2007 On-Road Mobile Source Emissions Inventories For the Houston-Galveston Ozone Nonattainment Area

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

Sponsored by the
Texas Natural Resource
Conservation Commission

March 2002

TECHNICAL NOTE

Transportation Air Quality Technical Support
Interagency Contract
with
Texas Natural Resource Conservation Commission

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DATE: 31 March, 2002

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SUBJECT: 2007 On-Road Mobile Source Emissions Inventories for the Houston-Galveston Ozone Nonattainment Area
(Umbrella Contract 9880077500-12: Task 2) - **Review Draft**

INTRODUCTION

This Technical Note documents the methods the Texas Transportation Institute (TTI) used to develop the Houston-Galveston ozone nonattainment area (HGA) August 2007 on-road mobile source emissions estimates. These emissions forecasts are based on the August 2000 primary ozone episode meteorological conditions. (The August 2000 base-case episode-specific on-road mobile emissions estimates documentation, also produced under this task, are provided in a separate Technical Note.)

The eight HGA counties are: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller. The forecast period for the emissions estimates is the 11-day base-year analysis sequence, Tuesday, August 22 through Friday, September 1. (Although the days-of-week are different for these dates in 2007, for modeling purposes the base-year episode date and day-of-week sequences are maintained.)

Emissions of volatile organic compounds (VOC), carbon monoxide (CO) (not required for ozone modeling, but included for review), and oxides of nitrogen (NOx), are estimated for each county and day on an hourly basis. The hourly estimates are computed by network links (characterized by 13 road types) for which the geographical coordinates are provided. Emissions are categorized by 28 vehicle types and 14 pollutant-specific emissions types. For speed limit impact analyses, a second set of emissions estimates was produced for the scenario where the eight county area maximum speed limits were reduced to 55 mph.

Documented within are the methods relating to calculating inventory elements including link-based 2007 vehicle miles traveled (VMT) estimates from Houston-Galveston Area Council's (HGAC) travel demand model (TDM), August day-of-week adjustments and Highway Performance Monitoring System (HPMS) consistency adjustments to VMT, VMT mix, speeds, MOBILE6 emissions factors, and emissions estimates. A speed limit impact analysis is included to compare emissions estimates from two speed limit scenarios: one based on the current speed limits (speed limits as they existed prior to the 55 mph maximum implemented in HGA in early 2002) and one based on a reduction of the maximum speed limit to 55 mph.

ACKNOWLEDGMENTS
Mary McGarry-Barber and Chris Kite, both with the Texas Natural Resource Conservation Commission (TNRCC), and Martin Boardman and Charles Bell, both of the Texas Transportation Institute (TTI), contributed to the development of the MOBILE6 emissions factors input data parameter values. Boardman produced the MOBILE6 model setups used, and performed the emissions factors analyses. Ranga T. Kandalam of HGAC provided the 2007 HGA network traffic assignment and intrazonal trips. Dennis Perkinson, Ph.D., of TTI, developed August day-of-week and HPMS consistency VMT adjustment factors and VMT mix. Bell prepared VMT and modeled operational speeds. Bell and Boardman performed the emissions estimations. L.D. White of TTI performed quality assurance checks, and each member of the assigned TTI staff contributed to the quality assurance of the emissions inventory elements by cross checking each others work. Dr. Perkinson was the principle investigator for this project. This work was performed by TTI under contract to TNRCC. Mary McGarry-Barber was the TNRCC 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 or other electronic media 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 TNRCC staff.

The 2007 emissions inventory datasets on CD-ROM were submitted to the TNRCC Technical Analysis Division on March 28, 2002. Appendix A lists the CD-ROM volume names and the data set file names and descriptions contained on each CD.

SUMMARY OF VMT AND EMISSIONS
A summary of 24-hour HGA network total VMT, average speed, and emissions for each of the eleven analysis days is presented in Table 1.

Table 1
HGA All Counties August 2007

On-Road Mobile Source VMT, Average Speed (mph), and Emissions (tons per day)*

Day	VMT	Speed	VOC	CO	NOx
Tuesday, August 22**	133,274,706	40.2	77.1	1,184.5	144.4
Wednesday, August 23	133,274,706	40.2	76.4	1,156.0	143.4
Thursday, August 24	133,274,706	40.2	76.3	1,151.3	143.4
Friday, August 25	145,378,096	39.5	86.2	1,299.8	130.7
Saturday, August 26	120,306,412	41.0	62.8	1,026.8	90.9
Sunday, August 27	99,344,645	41.9	51.7	866.1	69.2
Monday, August 28	133,274,706	40.2	79.7	1,205.9	145.6
Tuesday, August 29	133,274,706	40.2	80.5	1,207.5	145.6
Wednesday, August 30	133,274,706	40.2	82.4	1,225.5	146.0
Thursday, August 31	133,274,706	40.2	84.9	1,244.9	146.9
Friday, September 01	145,378,096	39.5	90.8	1,365.4	133.0

* Current Speed Limits Scenario
** August 22-24 are pre-ozone episode days.

OVERVIEW OF METHODOLOGY

To develop the HGA ozone episode emissions estimates, a directional link-based, hourly methodology was applied. Emissions estimates were calculated at the roadway network link-level for each hour of each analysis day.

The MOBILE6 model was used to develop hourly emissions factors by MOBILE6 road type and 28 vehicle types. (Only the speed sensitive freeway and arterial emissions factors were applied.) The activity basis was the Houston-Galveston 2007 TDM link-based and intrazonal VMT, adjusted to August day-of-week activity and for consistency with HPMS VMT. Automatic traffic recorder (ATR) data were used to produce the seasonal (August) day-of-week VMT adjustment factors. Hourly travel fractions were developed and applied to allocate the August day-of-week VMT by hour-of-day. Hourly operational speeds were modeled by link based on the current speed limits and on the 55 mph maximum speed limit scenario. Vehicle classification data were used to estimate time-of-day VMT mixes for apportioning fleetwide link-VMT to the 28 U.S. Environmental Protection Agency (EPA) vehicle types. Link-level emissions by vehicle type were calculated by hour. For the geographical allocation of emissions, the link endpoints (designated by network node numbers for which X-Y coordinates are provided) were recorded with the hourly link emissions.

TTI previously developed a series of computer programs to develop detailed on-road mobile source emissions inventories. These computer programs were used to produce and apply the major emissions inventory elements (adjusted operational time-of-day link VMT by vehicle type, operational link-speeds, and MOBILE6 emissions factors) to calculate the emissions estimates. Appendix B describes these programs and the process for their application.

ESTIMATION OF VMT

The outputs of the VMT estimation process are estimates of county 2007 VMT (and speeds, as discussed in a following section) by August day-of-week (average Monday through Thursday, Friday, Saturday, and Sunday), hour, and direction for each link of the Houston-Galveston 2007 Travel Demand Management (TDM) network and for each of the added intrazonal links. These link-based VMT estimates were also adjusted for consistency with HPMS VMT.

The PREPIN2 program (see Appendix B) was applied to produce the adjusted link-based VMT estimates. The PREPIN2 program output 192 hourly link files (four day-of-week times, 24 hours per day for each speed limit scenario) containing the county and road type-indexed link data (VMT and speeds) for each day-of-week period.

Data Sources

The HGA 2007, directional, four time-of-day period, equilibrium traffic assigned network and intrazonal trips and zonal radii (assumed intrazonal trip length) were provided by HGAC. These TDM data, which cover the HGA eight-county area, were used as the basis for developing the link-based August 2007 VMT estimates. Because the estimated intrazonal trips are not assigned to the network, the intrazonal trips and zonal radii were needed to estimate the intrazonal VMT. To adjust the 2007 Houston-Galveston TDM VMT and allocate it as needed for the August 2007 episode days, several other sources of data were required.

HPMS VMT 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. For the purpose of this study, county total HPMS Annual Average Daily Traffic (AADT) VMT were used to ensure the 2007 travel model VMT were consistent with the HPMS VMT estimates. (EPA and FHWA have endorsed HPMS as the appropriate source of VMT and require that VMT used to construct on-road mobile source emissions inventories should be made consistent with that reported through HPMS.)

ATR vehicle counts are collected by the Texas Department of Transportation (TxDOT) at selected locations on a continuous basis throughout Texas. These counts are available by season, month, and weekday, as well as on an annual average daily basis (i.e., AADT). Since they are continuous, they are especially well suited for making seasonal, day-of-week comparisons (i.e., adjustment factors), even though there may be relatively few ATR data collection locations in any given area. Data from the ATR stations in the HGA were grouped for this analysis. These ATR count data were used to produce the August day-of-week adjustment factors.

HGA time-of-day factors from previous HGA emissions inventory analyses were processed to estimate the hourly travel fractions for the 2000 base-case analysis and were also applied for this 2007 attainment year analysis. (TXDOT vehicle classification count data were used to develop the VMT mix, or VMT fractions, for the 28 EPA vehicle types, discussed in a later section.)

VMT Adjustments

The unadjusted travel model VMT and the day-of-week VMT as adjusted for this analysis are summarized in Table 2. The travel model VMT were adjusted for consistency with HPMS, and to August day-of-week-specific travel.

The HPMS adjustment factor was developed using the VMT from the 1995 travel model validation and the 1995 county HPMS VMT reported by TxDOT. The formula for the HPMS factor calculation is:

HPMS VMT (Annual Average Daily Traffic [AADT]) × Non-Summer Weekday Adjustment Factor = HPMS VMT Average Non-Summer Weekday Traffic (ANSWT)

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

ANSWT is the VMT produced by the travel model. HPMS VMT is from the HPMS for 1995 for the eight HGAC counties. The seasonal adjustment (i.e., AADT to ANSWT) is based on 1995 ATR data from the Houston area as defined by the Houston TxDOT District. For the HPMS adjustment factor, the actual values are:

97,926,113 × 1.06125 = 103,924,087.4

103,924,087.4 / 106,829,526.1 = 0.972803038

A similar procedure is used to calculate the August day-of-week adjustment factors. Aggregated ATR data (for 1999 and 2000) from the HGA ATR stations were used. The eight-county area August day-of-week factors were produced by dividing the average day-of-week traffic count by the ANSWT count. The August day-of-week factors are: Weekday 1.01855, Friday 1.11105, Saturday 0.91944, and Sunday 0.75924.

Table 2
HGA County August 2007 Travel Model and Adjusted VMT
(Rounded to Whole Numbers)

County	Travel Model VMT*	Weekday** VMT	Friday VMT	Saturday VMT	Sunday VMT
Brazoria	5,619,308	5,567,883	6,073,533	5,026,100	4,150,370
Chambers	2,880,345	2,853,986	3,113,172	2,576,279	2,127,397
Fort Bend	9,146,577	9,062,873	9,885,921	8,181,010	6,755,579
Galveston	5,277,858	5,229,557	5,704,482	4,720,695	3,898,178
Harris	97,333,009	96,442,270	105,200,711	87,057,955	71,889,283
Liberty	2,303,573	2,282,492	2,489,777	2,060,394	1,701,398
Montgomery	10,360,600	10,265,786	11,198,077	9,266,873	7,652,246
Waller	1,584,355	1,569,856	1,712,423	1,417,101	1,170,190
HGA	134,505,625	133,274,701	145,378,093	120,306,408	99,344,641

* VMT totals from time-of-day traffic assignments including intrazonal VMT.
** Average Monday through Thursday

Hourly Travel Factors
Hourly time-period volume factors developed for a previous HGA air quality analysis were processed to produce factors for apportioning the adjusted VMT by hour of day.

