heavy-duty vehicle classes. External registration distribution files are named reg02 and reg02_w, followed by a three-letter suffix corresponding to the county name. These files are included in Appendix B.

EXHIBIT III-8

COUNTY-TO-COUNTY WORKER FLOW PERCENTAGES					
	County of Employment				
Residence	Dallas	Tarrant	Collin	Denton	Other Counties
Dallas	87.16	4.47	4.62	1.28	2.47
Tarrant	19.36	75.98	0.53	1.32	2.81
Collin	45.22	1.32	48.66	1.97	2.83
Denton	40.47	6.71	6.32	43.96	2.54

Source: 2000 Census

Diesel Fractions

Diesel fractions for heavy-duty vehicle categories utilize July 2002 registration data. Dallas and Tarrant County data is combined for one set of diesel fractions applied to both Dallas and Tarrant input files. Similarly, Collin and Denton data is combined for those counties, and a third set of diesel fractions are calculated for Rockwall and the RIFCREC Counties. Light-duty and bus categories utilize MOBILE6.2 default values. The 02diesel fractions.txt file included in Appendix B lists specific data used for this analysis.

Hourly Vehicle Miles of Travel

Hourly Vehicle Miles of Travel is calculated from 2002 TxDOT Automated Traffic Recorders (ATR). ATR stations in the Fort Worth and Dallas districts supplied data for this analysis. Daily volumes recorded by the ATR for a set of mid-week days in August are aggregated by hour to determine the percent of daily traffic occurring during each hour. The external hourly VMT data files are included in Appendix B.

Trip Length Distributions

The DFWRTM is used to identify the number of trips within a time period (AM Peak, PM Peak, or Off-Peak) that are 10 minute intervals; 10 minutes or less, 11 to 20 minutes, 21 to 30 minutes, 31 to 40 minutes, 41 to 50 minutes, and 51 minutes or longer. Trips within these ten-minute intervals are aggregated over the total trips within the time period to determine the trip length distributions for AM Peak, PM Peak, and Off-Peak. AM Peak distributions are applied from 6 a.m. to 9 a.m., PM Peak distributions are applied from 3 p.m. to 7 p.m., and Off-Peak distributions are applied from 9a.m. to 3 p.m., and 7 p.m. to 6 a.m. The same trip length distributions are utilized for DFWRTM and RIFCREC counties. Three equivalent trip length files are included in Appendix B.

Post-Process Adjustments

Some State initiatives and local programs affecting the emission factors are accounted for in a post-process methodology utilizing the Texas Mobile Source Emission Software. The calculation for these adjustments is made outside the input files, however the process may include input parameter data and/or multiple input files.

Inspection/Maintenance and Anti-Tampering Programs

Inspection and Maintenance (I/M) Programs are modeled in Dallas, Tarrant, Collin, and Denton Counties for the summer and winter season. For Collin and Denton Counties, input files with alternate I/M program parameters are run and used for calculating daily emission factors.

Associated Anti-Tampering Programs (ATP) are modeled in a multi-step format to appropriately account for varied requirements for particular model year vehicles. Three input files are required for calculation of the ATP. One input file (a) models ATP for 1983 model year vehicles. The second file (b) models ATP for post-1983 vehicles. The third file (c) models no ATP. These files are combined as follows:

$$EmissionFactor(EF)_{Final} = EF_{ATP(a)} + EF_{ATP(b)} - EF_{ATP(c)}$$

This calculation is performed for both summer and winter emission factors.

Ellis, Johnson, Kaufman, Parker, Rockwall, Hood, Henderson, and Hunt Counties do not have I/M or corresponding ATP in 2002.

FINAL EMISSION FACTOR CALCULATION

The emission factors developed through use of the MOBILE6.2 Emission Factor Model as described above are combined with additional local information and adjustments to quantify the appropriate daily and annual emission factors used in this analysis. The following adjustments are applied to the emission factors post-process utilizing the Texas Mobile Source Emission Software. The following adjustments are applied prior to the emission calculation procedure discussed in Chapter IV.