Previously, time-of-day volume factors were applied to apportion HGAC TDM VMT from a single 24-hour assignment to each hour of the day (HGA MOBILE5b 2007 Emissions Analysis, TTI, December 2000). The single assignment hourly volume factors are a set of factors for each of the four day-of-week periods, by 24 time periods, five HGAC TDM area types, and the13 HGAC TDM network functional classes. The VMT factors may be grouped by four area types (by combining Central Business District and Urban area types (Table 3) and by three functional groups (Table 4).

Table 3
HGAC Network Area Types

1. Central Business District (CBD)
2. Urban
3. Urban Fringe
4. Suburban
5. Rural

Table 4
HGAC Functional Classification to Functional Group Table of Equals for Application of Hourly VMT Factors

Functional Group	Network Functional Classifications
1. Freeways, Interstates	1. Urban Interstate Freeways 2. Urban Other Freeways 10. Rural Interstate Freeways 11. Rural Other Freeways
2. Arterials, Major Collectors	5. Urban Principal Arterials 6. Urban Other Arterials 12. Rural Principal Arterials 13. Rural Other Arterials 14. Rural Major Collectors
3. Collectors, Locals	7. Urban Collectors 8. Locals (Centroid Connectors) 15. Rural Collectors 16. Locals (Intrazonals)

HGAC provided a four-period, time-of-day 2007 network traffic assignment. Table 5 shows the traffic assignment time-of-day travel periods.

Table 5
HGAC Time-of-Day Travel Periods

Period	Hours
AM Peak	6:00 a.m. - 9:00 a.m.
Midday	9:00 a.m. - 3:00 p.m.
PM Peak	3:00 p.m. - 7:00 p.m.
Overnight	7:00 p.m. - 6:00 a.m.

To produce the hourly volume fractions for allocating the four-period 2007 assignment and intrazonal VMT to the hours of day, the hourly travel factors (from the prior single assignment analysis) by area type and functional group were grouped within their corresponding four time-of-day periods and then normalized within each period. This procedure was performed using the prior 24-hour assignment hourly volume factors for each of the four day-of-week periods to produce the hourly VMT allocation factors for Weekday, Friday, Saturday, and Sunday, as summarized in the tables in Appendix C. These hourly volume factors were applied to the adjusted four-period, time-of-day link and intrazonal VMT by functional group and area type to allocate the VMT to each hour of the day.

The VMT summaries by eight county area, county, day, hour, road type, and vehicle type are included with the emissions inventory data provided to TNRCC on CD-ROM. Appendix A lists the electronic data files with descriptions that were provided to TNRCC.

ESTIMATION OF LINK SPEEDS

The operational speeds by direction and hour were calculated on each freeway, arterial, and collector link using the Houston Speed Model. Operational speeds were estimated for two scenarios: one based on the current speed limits (speed limits as they existed prior to the 55 mph maximum implemented in HGA in early 2002) and one based on a reduction of the maximum speed limit to 55 mph.

The Houston Speed Model requires a freeflow speed factor, a Level of Service (LOS) E speed factor and “speed reduction factor” (SFR) for each link. No speed model was used to estimate speeds for locals streets (that include centroid connector and intrazonal functional classifications). Additional details of these speed modeling methods are documented in the TTI Research Report 1279-9, “Texas Mobile Source Emissions Software, Version 2.0: User’s Guide,” February 1995. (Documentation of the most recent software versions are currently in review draft form.)

The Houston speed model calculates the operational link speeds by direction and time period as a function of the link's estimated freeflow speed, estimated LOS E speed, and volume-to-capacity (V/C) ratio-based SRFs. The SRFs describe the decay from a freeflow speed (i.e., the uncongested speed for a V/C ratio approaching 0.0) to an LOS E speed (i.e., the congested speed for a V/C ratio of 1.0). The values of the SRFs vary from 0.0 to 1.0.

The speed factors required to estimate the operational link speeds are grouped into the five functional groups as shown in Table 6 and the five area types as shown previously in Table 3. The capacity factors are grouped by the four time of day assignment periods as shown previously in Table 5.

Table 6
Functional Classification to Functional Group Table of Equals for Application of Capacity and Speed Factors

Functional Group	**Corresponding Network Functional Classifications**
1. Freeways, Interstates	1. Urban Interstate Freeways 2. Urban Other Freeways 10. Rural Interstate Freeways 11. Rural Other Freeways
2. Principal Arterials	5. Urban Principal Arterials 12. Rural Principal Arterials
3. Other Arterials, Major Collectors	6. Urban Other Arterials 13. Rural Other Arterials 14. Rural Major Collectors
4. Collectors	7. Urban Collectors 15. Rural Collectors
5. Locals	8. Locals (Centroid Connectors) 16. Locals (Intrazonals)

The V/C ratios by time period were required for each link. Directional time period link volumes were calculated by multiplying the associated directional link-VMT[1] by the time period volume factor divided by the link distance. The directional time-period link capacities were calculated by multiplying the time period directional link capacity by the time period capacity factor (see Appendix D). The hourly capacity factors from each of the four time-of-day periods are calculated as the inverse of the hours within the time period. The capacity factors for each time

[1] From one of the 4 time of day directional assignments used.

period are the same for each area type and functional class. The time period link V/C ratios were then calculated by dividing the directional link volume by the directional link capacity.

To estimate the link freeflow and LOS E speeds, the link data input speeds (i.e., speeds used by the travel model to produce correct link volumes, not the operational speeds), indexed by functional group and area type, were multiplied by the pair of speed factors corresponding to each functional group and area type. These speed factors were developed by dividing the distance-weighted average link input speeds (Table 7) into the average modeled freeflow speeds (V/C = 0.0), and the average modeled LOS E speeds (V/C = 1.0). The average freeflow and LOS E speeds are affected by the coded link-speed limits. For the 55 mph maximum speed limit scenario, the speed limit was reduced to 55 mph for all links with a speed limit greater than 55 mph. Tables 8 and 9 show the freeflow and LOS E speeds, respectively, used to produce the current speed limit scenario speed factor inputs to the Houston Speed model. Tables 10 and 11 show the freeflow and LOS E speeds, respectively, used to produce the maximum 55 mph speed limit scenario speed factor inputs to the Houston Speed model. The estimated link freeflow and LOS E speeds were assumed the same in each direction. The calculated freeflow and LOS E speed factors input for the two speed limit analyses are shown in Appendix D.

The speed model (for V/C ratios from 0.00 to 1.00) is expressed as:

$$S_{V/C} = S_{0.0} - SRF_{V/C} \times (S_{0.0} - S_{1.0})$$

where:

$S_{V/C}$ = estimated directional speed for the forecast V/C ratio on the link in the subject direction;

$S_{0.0}$ = estimated freeflow speed for V/C ratio equal to 0.0;

$S_{1.0}$ = estimated LOS E speed for V/C ratio equal to 1.0; and

$SRF_{V/C}$ = speed reduction factor for the V/C ratio on the link. The V/C ratio can be 0.0 to 1.0. See four SRF plots in Appendix D.

For V/C ratios greater than 1.0, the model extension discussed below is used. The speed extension model used for V/C > 1.0 is:

$$S_{V/C} = S_{1.0} \times (1.15/(1.0 + (0.15 \times (V.C)^4)))$$

where:

$S_{v/c}$ = estimated directional speed for the forecast V/C ratio on the link in the subject direction;

$S_{1.0}$ = estimated LOS E speed for the V/C ratio equal to 1.0; and

V/C = the forecast V/C ratio on the link. The V/C ratio can be 1.0 to 1.5. For V/C ratios greater than 1.5, the speed is computed for the V/C ratio of

1.5.

These models were applied, dependent on the link V/C ratio, to estimate the speeds at the link level for freeways, arterials, and collectors.

Table 7
Distance-Weighted Average Input Speeds

Area Type	Functional Group				
	1	2	3	4	5
	Freeways	Principal Arterials	Other Arterial	Collectors	Locals (Centroid Connectors)
CDB	38.84	17.10	16.28	19.24	10.33
Urban	45.61	30.97	29.10	29.26	18.56
Urban Fringe	50.55	35.18	33.13	32.42	20.78
Suburban	55.14	38.91	36.20	32.48	25.15
Rural	58.75	50.64	48.12	38.66	37.46

Table 8
Speeds Used for Calculating Freeflow (V/C = 0) Speed Factor
Scenario: Current Speed Limits

Area Type	Functional Group				
	1	2	3	4	5
	Freeways	Principal Arterials	Other Arterial	Collectors	Locals (Centroid Connectors)
CDB	55.52	22.33	23.10	20.50	10.33
Urban	60.95	28.50	26.33	22.95	18.56
Urban Fringe	62.34	35.93	30.38	25.68	20.78
Suburban	67.83	44.67	40.85	42.37	25.15
Rural	70.99	65.21	61.74	53.61	37.46

Table 9
Speeds Used for Calculating LOS E (V/C = 1) Speed Factor
Scenario: Current Speed Limits

Area Type	Functional Group				
	1	2	3	4	5
	Freeways	Principal Arterials	Other Arterial	Collectors	Locals (Centroid Connectors)
CDB	34.34	13.68	14.88	12.16	10.33
Urban	35.06	20.65	19.83	16.43	18.56
Urban Fringe	39.87	27.81	23.41	20.37	20.78
Suburban	49.74	34.78	31.32	32.91	25.15
Rural	50.15	53.17	51.81	45.84	37.46

Table10
Speeds Used for Calculating Freeflow (V/C = 0) Speed Factor
Scenario: Max Speed Limit 55 mph

Area Type	Functional Group				
	1	2	3	4	5
	Freeways	Principal Arterials	Other Arterial	Collectors	Locals (Centroid Connectors)
CBD	53.88	22.33	23.10	20.50	10.33
Urban	57.39	28.50	26.32	22.95	18.56
Urban Fringe	57.13	35.71	30.34	25.64	20.78
Suburban	58.70	43.62	40.09	42.11	25.15
Rural	60.38	57.09	56.51	52.07	37.46

TABLE 11
Speeds Used for Calculating LOS E (V/C = 1) Speed Factor
Scenario: Max Speed Limit 55 mph

Area Type	Functional Group				
	1	2	3	4	5
	Freeways	Principal Arterials	Other Arterial	Collectors	Locals (Centroid Connectors)
CBD	34.34	13.68	14.88	12.16	10.33
Urban	35.06	20.65	19.83	16.43	18.56
Urban Fringe	39.85	27.67	23.39	20.35	20.78
Suburban	49.69	34.07	30.82	32.76	25.15
Rural	50.15	47.42	47.95	44.68	37.46

Capacity data are not used, however, for the centroid connector and intrazonal functional classifications that comprise the locals road type. The centroid connector traffic assignment input speeds were thus 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 were provided electronically to TNRCC (see Appendix A for electronic data descriptions).