Daily Emission Factor Calculation

Daily emission factors utilize the summer emission factors, plus adjustments for ATP and I/M programs. Exhibit III-9 below summarizes the adjustments applied for each county. These factors are used in calculating the daily emissions as described in Chapter IV.

EXHIBIT III-9

DAILY EMISSION FACTOR CALCULATION PROCESS		
Counties	**Adjustments**	
	ATP	**May I/M Start**
Dallas, Tarrant	✓	N/A
Collin, Denton	✓	✓
Ellis, Henderson, Hood, Hunt, Johnson, Kaufman, Parker, Rockwall	N/A	N/A

Annual Emission Factor Calculation

Annual emission factors ($EmissionFactor_{Annual}$) are calculated by combining adjusted summer emission factors ($EmissionFactor_{Summer}$) and adjusted winter emission factors ($EmissionFactor_{Winter}$) using a 50 percent split. Thus, the annual emission factors represent a

combination of six months of summer season (May – October) and six months of winter season (January – April and November – December).

$$EmissionFactor_{\text{Annual}} = 0.5 EmissionFactor_{\text{Summer}} + 0.5 EmissionFactor_{\text{Winter}}$$

Adjusted summer season emission factors utilize summer emission factors with an ATP adjustment. The I/M adjustment utilized for daily emission factors for Collin and Denton Counties as described above is not applied for the annual emission factors because this is accounted for in the process described below.

The adjusted winter season emission factors are determined by combining two sets of winter emission factors in a two-thirds to one-third split. The winter months of January through April are represented with winter emission factors ($EmissionFactor_{\text{Jan-Apr}}$). The winter months of November and December are also represented with winter emission factors ($EmissionFactor_{\text{Nov - Dec}}$), but have added controls of an I/M program where appropriate.

$$EmissionFactor_{\text{Winter}} = \frac{2}{3} EmissionFactor_{\text{Jan-Apr}} + \frac{1}{3} EmissionFactor_{\text{Nov-Dec}}$$

I/M adjustments do not apply to Dallas, Ellis, Henderson, Hood, Hunt, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties. These counties utilize nonadjusted winter emission factors.

Final Emission Factors are included in Appendix E.

Vehicle Miles of Travel Mix (or Fractions) (VMT Mix)

Vehicle Miles of Travel (VMT) Mix is applied to the emission factors in a post-process methodology using the Impsum62 software utility developed by TTI. The VMT mix enables assignment of emission factors by vehicle type to a total volume to calculate emissions on a link or functional class. VMT mix is estimated for freeways, arterials, and collectors for three time periods and each of the following three areas: Core Urban Counties (Dallas and Tarrant), Core Rural Counties (Collin and Denton), and Perimeter Counties (RIFCREC Counties and Rockwall). These county groupings were determined by the vehicle activity behavior and demographics of the counties. The VMT Mix methodology utilizes data, assumptions, and procedure from TxDOT, TTI, MOBILE6.2 Mobile Source Emission Factor Model, Federal Highway Administration, and the DFWRTM. VMT mix files are included in Appendix D.

Vehicle counts reported in the 2002 TxDOT Vehicle Classification Report provide a base for the distribution of vehicles by type and functional class. The number of vehicles in each of the twelve axle-based categories are combined into intermediate groups, and then disaggregated into 28 vehicle types by applying appropriate TxDOT registration data, and MOBILE6 defaults. Exhibit III-10 outlines this process. For each functional class, the values are aggregated across the total vehicles to determine the fraction of vehicles from each class. Motorcycles are allocated as 0.1 percent for each functional class, subtracted from the Light-Duty Gasoline Vehicles category.

EXHIBIT III-10

VEHICLE CLASSIFICATION PROCESS						
Axle-Based Vehicle Classifications		Intermediate Groups	Detailed Groups			
C	Passenger Vehicles	Passenger Vehicles (PV)	Light-Duty Vehicle (LDV)	Light-Duty Gas Vehicle (LDGV)*		
				Light-Duty Diesel Vehicle (LDDV)*		
				Motorcycle (MC)^		
P	2 Axle, 4 Tire Single Unit		Light-Duty Truck (LDT)	Light Duty Truck 1 (LDT1)	LLDT*	LDGT1*
						LDGT2*
					LDDT*	LDDT12*
						LDDT34*
				Heavy-Light-Duty Truck (HLDT)	LDGT3*	
					LDGT4*	
B	Buses	Buses (Bus)	Heavy-Duty Diesel Bus – Transit (HDDBT)*			
			Heavy-Duty Diesel Bus – School (HDDBS)*			
			Heavy-Duty Gas Bus (HDGB)*			
SU2	2 Axle, 6 Tire Single Unit	Heavy-Duty Vehicles (HDV)	Heavy-Duty Gas Vehicle (HDGV)			HDGV2b
						HDGV3
						HDGV4
						HDGV5
SU3	3 Axle, Single Unit					HDGV6
						HDGV7
						HDGV8a
						HDGV8b
SU4	4+ Axle, Single Unit		Heavy-Duty Diesel Vehicle (HDDV)			HDDV2b
						HDDV3
						HDDV4
SE4	3 or 4 Axle, Single Trailer					HDDV5
						HDDV6
						HDDV7
						HDDV8a
SE5	5 Axle, Single Trailer	Heavy-Duty Diesel Vehicles (HDX)	HDDV8b			
SE6	6+ Axle, Single Trailer					
SD5	5 Axle, Multi Trailer					
SD6	6 Axle, Multi Trailer					
SD7	7+ Axle, Multi Trailer					

* Categories calculated using MOBILE6 defaults
^ Motorcycles are allocated as 0.1 percent for each functional class, subtracted from the Light-Duty Gasoline Vehicles category.

This “temporary” VMT mix calculation is then redistributed using local truck and non-truck splits identified by the Dallas-Fort Worth Regional Travel Model. This process is performed for each of the three functional classes and three time periods, where AM Peak is 6:30 a.m. – 9:00 a.m., PM Peak is 3:00 p.m. – 6:30 p.m., and Off-Peak represents all other hours of the day. Motorcycles and light-duty vehicles and light-duty trucks are classified as nontrucks. Heavy-duty vehicles and buses are considered trucks. Exhibit III-11 identifies the truck and non-truck splits applied for this analysis.

EXHIBIT III-11

TRUCK AND NON-TRUCK SPLITS							
County	Roadway Type	AM Peak		PM Peak		Off-Peak	
		Truck	Non-Truck	Truck	Non-Truck	Truck	Non-Truck
Dallas and Tarrant County	Freeway	7.69%	92.31%	7.43%	92.57%	11.53%	88.47%
	Arterial	3.83%	96.17%	3.89%	96.11%	7.11%	92.89%
	Collector	2.92%	97.08%	2.95%	97.05%	5.33%	94.67%
Collin and Denton County	Freeway	10.17%	89.83%	10.23%	89.77%	14.07%	85.93%
	Arterial	4.23%	95.77%	4.22%	95.78%	7.07%	92.93%
	Collector	2.23%	97.77%	2.36%	97.64%	4.19%	95.81%
Perimeter Counties	Freeway	20.09%	79.91%	19.40%	80.60%	21.52%	78.48%
	Arterial	10.38%	89.62%	9.81%	90.19%	11.85%	88.15%
	Collector	4.40%	95.60%	4.37%	95.63%	6.34%	93.66%

IV. EMISSION CALCULATION PROCEDURES

Emissions are estimated using the Texas Mobile Source Emissions Software, developed by TTI to maintain consistency with the other Texas counties. This software combines vehicle activity and emission factors to create emission estimates. For detailed information about the software, please see the Technical Supplement to Texas Mobile Source Emissions Software included in Appendix F. The 12-county emissions were calculated for two purposes: ozone season weekday emissions and annual emissions.