ESTIMATION OF VMT MIX

VMT mix was estimated using TxDOT weekday vehicle classification data for 1997 - 2000. As was the case with the seasonal adjustment factor and VMT estimation procedure, these data were aggregated to the HGA region (i.e., all eight HGAC counties).

TxDOT classification counts classify vehicles into the standard FHWA vehicle classifications (which are 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
SD6	Six-axle multi-trailer vehicles
SD7	Seven or more axle multi-trailer vehicles

EPA and MOBILE use a different vehicle classification scheme than the FHWA categories. There are 28 vehicle categories defined as a function of gross vehicle weight rating (GVWR) and fuel type. (See Table 12.) The FHWA axle/vehicle length based classification categories must be converted into 28 MOBILE GVWR/fuel type based categories.

Table 12
EPA MOBILE6 Vehicle Types

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

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

PV	C + P
HDV	SU2 + SU3 + SU4 + SE4 + 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 county registration data.

LDV	0.712 × PV (Harris County 2000 registration data shown)
LDT	0.288 × PV (Harris County 2000 registration data shown)

A third intermediate allocation further separates light-duty trucks into LDT1 and LDGT2. (Note that LDT1 is itself intermediate and is further divided into LDGT1 and LDDT.)

LDT1	0.842 × LDT (Harris County 2000 registration data shown)
LDGT2	0.158 × LDT (Harris County 2000 registration data shown)

Next, the remaining FHWA categories and this intermediate group are disaggregated into the eight EPA vehicle groups, as shown. Note that TxDOT vehicle classification count procedures do not distinguish between gasoline and diesel light-duty trucks consequently, MOBILE defaults for the year of interest are used. As before, actual Texas county 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	0.9977179 × LDV (MOBILE6 default for 2000 shown)
LDDV	0.0022821 × LDV (MOBILE6 default for 2000 shown)
LDGT1	0.9944118 × LDT1 (MOBILE6 default for 2000 shown)
LDDT	0.0055882 × LDT1 (MOBILE6 default for 2000 shown)
LDGT2	0.158 × LDT (Harris County 2000 registration data shown, as above)
HDGV	0.369 × HDV (Harris County 2000 registration data shown)
HDDV	0.631 × HDV (Harris County 2000 registration data shown)
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 can be summarized schematically. Starting with the TxDOT vehicle classification data. These date themselves provide sufficient information to complete the first step in the conversion process, the allocation of vehicles into passenger vehicles (PV) and heavy duty vehicles (HDV). Steps 2 and 3 further allocate these categories using county 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 13).

Table 13
Initial Vehicle Classification Conversion Procedure

<table>
<tr><th>Start</th><th>Step 1</th><th>Step 2</th><th>Step 3</th><th>Step 4</th></tr>
<tr><td rowspan="8">Total Vehicles</td><td rowspan="5">PV</td><td rowspan="3">LDV</td><td rowspan="2">LDGV</td><td>MC</td></tr>
<tr><td>LDGV</td></tr>
<tr><td colspan="2">LDDV</td></tr>
<tr><td rowspan="3">LDT</td><td rowspan="2">LDT1</td><td>LDGT1</td></tr>
<tr><td>LDDT</td></tr>
<tr><td colspan="2">LDGT2</td></tr>
<tr><td rowspan="2">HDV</td><td colspan="3">HDGV</td></tr>
<tr><td colspan="3">HDDV</td></tr>
</table>

MOBILE6 requires 28 vehicle classification categories (as opposed to the eight in MOBILE5). The 28-category typology is a subset of the eight category typology. A combination of EPA MOBILE6 defaults and Texas vehicle registration data are used to expand the basic EPA eight-category model. Thus, the procedures employed to expand the EPA eight-category scheme to the 28-category scheme are largely incremental extensions of the eight-category procedure, involving the disaggregation of the HDGV, LDGT, HDDV, and LDDT categories and the addition of three bus categories.

For the 28-category EPA scheme, heavy-duty vehicles (HDGV and HDDV) are separated into eight categories each. These 16 categories are separated from total heavy-duty vehicle counts (HDV) which have been separated by fuel type using county registration data. Each HDV category (HDGV and HDDV) is then divided into sub-categories based on regionally grouped TxDOT county vehicle registration data.

The 28-category EPA scheme also further divides the two light-duty truck 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. Adjusted loaded vehicle weight 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 light-duty truck 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;

- LDGT2 - Light light-duty trucks greater than 3,750 pounds loaded vehicle weight;
- LDGT3 - Heavy light-duty trucks to 5,750 pounds adjusted loaded vehicle weight; and
- LDGT4 - Heavy light-duty trucks greater than 5,750 pounds adjusted loaded vehicle weight.

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 forecasted. For future VMT mix estimates MOBILE6 default values consistent with the future year are used (i.e., 2007). No other adjustments are made to alter the count data and conversion procedure to accommodate future years. Table 14 shows the VMT mix estimation procedure summary. Tables 15 through 18 show the Weekday, Friday, Saturday, and Sunday VMT mixes developed for and applied in this emissions analysis.

Table 14
VMT Mix Estimation Procedure Summary

EPA-8	EPA-28	Conversion
LDGV	LDGV	.9977 * LDV
LDGT1	LDGT1	.2310 * LLDT
	LDGT2	.7690 * LLDT
LDGT2	LDGT3	.6850 * HDLT
	LDGT4	.3150 * HDLT
HDGV	HDGV2b	.513 * HDGV
	HDGV3	.193 * HDGV
	HDGV4	.089 * HDGV
	HDGV5	.038 * HDGV
	HDGV6	.092 * HDGV
	HDGV7	.037 * HDGV
	HDGV8a	.034 * HDGV
	HDGV8b	.004 * HDGV
	HDGB	.2045 * B
LDDV	LDDV	.0023 * LDV
LDDT	LDDT12	.1623 * LDDT
	LDDT34	.8377 * LDDT
HDDV	HDDV2b	.253 * HDDV
	HDDV3	.132 * HDDV
	HDDV4	.077 * HDDV
	HDDV5	.050 * HDDV
	HDDV6	.159 * HDDV
	HDDV7	.105 * HDDV
	HDDV8a	.178 * HDDV
	HDDV8b	.046 * HDDV
	HDDBT	.3253 * B
	HDDBS	.4702 * B
MC	MC	MC

Notes to Procedure Summary

Intermediate category factors and sources:

LDV	.712 * PV (by county, Harris County 2000 registration data shown)
LDT	.288 * PV (by county, Harris County 2000 registration data shown)
LDT1	.842 * LDT (by county, Harris County 2000 registration data shown)
HLDT	.158 * LDT (by county, Harris County 2000 registration data shown)
LLDT	.9944 * LDT1 (EPA MOBILE6 default)
LDDT	.0056 * LDT1 (EPA MOBILE6 default)
HDV	SU2+SU3+SU4+SE3+SE4+SE5+SE6+SD5+SD6+SD7
HDGV	.369 * HDV (by county, Harris County 2000 registration data shown)
HDDV	.631 * HDV (by county, Harris County 2000 registration data shown)

Category conversion factors and sources:

LDGV	.9977 * LDV (EPA MOBILE6 default)
LDGT1	.2310 * LLDT (EPA MOBILE6 default)
LDGT2	.7690 * LLDT (EPA MOBILE6 default)
LDGT3	.6850 * HLDT (EPA MOBILE6 default)
LDGT4	.3150 * HLDT (EPA MOBILE6 default)
HDGV2a	.513 * HDGV (Regional registration data)
HDGV3	.193 * HDGV (Regional registration data)
HDGV4	.089 * HDGV (Regional registration data)
HDGV5	.038 * HDGV (Regional registration data)
HDGV6	.092 * HDGV (Regional registration data)
HDGV7	.037 * HDGV (Regional registration data)
HDGV8a	.034 * HDGV (Regional registration data)
HDGV8b	.004 * HDGV (Regional registration data)
HDGB	.2045 * B (EPA MOBILE6 default)
LDDV	.0023 * LDV (EPA MOBILE6 default)
LDDT12	.1623 * LDDT (EPA MOBILE6 default)
LDDT34	.8377 * LDDT (EPA MOBILE6 default)
HDDV2b	.253 * HDDV (Regional registration data)
HDDV3	.132 * HDDV (Regional registration data)
HDDV4	.077 * HDDV (Regional registration data)
HDDV5	.050 * HDDV (Regional registration data)
HDDV6	.159 * HDDV (Regional registration data)
HDDV7	.105 * HDDV (Regional registration data)
HDDV8a	.178 * HDDV (Regional registration data)
HDDV8b	.046 * HDDV (Regional registration data)
HDDBT	.3253 * B (EPA MOBILE6 default)
HDDBS	.4702 * B (EPA MOBILE6 default)
MC	MC (default subtracted from LDGV, no conversion)

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 extensive vehicle classification data collected in the Houston area over several years. 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.)

Table 15
HGA Weekday VMT Mix by Time Period and Roadway Functional Classification Group

OBS	TP	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	AM_Peak	Art	0.6284834	0.0573574	0.1909388	0.0344061	0.0158225	0.0118662	0.0044643	0.0020587	0.0008790
2	AM_Peak	Col	0.5418741	0.0689016	0.2293686	0.0459844	0.0211470	0.0156386	0.0058835	0.0027131	0.0011584
3	AM_Peak	Fway	0.6547442	0.0532028	0.1771084	0.0305745	0.0140604	0.0118251	0.0044488	0.0020515	0.0008759
4	Mid_Day	Art	0.5906814	0.0539217	0.1795015	0.0322802	0.0148448	0.0224853	0.0084594	0.0039010	0.0016656
5	Mid_Day	Col	0.5104779	0.0645886	0.2150109	0.0431111	0.0198257	0.0264665	0.0099572	0.0045916	0.0019605
6	Mid_Day	Fway	0.6203806	0.0505375	0.1682358	0.0291080	0.0133860	0.0211431	0.0079544	0.0036681	0.0015662
7	Ovr_Nite	Art	0.6266956	0.0574144	0.1911286	0.0343738	0.0158076	0.0125953	0.0047386	0.0021851	0.0009330
8	Ovr_Nite	Col	0.5584096	0.0710060	0.2363740	0.0473888	0.0217929	0.0111875	0.0042089	0.0019409	0.0008287
9	Ovr_Nite	Fway	0.6396560	0.0519800	0.1730379	0.0299057	0.0137529	0.0160085	0.0060227	0.0027773	0.0011858
10	PM_Peak	Art	0.6278859	0.0576569	0.1919359	0.0345920	0.0159080	0.0119659	0.0045018	0.0020759	0.0008864
11	PM_Peak	Col	0.5429039	0.0689983	0.2296904	0.0460495	0.0211770	0.0152871	0.0057513	0.0026522	0.0011324
12	PM_Peak	Fway	0.6541984	0.0534374	0.1778894	0.0308403	0.0141827	0.0118384	0.0044538	0.0020538	0.0008769