Ozone Season Weekday Emission Calculations

The ozone season weekday emissions were calculated using the following formula:

$$Emissions_{\text{OzoneWeekday}} = VehicleActivity \times EmissionFactors_{\text{Summer}}$$

Vehicle activity used for the DFWRTM counties is taken from output created by the DFWRTM. The DFWRTM identifies the vehicle activity information for each link in Collin, Dallas, Denton, Rockwall, and Tarrant Counties as discussed in Chapter II. Application of emission factors to each of these links requires assignment of VMT mix as described in Chapter III and coordination of functional classes. The appropriate weighted emission factors are applied to the links based on identified VMT mix and speed. Freeway emission factors are applied to freeway, tollways and HOV links. Arterial/collector emission factors are applied to principal arterials, minor arterials, collectors, frontage roads, zone connectors, and intrazonal links. Ramp emission factors are applied to ramp links. Local emission factors have a set MOBILE default speed of 12.9 miles per hour which is applied.

Emission factors for freeways and arterial/collectors are specific to the speed identified on the links. Ramp emission factors have a set speed of 34.6 miles per hour, which is applied to all ramps regardless of the speed identified by the DFWRTM.

In a similar process used for the DFWRTM counties, the vehicle activity is applied for the RIFCREC counties not on a link-by-link basis but on a countywide basis. Vehicle activity and speed estimates are identified for a functional class as discussed in Chapter II.

Annual Emission Calculations

To calculate annual emissions, the following formula was used:

$$Emissions_{\text{Annual}} = VehicleActivity \times VMT_{\text{AnnualizationFactor}} \times EmissionFactor_{\text{Annual}}$$

The vehicle activity, which has been discussed previously in Chapter II is multiplied by a VMT annualization factor. This factor is developed using the following formula:

$$VMT_{\text{AnnualizationFactor}} = VMT_{\text{OzoneWeekday(AADT)}} / VMT_{\text{AnnualWeek(ASWT)}} \times 365$$

Vehicle activity annualization factors for vehicle activity was required to produce county level annual emission estimates. These annualization factors convert a summer weekday vehicle activity to an annual vehicle activity total for each of the 12 counties. TxDOT's 2002 ATR data was used to develop these annualization factors at TxDOT District levels. The 2002 summer weekday vehicle activity by county was used as a base value to produce county level annual vehicle activity totals.

To develop the annualization factors, a conversion ratio was established for each of the four TxDOT Districts (Dallas, Fort Worth, Paris, and Tyler). The conversion ratio adjusts summer weekday vehicle activity to an Annual Average Daily Traffic (AADT). The conversion ratio is then multiplied by 365 (number of days in 2002) to produce the annualization factors. The

district level annualization factor is multiplied with each appropriate county level summer weekday vehicle activity numbers to produce county level annual vehicle activity totals. The 2002 TxDOT Dallas District annualization factor is produced as follows:

$(959{,}043_{AADT} / 1{,}034{,}162_{ASWT}) \times 365 = 338.48729$ Annualization Factor $_{\text{TxDOT Dallas District}}$

Annual Emission Factors

The vehicle activity and VMT annualization factor are then multiplied by the annual emission factor discussed in Chapter III. As a reminder, the formula for annual emission factors is:

$$EmissionFactor_{\text{Annual}} = (0.5 \times EmissionFactor_{\text{Summer}} + 0.5 \times EmissionFactor_{\text{Winter}})$$

The Texas Mobile Source Emissions Software is used to put all these individual pieces together to create the desired result. For the state to include the data developed for the 12 North Central Texas Counties into the statewide emissions inventory, specially formatted files were created. These files are in the National Emissions Inventory Input Format or NIF. This format is the most common way for agencies to transmit data to the U.S. EPA. There are strict guidelines for the file structure that allow for the file uniformity and the ability for multiple agencies to do the same work.

For U.S. EPA to measure the input of ozone by region, an additional calculation was performed for the NIF files. A summer ozone season factor was created and applied to the emissions in order to get a result representing summer ozone season emissions.

Summer Ozone Weekday 2002 VMT Factor

Vehicle activity adjustments were made at county levels to establish a consistency for a typical ozone season weekday activity for statewide reporting needs. Two methods of approach were required, one for the five counties that were modeled using the Dallas-Fort Worth Regional Travel Model, and one for the seven counties not modeled. Under both methods, TxDOT's 2002 ATR data was used to establish consistency for reporting needs.