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	0.0021281	0.0008558	0.0007865	0.0000925	0.0006309	0.0000437	0.0107870	0.0056280	0.0032830	0.0021318
2	0.0028046	0.0011279	0.0010365	0.0001219	0.0005441	0.0000525	0.0133387	0.0069593	0.0040596	0.0026361
3	0.0021207	0.0008529	0.0007837	0.0000922	0.0006573	0.0000406	0.0102132	0.0053286	0.0031084	0.0020184
4	0.0040324	0.0016217	0.0014903	0.0001753	0.0005930	0.0000411	0.0202510	0.0105657	0.0061633	0.0040022
5	0.0047464	0.0019089	0.0017541	0.0002064	0.0005127	0.0000492	0.0228311	0.0119119	0.0069486	0.0045121
6	0.0037918	0.0015249	0.0014013	0.0001649	0.0006228	0.0000385	0.0182175	0.0095048	0.0055445	0.0036003
7	0.0022588	0.0009084	0.0008348	0.0000982	0.0006291	0.0000438	0.0115259	0.0060135	0.0035079	0.0022778
8	0.0020063	0.0008069	0.0007415	0.0000872	0.0005607	0.0000541	0.0096480	0.0050337	0.0029364	0.0019067
9	0.0028709	0.0011546	0.0010610	0.0001248	0.0006421	0.0000396	0.0139316	0.0072686	0.0042400	0.0027533
10	0.0021459	0.0008630	0.0007931	0.0000933	0.0006303	0.0000440	0.0108380	0.0056546	0.0032985	0.0021419
11	0.0027416	0.0011026	0.0010132	0.0001192	0.0005452	0.0000526	0.0131888	0.0068811	0.0040140	0.0026065
12	0.0021231	0.0008538	0.0007846	0.0000923	0.0006567	0.0000407	0.0102240	0.0053342	0.0031116	0.0020205

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0067792	0.0044768	0.0075893	0.0019613	0.0010000	0.0004000	0.0013912	0.0025038	0.0012548
2	0.0083828	0.0055358	0.0093846	0.0024252	0.0010000	0.0005973	0.0020774	0.0037388	0.0015073
3	0.0064186	0.0042387	0.0071856	0.0018569	0.0010000	0.0003752	0.0013049	0.0023485	0.0011639
4	0.0127269	0.0084045	0.0142477	0.0036820	0.0010000	0.0001939	0.0006745	0.0012139	0.0011796
5	0.0143484	0.0094754	0.0160630	0.0041511	0.0010000	0.0002028	0.0007054	0.0012696	0.0014130
6	0.0114490	0.0075606	0.0128171	0.0033123	0.0010000	0.0002202	0.0007658	0.0013782	0.0011056
7	0.0072435	0.0047835	0.0081091	0.0020956	0.0010000	0.0001436	0.0004995	0.0008989	0.0012560
8	0.0060634	0.0040041	0.0067879	0.0017542	0.0010000	0.0001787	0.0006213	0.0011182	0.0015534
9	0.0087554	0.0057819	0.0098017	0.0025330	0.0010000	0.0002401	0.0008349	0.0015025	0.0011371
10	0.0068113	0.0044980	0.0076252	0.0019706	0.0010000	0.0002722	0.0009466	0.0017036	0.0012613
11	0.0082886	0.0054736	0.0092791	0.0023980	0.0010000	0.0005723	0.0019903	0.0035820	0.0015094
12	0.0064253	0.0042431	0.0071931	0.0018589	0.0010000	0.0002885	0.0010034	0.0018058	0.0011690

Table 16
HGA Friday VMT Mix by Time Period and Roadway Functional Classification Group

OBS	TP	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	AM_Peak	Art	0.6777174	0.0527440	0.1755811	0.0318931	0.0146668	0.0067684	0.0025464	0.0011743	0.0005014
2	AM_Peak	Col	0.5958416	0.0646053	0.2150666	0.0434638	0.0199879	0.0090956	0.0034219	0.0015780	0.0006737
3	AM_Peak	Fway	0.7026576	0.0486901	0.1620859	0.0282061	0.0129713	0.0067128	0.0025255	0.0011646	0.0004972
4	Mid_Day	Art	0.6513588	0.0507039	0.1687896	0.0305979	0.0140712	0.0131150	0.0049341	0.0022753	0.0009715
5	Mid_Day	Col	0.5734541	0.0618676	0.2059529	0.0416270	0.0191432	0.0157252	0.0059161	0.0027282	0.0011648
6	Mid_Day	Fway	0.6788612	0.0471580	0.1569857	0.0273800	0.0125913	0.0122378	0.0046041	0.0021231	0.0009065
7	Ovr_Nite	Art	0.6763299	0.0528386	0.1758959	0.0318887	0.0146648	0.0071900	0.0027050	0.0012474	0.0005326
8	Ovr_Nite	Col	0.6075029	0.0658729	0.2192863	0.0443165	0.0203800	0.0064378	0.0024220	0.0011169	0.0004769
9	Ovr_Nite	Fway	0.6923770	0.0479800	0.1597220	0.0278263	0.0127966	0.0091657	0.0034483	0.0015902	0.0006789
10	PM_Peak	Art	0.6769742	0.0530117	0.1764723	0.0320608	0.0147439	0.0068243	0.0025674	0.0011839	0.0005055
11	PM_Peak	Col	0.5965946	0.0646550	0.2152318	0.0434977	0.0200035	0.0088855	0.0033429	0.0015415	0.0006582
12	PM_Peak	Fway	0.7019747	0.0488981	0.1627782	0.0284474	0.0130822	0.0067194	0.0025280	0.0011657	0.0004977

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	0.0012138	0.0004882	0.0004486	0.0000528	0.0006783	0.0000403	0.0072100	0.0037617	0.0021943	0.0014249
2	0.0016312	0.0006560	0.0006028	0.0000709	0.0005965	0.0000493	0.0090908	0.0047430	0.0027668	0.0017966
3	0.0012039	0.0004842	0.0004449	0.0000523	0.0007032	0.0000372	0.0067938	0.0035446	0.0020677	0.0013427
4	0.0023520	0.0009459	0.0008692	0.0001023	0.0006519	0.0000387	0.0138411	0.0072214	0.0042125	0.0027354
5	0.0028201	0.0011342	0.0010422	0.0001226	0.0005741	0.0000472	0.0158958	0.0082934	0.0048378	0.0031415
6	0.0021947	0.0008826	0.0008111	0.0000954	0.0006794	0.0000360	0.0123560	0.0064466	0.0037605	0.0024419
7	0.0012894	0.0005186	0.0004765	0.0000561	0.0006769	0.0000404	0.0077099	0.0040226	0.0023465	0.0015237
8	0.0011545	0.0004643	0.0004267	0.0000502	0.0006081	0.0000503	0.0065057	0.0033943	0.0019800	0.0012857
9	0.0016438	0.0006611	0.0006075	0.0000715	0.0006929	0.0000366	0.0093470	0.0048767	0.0028447	0.0018472
10	0.0012238	0.0004922	0.0004523	0.0000532	0.0006775	0.0000405	0.0072430	0.0037790	0.0022044	0.0014314
11	0.0015935	0.0006409	0.0005889	0.0000693	0.0005972	0.0000494	0.0089829	0.0046867	0.0027339	0.0017753
12	0.0012050	0.0004846	0.0004453	0.0000524	0.0007025	0.0000373	0.0068001	0.0035479	0.0020696	0.0013439

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0045312	0.0029923	0.0050726	0.0013109	0.0010000	0.0002282	0.0009299	0.0016735	0.0011557
2	0.0057132	0.0037728	0.0063959	0.0016529	0.0010000	0.0003474	0.0014158	0.0025481	0.0014156
3	0.0042696	0.0028196	0.0047799	0.0012352	0.0010000	0.0002130	0.0008680	0.0015622	0.0010669
4	0.0086986	0.0057443	0.0097380	0.0025166	0.0010000	0.0001131	0.0004610	0.0008297	0.0011110
5	0.0099898	0.0065971	0.0111836	0.0028901	0.0010000	0.0001205	0.0004911	0.0008839	0.0013556
6	0.0077653	0.0051280	0.0086932	0.0022466	0.0010000	0.0001275	0.0005194	0.0009348	0.0010333
7	0.0048454	0.0031998	0.0054244	0.0014018	0.0010000	0.0000820	0.0003341	0.0006013	0.0011578
8	0.0040886	0.0027000	0.0045772	0.0011829	0.0010000	0.0001028	0.0004190	0.0007540	0.0014434
9	0.0058742	0.0038792	0.0065761	0.0016995	0.0010000	0.0001374	0.0005601	0.0010081	0.0010513
10	0.0045519	0.0030060	0.0050959	0.0013169	0.0010000	0.0001552	0.0006326	0.0011385	0.0011616
11	0.0056454	0.0037281	0.0063200	0.0016333	0.0010000	0.0003326	0.0013556	0.0024397	0.0014167
12	0.0042736	0.0028222	0.0047842	0.0012364	0.0010000	0.0001638	0.0006673	0.0012010	0.0010714

Table 17
HGA Saturday VMT Mix by Time Period and Roadway Functional Classification Group

OBS	TP	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	AM_Peak	Art	0.7016430	0.0518543	0.1726192	0.0294437	0.0135404	0.0042605	0.0016029	0.0007392	0.0003156
2	AM_Peak	Col	0.6231489	0.0641598	0.2135834	0.0405328	0.0186400	0.0057834	0.0021758	0.0010034	0.0004284
3	AM_Peak	Fway	0.7257830	0.0477584	0.1589842	0.0259798	0.0119474	0.0042158	0.0015860	0.0007314	0.0003123
4	Mid_Day	Art	0.6842247	0.0505770	0.1683672	0.0286608	0.0131804	0.0083761	0.0031512	0.0014532	0.0006205
5	Mid_Day	Col	0.6084145	0.0623284	0.2074870	0.0393806	0.0181101	0.0101433	0.0038161	0.0017598	0.0007514
6	Mid_Day	Fway	0.7099857	0.0468340	0.1559072	0.0255342	0.0117425	0.0077816	0.0029276	0.0013500	0.0005764
7	Ovr_Nite	Art	0.7005012	0.0519691	0.1730013	0.0294519	0.0135442	0.0045278	0.0017034	0.0007855	0.0003354
8	Ovr_Nite	Col	0.6308416	0.0649558	0.2162333	0.0410356	0.0188712	0.0040645	0.0015292	0.0007052	0.0003011
9	Ovr_Nite	Fway	0.7190670	0.0473183	0.1575193	0.0257696	0.0118508	0.0057876	0.0021774	0.0010041	0.0004287
10	PM_Peak	Art	0.7007459	0.0521080	0.1734637	0.0295931	0.0136091	0.0042949	0.0016158	0.0007451	0.0003181
11	PM_Peak	Col	0.6236859	0.0641834	0.2136619	0.0405481	0.0186470	0.0056476	0.0021247	0.0009798	0.0004183
12	PM_Peak	Fway	0.7249718	0.0479553	0.1596400	0.0261982	0.0120479	0.0042193	0.0015874	0.0007320	0.0003125

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	0.0007641	0.0003073	0.0002824	0.0000332	0.0007030	0.0000395	0.0045380	0.0023676	0.0013811	0.0008968
2	0.0010372	0.0004171	0.0003833	0.0000451	0.0006244	0.0000489	0.0057798	0.0030156	0.0017591	0.0011423
3	0.0007560	0.0003041	0.0002794	0.0000329	0.0007271	0.0000364	0.0042662	0.0022259	0.0012984	0.0008431
4	0.0015021	0.0006041	0.0005551	0.0000653	0.0006856	0.0000385	0.0088390	0.0046116	0.0026901	0.0017468
5	0.0018191	0.0007316	0.0006723	0.0000791	0.0006097	0.0000475	0.0102524	0.0053491	0.0031203	0.0020262
6	0.0013955	0.0005612	0.0005157	0.0000607	0.0007113	0.0000357	0.0078561	0.0040988	0.0023910	0.0015526
7	0.0008120	0.0003266	0.0003001	0.0000353	0.0007018	0.0000396	0.0048547	0.0025329	0.0014775	0.0009594
8	0.0007289	0.0002932	0.0002694	0.0000317	0.0006321	0.0000495	0.0041070	0.0021428	0.0012500	0.0008117
9	0.0010379	0.0004174	0.0003836	0.0000451	0.0007204	0.0000360	0.0059015	0.0030790	0.0017961	0.0011663
10	0.0007702	0.0003098	0.0002847	0.0000335	0.0007021	0.0000397	0.0045580	0.0023781	0.0013872	0.0009008
11	0.0010128	0.0004073	0.0003743	0.0000440	0.0006250	0.0000489	0.0057089	0.0029786	0.0017375	0.0011282
12	0.0007567	0.0003043	0.0002796	0.0000329	0.0007263	0.0000365	0.0042695	0.0022276	0.0012994	0.0008438

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0028519	0.0018834	0.0031927	0.0008251	0.0010000	0.0001436	0.0005853	0.0010533	0.0011330
2	0.0036324	0.0023987	0.0040664	0.0010509	0.0010000	0.0002209	0.0009002	0.0016200	0.0014018
3	0.0026811	0.0017706	0.0030015	0.0007757	0.0010000	0.0001338	0.0005451	0.0009810	0.0010435
4	0.0055549	0.0036683	0.0062187	0.0016071	0.0010000	0.0000722	0.0002944	0.0005298	0.0011051
5	0.0064432	0.0042549	0.0072131	0.0018641	0.0010000	0.0000777	0.0003168	0.0005701	0.0013618
6	0.0049372	0.0032604	0.0055272	0.0014284	0.0010000	0.0000810	0.0003302	0.0005943	0.0010233
7	0.0030510	0.0020148	0.0034156	0.0008827	0.0010000	0.0000516	0.0002104	0.0003786	0.0011355
8	0.0025811	0.0017045	0.0028895	0.0007467	0.0010000	0.0000649	0.0002645	0.0004760	0.0014192
9	0.0037088	0.0024492	0.0041520	0.0010730	0.0010000	0.0000868	0.0003537	0.0006365	0.0010339
10	0.0028645	0.0018916	0.0032068	0.0008287	0.0010000	0.0000977	0.0003981	0.0007164	0.0011385
11	0.0035878	0.0023693	0.0040166	0.0010380	0.0010000	0.0002114	0.0008615	0.0015505	0.0014023
12	0.0026832	0.0017719	0.0030038	0.0007763	0.0010000	0.0001028	0.0004190	0.0007541	0.0010478

TABLE 18
HGA Sunday VMT Mix by Time Period and Roadway Functional Classification Group

OBS	TP	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2B	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	AM_Peak	Art	0.6615320	0.0617628	0.2056041	0.0336563	0.0154777	0.0028750	0.0010816	0.0004988	0.0002130
2	AM_Peak	Col	0.5793022	0.0753528	0.2508442	0.0456850	0.0210094	0.0038481	0.0014477	0.0006676	0.0002850
3	AM_Peak	Fway	0.6878006	0.0571753	0.1903326	0.0298488	0.0137267	0.0028593	0.0010757	0.0004961	0.0002118
4	Mid_Day	Art	0.6503704	0.0607321	0.2021729	0.0330282	0.0151888	0.0056982	0.0021438	0.0009886	0.0004221
5	Mid_Day	Col	0.5705941	0.0738468	0.2458308	0.0447774	0.0205920	0.0068086	0.0025615	0.0011812	0.0005043
6	Mid_Day	Fway	0.6773427	0.0564443	0.1878991	0.0295334	0.0135816	0.0053132	0.0019989	0.0009218	0.0003936
7	Ovr_Nite	Art	0.6604838	0.0619022	0.2060681	0.0336671	0.0154827	0.0030555	0.0011495	0.0005301	0.0002263
8	Ovr_Nite	Col	0.5840338	0.0759733	0.2529098	0.0460612	0.0211823	0.0026933	0.0010133	0.0004673	0.0001995
9	Ovr_Nite	Fway	0.6834544	0.0568161	0.1891367	0.0296949	0.0136559	0.0039370	0.0014812	0.0006830	0.0002916
10	PM_Peak	Art	0.6604009	0.0620382	0.2065209	0.0338125	0.0155495	0.0028969	0.0010899	0.0005026	0.0002146
11	PM_Peak	Col	0.5796827	0.0753651	0.2508849	0.0456930	0.0210130	0.0037570	0.0014135	0.0006518	0.0002783
12	PM_Peak	Fway	0.6867731	0.0573896	0.1910458	0.0300884	0.0138369	0.0028606	0.0010762	0.0004963	0.0002119

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	0.0005156	0.0002074	0.0001905	0.0000224	0.0006641	0.0000469	0.0030624	0.0015978	0.0009320	0.0006052
2	0.0006901	0.0002775	0.0002550	0.0000300	0.0005817	0.0000572	0.0038460	0.0020066	0.0011705	0.0007601
3	0.0005128	0.0002062	0.0001895	0.0000223	0.0006904	0.0000434	0.0028938	0.0015098	0.0008807	0.0005719
4	0.0010219	0.0004110	0.0003777	0.0000444	0.0006529	0.0000461	0.0060135	0.0031375	0.0018302	0.0011884
5	0.0012210	0.0004911	0.0004512	0.0000531	0.0005729	0.0000560	0.0068822	0.0035907	0.0020946	0.0013601
6	0.0009529	0.0003832	0.0003521	0.0000414	0.0006799	0.0000428	0.0053644	0.0027988	0.0016327	0.0010602
7	0.0005480	0.0002204	0.0002025	0.0000238	0.0006631	0.0000470	0.0032763	0.0017094	0.0009971	0.0006475
8	0.0004830	0.0001943	0.0001785	0.0000210	0.0005864	0.0000577	0.0027216	0.0014200	0.0008283	0.0005379
9	0.0007061	0.0002840	0.0002609	0.0000307	0.0006861	0.0000431	0.0040148	0.0020947	0.0012219	0.0007934
10	0.0005195	0.0002089	0.0001920	0.0000226	0.0006630	0.0000471	0.0030746	0.0016041	0.0009357	0.0006076
11	0.0006738	0.0002710	0.0002490	0.0000293	0.0005821	0.0000572	0.0037981	0.0019816	0.0011559	0.0007506
12	0.0005130	0.0002063	0.0001896	0.0000223	0.0006894	0.0000435	0.0028949	0.0015104	0.0008811	0.0005721

OBS	P_HDDV_6	P_HDDV_7	P_HDDV8A	P_HDDV8B	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.0019246	0.0012710	0.0021546	0.0005568	0.0010000	0.0000969	0.0003950	0.0007108	0.0013448
2	0.0024171	0.0015962	0.0027059	0.0006993	0.0010000	0.0001470	0.0005990	0.0010780	0.0016407
3	0.0018186	0.0012010	0.0020359	0.0005261	0.0010000	0.0000907	0.0003697	0.0006654	0.0012449
4	0.0037792	0.0024957	0.0042308	0.0010934	0.0010000	0.0000492	0.0002003	0.0003605	0.0013223
5	0.0043252	0.0028563	0.0048421	0.0012513	0.0010000	0.0000522	0.0002126	0.0003827	0.0016079
6	0.0033713	0.0022263	0.0037742	0.0009754	0.0010000	0.0000553	0.0002255	0.0004058	0.0012290
7	0.0020590	0.0013597	0.0023051	0.0005957	0.0010000	0.0000348	0.0001420	0.0002555	0.0013478
8	0.0017104	0.0011295	0.0019148	0.0004948	0.0010000	0.0000430	0.0001753	0.0003154	0.0016542
9	0.0025231	0.0016662	0.0028246	0.0007300	0.0010000	0.0000590	0.0002406	0.0004330	0.0012371
10	0.0019322	0.0012760	0.0021631	0.0005590	0.0010000	0.0000659	0.0002685	0.0004833	0.0013508
11	0.0023869	0.0015763	0.0026722	0.0006906	0.0010000	0.0001407	0.0005732	0.0010315	0.0016409
12	0.0018193	0.0012014	0.0020367	0.0005263	0.0010000	0.0000697	0.0002841	0.0005113	0.0012495

ESTIMATION OF EMISSIONS FACTORS

The MOBILE6 model was applied to calculate HGA 2007 county-specific emissions factors (g/mi) of VOC, CO, and NOx for each of the 11 analysis days by speed, emissions type (i.e., emissions factor subcomponent), hour, MOBILE6 road type, and vehicle type.

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. The 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 HGA August 2000 primary ozone episode climatic conditions, and a 2007 vehicle fleet, 2007 activity, and 2007 emissions control programs.

The following emissions factors documentation discusses the MOBILE6 input/output files, summarizes the control programs modeled, describes the classification-level of the applied MOBILE6 emissions factors, briefly describes all of the MOBILE6 commands that may affect emissions factor calculations, and identifies the commands that were applied. The non-default (i.e., local) inputs applied are identified as well as the EPA defaults used. The details of the development of the locality-specific inputs are provided. Also, the emissions factor post-processing procedures are described.

MOBILE6 Input and Output Files

The MOBILE6 commands and particular 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 POLFAC6 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 output tables. (RATEADJ6 and RATEADJV6 were applied to POLFAC6 output where post-processing of emissions factors was required, discussed later.) The final product of the emissions factor modeling is 88 emissions factor files (i.e., one hourly emissions factor table for each county for each day). (Daily 24-hour emissions factor tables were also produced for quality assurance purposes, but were not applied otherwise for this analysis.)

All of the MOBILE6 input files (command files and external data files) and output files (MOBILE6 emissions factor tables developed with POLFAC6, RATEADJ6, and RATEADJV6) were previously provided to TNRCC electronically (on CD-ROM). The CD-ROM volume names and MOBILE6 input and output file names are listed in Appendix A.

Control Programs Modeled (And Emissions Factor Post Processing Summary)

All federal motor vehicle control programs were modeled (this is the MOBILE6 default). Also modeled were the federal programs to offset heavy-duty diesel (HDDV) defeat device effects—the low emissions rebuild program, and the HDDV 2004 standard pull-ahead program (this is the

MOBILE6 default). The Reformulated Gasoline (RFG) program, the vehicle Inspections and Maintenance (I/M) programs, Anti-Tampering Programs (ATP), and the Texas Low-Emissions Diesel Fuel Program were modeled as well.

Post-processing of MOBILE6 emissions factors was required to properly model the ATP and I/M programs, as well as to model the impacts of the low-emissions diesel fuel. The limits of MOBILE6 as related to the ATP, I/M, and diesel fuel modeling requirements for this analysis, and the post-processing procedures applied to overcome these limits are discussed in more detail later.