For the DFWRTM counties (Collin, Dallas, Denton, Rockwall, and Tarrant), an August weekday 2002 modeled vehicle activity was converted to a typical 2002 summer weekday vehicle activity. This required the development of a modeled conversion ratio to make this adjustment. Each ratio was developed at the TxDOT District level and applied to the appropriate counties within each TxDOT district. For example, Collin County, which was modeled, the conversion ratio was developed as follows:

$$(1{,}034{,}162_{\text{AWST-Summer Weekday}} / 1{,}020{,}096_{\text{ADT – August Mid Weekday}}) = 1.01379$$

For the non-modeled counties (Ellis, Henderson, Hood, Hunt, Johnson, Kaufman, and Parker), TxDOT's 2002 HPMS data was converted from a 2002 AADT to a typical 2002 summer weekday vehicle activity. This required the development of a non-modeled conversion ratio to make this adjustment. Each ratio was developed at the TxDOT District level and applied to the appropriate counties within each TxDOT district. For example, Ellis County, which was not modeled, the conversion ratio was developed as follows:

$$(1{,}034{,}162_{\text{AWST-Summer Weekday}} / 959{,}043_{\text{AADT}}) = 1.07833$$

V. SUMMARY OF VEHICLE MILES OF TRAVEL, SPEED, AND EMISSIONS

Estimates

For TCEQ to provide a complete statewide emissions inventory outlined in the Consolidated Emissions Reporting Rule, all 254 Texas counties were inventoried and followed a uniform process for reporting needs. NCTCOG has calculated VMT and emissions estimates to show ozone season weekday and annual values by county for 12 North Central Texas counties. These 12 counties include Collin, Dallas, Denton, Ellis, Henderson, Hood, Hunt, Johnson, Kaufman, Parker, Rockwall and Tarrant. The emission types reported are volatile organic compounds (VOC), carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), ammonia (NH_3), and particulate matter (PM-10 and PM-2.5). Exhibit V-1 shows the annual VMT and emissions estimates for the 12 counties used in this analysis. Exhibit V-2 shows the ozone season weekday VMT and emissions estimates for the same 12 counties.

EXHIBIT V-1

2002 CONSOLIDATED EMISSIONS REPORTING RULE (CERR)
DALLAS-FORT WORTH MODELING DOMAIN: ALL COUNTIES

Vehicle Miles of Travel, Speed and Emissions

Annual

County	VMT (miles)	Speed (mph)	VOC (tons)	CO (tons)	NO_x (tons)	SO_2 (tons)	NH_3 (tons)	PM-10 (tons)	PM-2.5 (tons)
Collin	4,641,732,273	30.26	5,650.41	90,022.87	10,406.62	333.04	488.58	227.28	146.83
Dallas	23,259,820,332	25.15	26,598.61	421,581.54	52,977.25	1,674.66	2,437.78	1,155.35	751.51
Denton	4,316,153,627	29.99	5,145.67	84,680.04	10,416.64	317.02	452.31	217.90	142.17
Ellis	1,273,608,340	48.12	1,612.95	27,908.18	6,619.49	124.73	124.36	97.52	70.77
Henderson	588,893,928	39.46	1,016.07	14,427.16	1,621.83	46.81	59.49	35.38	24.35
Hood	303,750,457	38.45	447.05	6,564.87	778.24	23.88	30.96	17.92	12.28
Hunt	827,147,497	43.67	1,333.40	20,166.98	3,668.16	75.28	81.55	58.49	41.80
Johnson	970,789,002	42.79	1,519.64	23,213.52	3,856.62	85.46	96.50	65.82	46.61
Kaufman	1,124,664,044	46.37	1,561.18	25,346.34	4,546.92	100.34	111.88	77.11	54.74
Parker	904,825,505	44.43	1,321.95	20,946.62	4,215.87	84.33	89.04	65.54	47.06
Rockwall	581,521,442	32.86	632.01	11,586.05	2,690.26	55.40	57.50	43.01	31.01
Tarrant	14,293,792,636	26.48	15,611.03	259,651.46	32,817.55	1,032.14	1,497.43	709.26	460.85