Classification of MOBILE6 Emissions Factors

Each POLFAC6 emissions factor table, for a particular county and calendar day, provides the 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.

MOBILE6 vehicle type, roadway type, and emissions type classifications are described in Tables 19 through 21. Tables 22 and 23 show the speeds and sequence for hourly time periods, respectively.

The 28 MOBILE6 vehicle types as defined by fuel-type (gasoline or diesel) and GVWR category, are shown in sequence by EPA vehicle type number in Table 19.

Table 19
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 1and 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)

Source: MOBILE6 User's Guide (EPA, January 2002)

The eight MOBILE6 emissions type classifications are shown in Table 20. Expanding these emissions types by individual pollutant yields 12 pollutant-specific emissions types. In addition to

these 12 pollutant-specific emissions types, POLFAC6 emissions factor tables contain the three composite emissions factors (i.e., one for each pollutant). Thus, POLFAC6 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 accounted for as an area source emissions category.

Table 20
MOBILE6 Emission Type Classifications

Number	Abbreviation	Description	Pollutants	Vehicle Classes
1	Running	Exhaust Running Emissions	HC,CO,NO_x	All
2	Start	Exhaust Engine Start Emissions (trip start)	HC,CO,NO_x	LD plus MC
3	Hot Soak	Evaporative Hot Soak Emissions (trip end)	HC	Gas, inc. MC
4	Diurnal	Evaporative Diurnal Emissions (heat rise)	HC	Gas, inc. MC
5	Resting	Evaporative Resting Loss Emissions (leaks and seepage)	HC	Gas, inc. MC
6	Run Loss	Evaporative Running Loss Emissions	HC	Gas, less MC
7	Crankcase	Evaporative Crankcase Emissions (blow-by)	HC	Gas, inc. 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. The driving cycle (or roadway type) descriptions are provided in Table 17 (see numbers one through four). 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 POLFAC6 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 POLFAC6 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 POLFAC6 to facilitate the geographical allocation of the link-emissions estimates by the roadway link coordinates.

Table 21
MOBILE6 Roadway Classifications

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)

The 14 speeds for which the MOBILE6 freeway and arterial emissions factors are calculated and tabulated are presented in Table 22. Later in the emissions estimation process, emissions factors for average link speeds that are not represented in the 14 speeds as tabulated, are calculated by interpolation (except for those link 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 applied, respectively). The MOBILE6 Local and Ramp road type emissions factors are not speed sensitive and are each characterized by one average speed. (Although calculated and tabulated by POLFAC6, the single-speed Local and Ramp emissions factors are not applied in this analysis.)

Table 22
Speeds for POLFAC6 Tabulated MOBILE6 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

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.

For this analysis, hourly input values to MOBILE6 are representative of the calendar day. The hourly temperature inputs for each MOBILE6 run, for instance, are from one calendar day, as opposed to values spanning two days from 6 a.m. on one day to 6 a.m. on the next day. Table 23 shows the MOBILE6 sequence for hourly inputs and the resulting chronological order for calendar day hourly input as applied for this analysis.

TABLE 23
General Sequence for Calendar Day Hourly* Inputs to MOBILE6

MOBILE6 Input Sequence Number	Abbreviation	Description	Chronological Order
1	6 a.m.	6 a.m. through 6:59 a.m.	7
2	7 a.m.	7 a.m. through 7:59 a.m.	8
3	8 a.m	8 a.m. through 8:59 a.m.	9
4	9 a.m.	9 a.m. through 9:59 a.m.	10
5	10 a.m.	10 a.m. through 10:59 a.m.	11
6	11 a.m.	11 a.m. through 11:59 a.m.	12
7	12 Noon	12 p.m. through 12:59 p.m.	13
8	1 p.m.	1 p.m. through 1:59 p.m.	14
9	2 p.m.	2 p.m. through 2:59 p.m.	15
10	3 p.m.	3 p.m. through 3:59 p.m.	16
11	4 p.m.	4 p.m. through 4:59 p.m.	17
12	5 p.m.	5 p.m. through 5:59 p.m.	18
13	6 p.m.	6 p.m. through 6:59 p.m.	19
14	7 p.m.	7 p.m. through 7:59 p.m.	20
15	8 p.m.	8 p.m. through 8:59 p.m.	21
16	9 p.m.	9 p.m. through 9:59 p.m.	22
17	10 p.m.	10 p.m. through 10:59 p.m.	23
18	11 p.m.	11 p.m. through 11:59 p.m.	24
19	12 Midnight	12 a.m. through 12:59 a.m.	1
20	1 a.m.	1 a.m. through 1:59 a.m.	2
21	2 a.m.	2 a.m. through 2:59 a.m.	3
22	3 a.m.	3 a.m. through 3:59 a.m.	4
23	4 a.m.	4 a.m. through 4:59 a.m.	5
24	5 a.m.	5 a.m. through 5:59 a.m.	6

* For some MOBILE6 hourly input parameters, overnight hours are grouped.

Application of MOBILE6 Commands and Associated Input Parameters
All of the MOBILE6 commands that may affect calculation of emissions factors (excluding commands such as those that affect only the output format or content) are listed and described in the Tables 24 through 29. Respectively, these six tables are: MOBILE6 External Conditions,

MOBILE6 Vehicle Fleet Characteristics, MOBILE6 Activity, MOBILE6 State Programs, MOBILE6 Fuel, and MOBILE6 Alternative Emissions Regulations and Control Measures.

In these tables, parameters associated with each MOBILE6 command are labeled as either EPA default, locality-specific, NOT APPLIED, or are otherwise described. The tabulated commands where the associated input parameters are labeled only as "EPA default" are not input for this analysis—MOBILE6 does not require a user-input command to apply these MOBILE6 default values.

The procedures used to develop the locality-specific inputs to MOBILE6 are detailed following the six MOBILE6 input category tables.

Table 24
MOBILE6 External Conditions

Command	Function/Description	Input Parameter Values
CALENDAR YEAR	Identifies calendar year for which emissions factors are to be calculated. (**Required** to run model).	**2007**
EVALUATION MONTH	Provides option of calculating January 1 or July 1 emission factors for the 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.)	**Locality Specific**. Hourly, by county for each episode day from the August 2000 ozone episode.
ALTITUDE	Specifies high - or low-altitude for modeling area.	**EPA default** (low altitude).
ABSOLUTE HUMIDITY	Used to specify daily average humidity (which 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.	**Locality Specific**. One daily absolute humidity value in terms of grains of water per pound of dry air, by county and episode day from the August 2000 episode.

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.	**EPA default**.
PEAK SUN	Specifies midday hours with peak sun intensity.	**EPA default**.
SUNRISE/SUNSET	Allows user to specify time of sunrise, sunset.	**Locality Specific**. (from August 2000 episode analysis)

Table 25
MOBILE6 Vehicle Fleet Characteristics

Command	Function/Description	Input Parameter Values
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**. July 2001 TxDOT registrations (as used for the August 2000 ozone episode emissions analysis) are applied except for buses for which MOBILE6 default is used.
DIESEL FRACTIONS	Permits user to supply locality specific diesel fractions for 14 of the 16 composite vehicle categories by age.	**Locality Specific/EPA default**. TxDOT registrations specify gasoline and diesel for eight HDV classes. HDVDiesel fractions applied for the August 2000 analysis were adjusted and applied for 2007. EPA defaults are applied for the other six classes.
MILE ACCUM RATE	Allows the user to supply the annual mileage accumulation rates by vehicle type and age.	**EPA default**.
NGV FRACTION	Lets user specify percent of natural gas vehicles in the fleet by type and age certified to operate on either compressed or liquefied natural gas.	**EPA default**. The EPA default percentage of NGV vehicles in the fleet is zero.
NGV EF	Permits the user to enter alternate NGV emission factors for each of the 28 vehicle types, for running and start emissions.	**EPA default**. EPA default is none.

Table 26
MOBILE6 Activity

Command	Function/Description	Input Parameter Values
VMT FRACTIONS	Used in MOBILE6 to weight the emissions of various vehicle types into average rates for groupings of vehicle classes.	**POST-PROCESSED.** VMT mix fractions are applied to link-VMT later in the emissions estimation process.
VMT BY FACILITY	VMT fractions by MOBILE6 road types are used to combine the four individual road type emissions factors into the "all road types" emissions factors.	**Locality Specific**. Not used for hourly emissions estimates; developed and applied to produce "all road types" daily emissions factors for QA checks against hourly results.
VMT BY HOUR	Lets user allocate VMT fractions by hour of day; applied in conversion of g/hr to g/mi, as well as in weighting of hourly g/mi rates to get daily emissions factors.	**Locality specific**. This input, total VMT fractions by hour, was produced from PREPIN output (post-processed travel model output) for application at the county level.
SPEED VMT	Allows user to allocate VMT by average speed (14 preselected: 2.5 and 5 through 65 at 5 mph increments) for arterials and freeways for each hour of the day.	Internally applied by POLFAC6 for the calculation of emissions factors by the 14 MOBILE6 speeds for individual MOBILE6 freeway and arterial road types.
AVERAGE SPEED	Allows a single average speed for combined freeways and arterial 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.	**EPA default**. Used weekday and weekend specific values.
START DIST	Allows user to allocate engine starts by hour of the day for weekend days and weekdays.	**EPA default**. Used weekday and weekend values.
SOAK DISTRIBU-TION	Allows the user to enter alternate vehicle soak duration distributions for weekend days and weekdays.	**EPA default**. Used weekday and weekend values.
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.	**EPA default**. Used weekday and weekend values.
DIURN SOAK ACTIVITY	Lets user set diurnal soak time distributions for each of 18 daily time periods.	**EPA default**.
WE DA TRI LEN DI	Specifies alternate fractions of VMT that occur during trips of various durations at each hour of the average weekday.	**Locality Specific**. Used latest distributions developed by HGAC.
WE EN TRI LEN DI	Specifies hourly alternate fractions of VMT for trips of various lengths for weekend days.	**NOT APPLIED**. Used HGAC weekday distributions for all days.

Command	Function/Description	Input Parameter Values
WE VEH US	Lets user to direct MOBILE6 to use weekend activity data for calculating emissions factors.	Applied this command for weekend day analyses (i.e., August 26, and 27).

Table 27
MOBILE6 State Programs

Command	Function/Description	Input Parameter Values
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 anti-tampering program (ATP).	**Locality Specific**. Program design, by county.
I/M Commands:		**Locality Specific**. Program design, by county.
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. Don't 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). Don't use with evap.	
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. Don't use with evaporative.	
I/M EFFECTIVENESS	Optional for exhaust. Don't use with evaporative.	
I/M DESC FILE	Optional for both.	

Table 28
MOBILE6 Fuels

Command	Function/Description	Input Parameter Values
FUEL PROGRAM	Allows users to specify: **1)** Conventional Gasoline East Tier 2 sulfur phase-in schedule (includes Texas), **2)** Reformulated Gasoline (RFG), **3)** Conventional Gasoline West Tier 2 sulfur geographical phase-in area (GPA) schedule (not applicable to Texas), or **4)** sulfur content for gasoline after 1999.	**Option 2.** Applied RFG (EPA parameters) for the southern volatility region. This option overrides the FUEL RVP command input.
SULFUR CONTENT	Allows user to apply alternate sulfur content to conventional gasoline through calendar year 1999.	**NOT APPLIED**. For pre-2000 years of evaluation only.
OXYGENATED FUELS	Permits the user to model the effects of oxygenated gasoline on exhaust emissions for all gasoline-fueled vehicle types.	**NOT APPLIED**. See FUEL PROGRAM, above.
FUEL RVP	Allows user to specify fuel RVP for area being modeled (**required** to run model).	**Locality Specific**. 2007 EPA summer RFG southern region default (6.8 psi).
SEASON	Identifies effective season for RFG calculation regardless of month modeled.	**EPA Default**. EPA default is summer for July month of evaluation.

Table 29
MOBILE6 Alternative Emissions Regulations and Control Measures

Command	Function/Description	Input Parameter
NO CLEAN AIR ACT	Models vehicle emissions as if the Federal Clean Air Act Amendments of 1990 had not been implemented.	**NOT APPLIED**
HDDV NOx Off-Cycle Emissions Effects:		
NO DEFEAT DEVICE	Turns off the effects of the HDD vehicle NOx off-cycle emission effects (defeat device emissions).	**NOT APPLIED**
NO NOX PULL AHEAD	Turns off HDD NOx emission reduction effects of Pull Ahead program.	**NOT APPLIED**
NO REBUILD	Turns off HDD NOx emission reduction effects of Rebuild program.	**NOT APPLIED**
REBUILD EFFECTS	Lets user change Rebuild program effectiveness rate.	**EPA Default** (0.90 command file input)
Tier 2 Emission Standards and Fuel Requirements:	Allow the overriding of the default Tier 2 emissions standards and fuel requirements settings.	**NOT APPLIED**
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 evap. standard phase-in schedules.	
T2 CERT	Lets user specify alternate Tier 2 50,000 mile certification standards.	
94+ LDG IMPLEMENTATON	Allows use of alternate 1994 and later fleet penetration fractions for light-duty gasoline vehicles under the Tier 1, NLEV (or California LEV 1), and Tier 2 emission standard programs.	**NOT APPLIED**
NO 2007 HDDV RULE	Disables 2007 heavy duty vehicle emission standards.	**NOT APPLIED**

External Conditions – Locality Specific Inputs to MOBILE6

MOBILE6 local inputs for hourly temperatures, daily average humidity, and sunrise and sunset times were developed and applied by calendar day based on local (central daylight) time. TNRCC developed the values and TTI formatted them for input to MOBILE6. These are the same MOBILE6 inputs that were used in developing the August 2000 base-case ozone episode on-road mobile source emissions inventories (developed previously under this task).

Temperatures (HOURLY TEMPERATURES Command)

TNRCC developed ambient hourly temperatures (degrees Fahrenheit) for input to MOBILE6 by county for each of the analysis days, August 22, 2000 to September 1, 2000. The temperatures are hourly averages from monitoring stations within the HGA counties. TNRCC obtained the monitoring data from the EPA Aerometric Information Retrieval System, the National Weather

Service, and TNRCC Monitoring Operations. Each county with more than one monitoring station uses the hourly average temperatures from the monitoring stations within its border. Counties without monitoring stations (Fort Bend, Liberty, and Waller), use average hourly temperatures from monitoring stations from adjacent counties.

The MOBILE6 User's Guide states that the 24 hourly temperature inputs are to be entered from 6 a.m. continuing through 5 a.m. of the "next day." The emissions estimation method applied by TTI, however, applies the hourly input data by "calendar day." This calendar day method simplifies the emissions estimation process, especially when modeling consecutive calendar days exhibiting different hourly travel activity. Thus, the hourly average temperatures for each calendar day provided by TNRCC were sequenced starting with 6 a.m. through 11 p.m. followed by 12 a.m. through 5 a.m. of the same calendar day.

Modeling eight counties for 11 days results in 88 hourly temperature datasets. The temperatures are input in the MOBILE6 command file. A summary of the temperatures used are found in Appendix E.

Humidity (ABSOLUTE HUMIDITY Command)
The ABSOLUTE HUMIDITY command was applied to specify a daily average humidity value for each of the analysis days. The units for absolute humidity are grains of water per pound of dry air.

TNRCC developed and provided the average daily humidity inputs by county for each day for input to MOBILE6. Hourly relative humidity, barometric pressure, and temperature data were required to develop the absolute humidity input. In counties where no barometric or relative humidity data were available, data from adjacent counties were applied. Special care was taken to ensure that the absolute humidity value and the temperature range for each day would not result in a relative humidity exceeding 100 percent.

The humidity value is input in the MOBILE6 command file. The 88 humidity values used (one per county per day) 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. TNRCC provided the sunrise and sunset times which are the same for all counties and days. The times are 7 a.m. and 8 p.m. central daylight time.

Vehicle Fleet Characteristics – Locality Specific Inputs to MOBILE6
County-specific vehicle registration (age) distributions and diesel fractions inputs to MOBILE6 were developed for vehicle types for which TxDOT registrations data were available.

The county-specific age distributions developed for the HGA 2000 ozone episode base-case emissions estimates were applied for this 2007 analysis. The county-specific diesel fractions for 2007 were forecasted from the diesel fractions developed for the 2000 ozone episode base-case emissions analysis by assuming that the most recent fractions, by vehicle type, were the same for the future years (mid-year 2001 fractions were applied to 2002 through 2007).

Vehicle Registration Distributions (REG DIST Command)

The user-supplied vehicle registration distributions input to MOBILE6 are by vehicle age for any of the 16 composite (combined gas and diesel) vehicle types as shown in Table 30. EPA default distributions are internally applied by MOBILE6 for vehicle classes for which 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.

Table 30
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)

* ALVW = Alternative Loaded Vehicle Weight: The adjusted loaded vehicle weight is the numerical average of the vehicle curb weight and the gross vehicle weight rating (GVWR).
Source: MOBILE6 User's Guide (EPA, January 2002)

TTI developed county-specific MOBILE6 age distributions fractions input 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 three datasets provided by TxDOT. The TxDOT registrations data provided are summarized as:

- July 2001 registrations for:
  LDV, LDT12, LDT34, MC, HDGT, HDDT;
- February 2002 registrations for:
  gas: HDV2B, HDV3, HDV4, HDV5, HDV6, HDV7, HDV8A, HDV8B; and
- February 2002 registrations for:
  diesel: HDV2B, HDV3, HDV4, HDV5, HDV6, HDV7, HDV8A, HDV8B.

The July 2001 registration totals 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 February 2002 HDV totals for gasoline and diesel class registrations are subsets of the July 2001 total HDGT and total HDDT classes, respectively, and correspond to the HDV weight classes for numbers six through 13 in Table 30.

There were four main steps to developing the county-specific MOBILE6 registration distribution inputs for the 14 non-bus vehicle classes. The first step in the process transforms the 16 HDV (eight gasoline and eight diesel) February 2002 registrations to estimated July, 2001 registrations. The next step results in July 2001 registrations by the 25 age groups for 12 of the 16 composite (by fuel) vehicle classes (eight HDV, LDV, LDT12, LDT34, MC). The third step converts the registrations from numbers of vehicles registered, to fractions registered by age for each of the 12 classes. The registrations are then expanded from 12 classes to 14.

To estimate July 2001 HDV registrations from the 2002 HDV registrations data, the 2002 registrations were dropped from the data set and the mid-year scaling factors were then applied to the resulting approximated end-of-year 2001 HDV registrations. These scaling factors (one each for the gasoline and diesel registrations) were developed from the HDGT and HDDT registrations from the mid-year 2001 data; the scaling factors are current year (July 2001) registrations divided by total registrations. The July 2001 scaling factors were then applied to the 2001 (approximated end-of-year) individual eight HDV class registrations, as appropriate by fuel type, to obtain the mid-year 2001 registrations estimates for the 16 HDV fuel-type specific classes. No vehicle scrappage estimates or vehicle migration estimates were made for the period from July 2001 to February 2002.

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 1977 and older registrations were summed to yield the “age 25 and older” registrations for the 12 composite vehicle classes: eight HDVs, LDV, LDT12, LDT34, and MC. (The HDGT and HDDT registrations from the July 2001 original data set were not used.)

Conversion of the registrations from numbers of vehicles to fractions of vehicles by age was performed 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 2001 estimated county-specific registration distribution fractions for the 12 composite classes were expanded to 14 classes: LDV, LDT1, LDT2, LDT3, LDT4, MC, HDV2B, HDV3, HDV4, HDV5, HDV6, HDV7, HDV8A, HDV8B. The LDT12 age fractions, were used for both the MOBILE6 LDT1 and LDT2 classes and the LDT34 age fractions were used in MOBILE6 for both the LDT3 and LDT4 classes. The MOBILE6 vehicle registration

distributions are input from external data files. A total of eight data sets (external data files) were developed, one per county for the evaluation year.

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 diesel fractions are entered by the user, 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 to be the same as the 1972 model year fractions. For the 1997 and later model years, the default diesel fractions are assumed to be the same as the 1996 model year fractions.

TTI used a combination of estimated county-specific diesel fractions and EPA default diesel fractions to model the 2007 attainment year emissions factors. Table 31 shows the MOBILE6 diesel fractions input categories and the data source for the fractions for this analysis were derived from. The county specific diesel fraction estimates were calculated based on TxDOT individual diesel and gasoline vehicle registrations for the eight HDV (HDV2b through HDV8b) weight classes, as shown in Table 31. As discussed previously, these TxDOT registrations data were adjusted to represent registrations as of July, 2001 (see registrations distributions discussion). To obtain the county-specific HDV diesel fractions by model year, the diesel registrations were divided by the sum of the gasoline and diesel registrations. This calculation was performed by county, HDV composite vehicle class, and model year.

The HDV diesel fractions (derived from estimated mid-year 2001 county-specific HDV registration distributions) were forecast from 2001 to 2007 by applying the latest diesel fraction (2001) to each of the future years (2002 through 2007). These estimated 2007 HDV diesel fractions were then combined with the July 2007 EPA default diesel fractions for the remaining vehicle classes, formatted for input to MOBILE6, and applied as the 2007 future case episode modeling emissions inventories HGA fleet diesel fractions. Diesel fractions are entered in the MOBILE6 command file. A total of eight diesel fractions data sets were developed, one per county for the evaluation year.

Table 31
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 February, 2002 Registrations
7	HDV3	Class 3 Heavy-Duty Vehicles	TxDOT February, 2002 Registrations
8	HDV4	Class 4 Heavy-Duty Vehicles	TxDOT February, 2002 Registrations
9	HDV5	Class 5 Heavy-Duty Vehicles	TxDOT February, 2002 Registrations
10	HDV6	Class 6 Heavy-Duty Vehicles	TxDOT February, 2002 Registrations
11	HDV7	Class 7 Heavy-Duty Vehicles	TxDOT February, 2002 Registrations
12	HDV8A	Class 8a Heavy-Duty Vehicles	TxDOT February, 2002 Registrations
13	HDV8B	Class 8b Heavy-Duty Vehicles	TxDOT February, 2002 Registrations
14	HDBS	School Buses	EPA MOBILE6 Evaluation Year Default

Activity – Locality Specific Inputs to MOBILE6
The user-input locality-specific activity parameters applied to develop the MOBILE6 hourly emissions factors for this analysis are the fleet total hourly VMT fractions (by county), and average hourly weekday trip length distributions (for the area).