EXHIBIT V-2

2002 CONSOLIDATED EMISSIONS REPORTING RULE (CERR)
DALLAS-FORT WORTH MODELING DOMAIN: ALL COUNTIES

Vehicle Miles of Travel, Speed and Emissions

Ozone Season Weekday

County	VMT (miles)	Speed (mph)	VOC (lbs)	CO (lbs)	NO_x (lbs)	SO_2 (lbs)	NH_3 (lbs)	PM-10 (lbs)	PM-2.5 (lbs)
Collin	13,713,166	30.26	30,096.78	410,170.63	55,514.41	1,623.22	2,886.83	1,324.25	848.92
Dallas	68,716,968	25.15	143,041.95	1,913,911.85	284,657.49	8,155.85	14,403.95	6,730.51	4,344.36
Denton	12,751,302	29.99	27,425.79	388,322.84	55,898.30	1,554.03	2,672.55	1,270.77	823.28
Ellis	3,762,647	48.12	8,836.22	135,116.24	37,441.45	705.55	734.82	574.61	416.57
Henderson	1,735,269	39.46	5,559.34	68,109.62	8,674.00	260.47	350.58	207.62	142.66
Hood	914,758	38.45	2,504.01	31,568.20	4,277.56	135.69	186.46	107.50	73.54
Hunt	2,403,917	43.67	7,202.07	94,853.34	20,131.57	417.04	474.00	338.83	241.84
Johnson	2,923,574	42.79	8,505.37	113,103.84	21,789.19	489.54	581.21	395.04	279.37
Kaufman	3,322,618	46.37	8,557.33	121,576.60	25,332.02	564.31	661.04	454.14	321.94
Parker	2,724,922	44.43	7,400.73	102,758.38	24,103.88	484.79	536.30	393.50	282.23
Rockwall	1,718,001	32.86	3,416.89	55,424.89	15,202.04	312.86	339.76	253.43	182.55
Tarrant	43,046,382	26.48	85,550.56	1,210,546.34	179,803.63	5,127.29	9,019.17	4,214.41	2,718.23

APPENDIX A

Electronic Data

The modeled output from the Texas Transportation Institute's Texas Mobile Source Emissions Software is included in this appendix. All data is organized by county and time-of-day for ozone season weekday (daily) and annual emissions. Also included are files used to create the National Emission Inventories Input Format or NIF files. These files have a standardized format that allows the EPA to quickly combine files from different regions to create databases. Refer to electronic copy of documentation contained on CD.

APPENDIX B

External Files

This appendix includes specific local data files referenced by the Texas Transportation Institute's Texas Mobile Source Emissions Software. These files allow the software to calculate results specific to the analysis area. Refer to electronic copy of documentation contained on CD number 1.

APPENDIX C

Technical Reports

The methodologies outlined in the technical reports provided in this appendix were used to develop MOBILE6 input files. These reports were written by EPA to provide guidance on different types of soak length emissions, fleet characteristics, and VMT weighting by facility type. Refer to electronic copy of documentation contained on CD number 1.

APPENDIX D

MOBILE6 Input Files

The MOBILE6 input files were developed specific to the Dallas-Fort Worth area. Input files for all 12 counties are included to create ozone season weekday (daily) and annual emission factors. Refer to electronic copy of documentation contained on CD number 1.

APPENDIX E

Emission Factors

The files included in this appendix are the product of the MOBILE6 model run. The results provided are for ozone season weekday (daily) and annual emissions. Refer to electronic copy of documentation contained on CD number 1.

APPENDIX F

Texas Transportation Institute Software

The Texas Transportation Institute mobile source emissions software is provided in this appendix to allow recreation of the emissions output if necessary. The appendix also contains files to properly manipulate the input data and the vehicle activity used to calculate the emissions estimates. Refer to electronic copy of documentation contained on CD number 1.