Additional activity inputs to the model were fractions of hourly VMT across road types, and hourly fractions of VMT by the 14 speeds, for arterials and freeways. Weekend day hourly vehicle usage rates (MOBILE6 defaults) for particular activity input parameters (see Table 22) were applied for the Saturday and Sunday episode days.

For this analysis, hourly activity inputs represent a calendar day and are input starting from 6 a.m. through 11:59 p.m. followed by 12 a.m. through 5:59 a.m. of the same calendar day. The hourly VMT fractions and hourly VMT across road types were developed based on the 2007 VMT estimates. The hourly weekday trip length distributions are the same as those applied for the August 2000 base-case, ozone-episode emissions estimates previously developed under this task.

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 is discussed previously in this documentation.

VMT Distributions by Road Type (VMT BY FACILITY Command)
These distributions were not used to calculate the emissions factors applied for estimating the hourly 2007 emissions factors for this analysis. (TTI developed and applied these MOBILE6 inputs to produce composite "daily all roads" emissions factors for use in quality assurance checks.)

The inputs for the VMT BY FACILITY command are fractions for each hour of the day of VMT across the four MOBILE6 road types (Freeway, Arterial, Local, Ramp). Each hourly set of fractions sums to one. The VMT by facility fractions are by vehicle type, thus 28 sets of hourly VMT fractions across facilities may be entered.

These inputs were produced from the 2007 VMT estimates for each county by day-of-week. The hourly link VMT were summed by hour into two categories—freeway, and non-freeway. The hourly VMT fractions were calculated for these two groups as freeway VMT divided by the total VMT and non-freeway VMT divided by total VMT. As the MOBILE6 Local and Ramp road type emissions factors are not applied in this analysis, their corresponding VMT fractions by hour were set to zero. The same distributions were used for each of the 28 vehicle types. The VMT by facility fractions are entered as an external data file. A total of 32 input datasets were developed, one for each of the four day-of-week VMT estimates for each of the eight counties.

Total VMT by Hour (VMT BY HOUR Command)
Hourly fleet total VMT distributions are input to MOBILE6 through use of 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.)

The VMT by hour fractions were developed using the 2007 VMT estimates by county. The hourly link-VMT total for each hour was divided by the daily link-VMT total. These hourly VMT fractions for each county were developed for each of the Weekday (Monday through Thursday average), Friday, Saturday, and Sunday VMT estimates.

These fractions are input to MOBILE6 as an external data file. A total of 32 input data sets were developed, one for each of the four day-of-week 2007 VMT estimates for each of the eight counties.

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 POLFAC6 program (that is, no user speed input commands or data parameter values are required when producing MOBILE6 emissions factors tables with POLFAC6). POLFAC6 uses the SPEED VMT inputs to produce the individual Freeway and Arterial emissions factors indexed by the 14 MOBILE6 speed bin speeds.

Trip Length Distributions by Hour of Day (WE DA TRI LEN DI Command)
The trip length distributions (TLDs) input to MOBILE6 are called by the WE DA TRI LEN DI (for weekdays) command, or by the WE EN TRI LEN DI (for weekend days) command. TLDs specify the percentage of average weekday (or weekend) VMT that occurs during trips of different durations at each hour of the day.

The VMT distributions are entered as percentages for six trip length ranges, and must sum to 100 percent. The percentage values correspond to VMT accumulated within the trip durations:

- Under 10 minutes,
- 11-20 minutes,
- 21-30 minutes,
- 31-40 minutes,
- 41-50 minutes, and
- 51 minutes and longer.

HGA regional TLDs were applied for this analysis (Table 24). These TLDs were taken from the report "Conformity Determinations for The 2022 Metropolitan Transportation Plan and the 2000-2022 Transportation Improvement Program for Houston-Galveston Transportation Management area," March 23, 2000 prepared by HGAC. No weekend day TLD data were available, thus the weekday values shown in Table 28 were applied to all of the analysis days. The HGA area-wide hourly TLD data were input to MOBILE6 in an external data file.

Table 32
HGA Percent of VMT by Trip Length, Hourly

Hour	Trip Length Ranges (minutes)					
	< 10	**11-20**	**21-30**	**31-40**	**41-50**	**>51**
6 a.m.	13.1	28.4	24.0	14.9	08.4	11.2
7 a.m.	08.9	21.5	23.2	18.6	12.6	15.2
8 a.m.	08.9	21.5	23.2	18.6	12.6	15.2
9 a.m.	13.9	29.8	24.4	14.5	07.8	09.6
10 a.m.	13.9	29.8	24.4	14.5	07.8	09.6
11 a.m.	13.9	29.8	24.4	14.5	07.8	09.6
12 p.m.	13.9	29.8	24.4	14.5	07.8	09.6
1 p.m.	13.9	29.8	24.4	14.5	07.8	09.6
2 p.m.	13.9	29.8	24.4	14.5	07.8	09.6
3 p.m.	13.9	29.8	24.4	14.5	07.8	09.6
4 p.m.	11.1	24.6	23.1	16.8	10.8	13.6
5 p.m.	11.1	24.6	23.1	16.8	10.8	13.6
6 p.m.	11.1	24.6	23.1	16.8	10.8	13.6
7 p.m. through 5 a.m.	13.1	28.4	24.0	14.9	08.4	11.2

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 TLDs. For Saturday and Sunday episode days the WE VEH US command was applied to model the EPA default weekend usage rates for these parameters, except for the TLDs where the region-specific average weekday input data were used.

State Programs
For this analysis, the State Programs inputs to MOBILE6 model the effects of vehicle ATPs and exhaust and evaporative I/M programs that apply to the gasoline fueled vehicle classes, except motorcycles. For 2007, all HGA counties are to administer ATP and I/M programs. For the development of MOBILE6 ATP and I/M program setups and post-processing procedures

(discussed in a later section), the eight HGA counties were grouped according to their exhaust I/M program start dates as:

- Harris (1997),
- Urban (2003: Brazoria, Fort Bend, Galveston, Montgomery), and
- Rural (2004: Chambers, Liberty, and Waller).

For the Urban and Rural county categories, the ATP start dates coincide with the exhaust I/M program start dates for those counties.

Vehicle ATP (ANTI-TAMP PROG Command)
Table 33 describes the HGA counties 2007 ATP setups. The MOBILE6 ATP setups are entered in the MOBILE6 command file. For all counties, the ATP is composed of two sub-programs. The post-processing procedures required to account for the full effects of the two-part ATP are discussed later.

Table 33
HGA Counties 2007 ATP:
MOBILE6 Command and Data Parameter Values

Geographic coverage: All counties

MOBILE6 Inputs: The command and data parameter values for the two ATP sub-programs, ATP1 and ATP2, respectively, are:

ANTI-TAMP PROG
83 83 22222 22222222 2 11 096. 21112222

ANTI-TAMP PROG
84 05 22222 22222222 2 11 096. 22112222

Data parameter value definitions:

- the first number ("##") is the last two digits of the program start year, where start years are: Harris County, 84; Urban counties, 03; Rural counties, 04.
- the second number is the last two digits of earliest model year covered* by the program. The program is designed to cover 24 year old vehicles and newer.
- the third number is the final model year covered* by the program. Vehicles less than two years old are exempt from the program.
- the next 14 values are on/off toggles to identify the vehicle types covered (1=no, 2=yes). The vehicle are in input string order are: LDGV, LDGT1, LDGT2, LDGT3, LDGT4; and HDGV2B, HDGV3, HDGV4, HDGV5, HDGV6, HDGV7, HDGV8A, HDGV8B; and GAS BUS.
- the next entry must be one (EPA no longer supports additional credit for test only program). A "2" will cause ATP credit to be discontinued.
- the next data parameter is the program inspection frequency (1= annual, 2= biennial).
- the next number is the program compliance rate in percent.
- the last eight data parameters in the input string are on/off toggles (1=no, 2=yes) indicating which checks are performed, in the following order: 1) air pump disablement, 2) catalyst removal, 3) fuel inlet restrictor removal, 4) tailpipe lead deposit, 5) exhaust gas recirculation disablement, 6) evaporative system disablement, 7) positive crankcase ventilation system disablement, and 8) missing gas cap.

**Note*: Vehicles less than two years old and 25 years old and older are exempt from inspection.

I/M Programs

Table 34 describes the HGA I/M setups required to model the I/M programs as designed for operation in 2007. The emissions factor post-processing procedure necessary to model the effects of the May 1 start date for the Urban and Rural counties is described later. The I/M commands

and data parameters were input to MOBILE6 in an external data file called from the command file using the I/M DESC FILE command.

Table 34
MOBILE6 I/M Commands and Data Parameter Values for HGA 2007

Geographic coverage: All eight counties.

MOBILE6 inputs: The commands (in bold) with their corresponding data parameters values as defined by program design, are described below. Except for the I/M EFFECTIVENESS command, the first data value following each command identifies the program (i.e., 1 through 6) to which the command and its associated parameters apply. Stringency applies only to exhaust I/M programs (thus "&" takes the values 1, 2, and 3). Compliance and Waiver Rates applies to all I/M programs (thus "#" takes values 1 through 6).
I/M STRINGENCY: & 20 (percent stringency level for pre-1981 cars and light trucks)
I/M COMPLIANCE: # 96 (percent compliance)
I/M WAIVER RATES: # 3 3 (pre-1981 and post-1980 waiver rates in percent)
I/M EFFECTIVENESS: 1 1 1 (fractional exhaust I/M effectiveness for HC, CO, and NOx)

I/M PROGRAM	**I/M MODEL YEARS**	**I/M VEHICLES**
1 ???? 2050 1 TRC 2500/IDLE	1 1983 2005	1 11111 22222222 2
2 ???? 2050 1 TRC ASM 2525/5015 PHASE-IN	2 1983 1995	2 22222 11111111 1
3 ???? 2050 1 TRC OBD I/M	3 1996 2005	3 22222 11111111 1
4 ???? 2050 1 TRC GC	4 1983 2005	4 11111 22222222 2
5 ???? 2050 1 TRC GC	5 1983 1995	5 22222 11111111 1
6 ???? 2050 1 TRC EVAP OBD & GC	6 1996 2005	6 22222 11111111 1

Explanation of command data parameters:
I/M PROGRAM command*:*
the parameters, by numerical order, are defined as:
2nd and 3rd are the program start (see ???? explanation below) and end years, respectively,
4th is the program frequency (1=annual, 2=biennial),
5th is the program type (TRC= test and repair computerized),
6th is inspection type (2500/IDLE=test at idle, 2,500 rpm; ASM 2525/5015 PHASE-IN = Acceleration Simulated Mode-2 Test with phase-in cut points; OBD I/M and EVAP OBD & GC are on-board diagnostic exhaust and evaporative I/M [with GC], respectively, and GC=gas cap pressure check).
The start year field (????) varies by county grouping and by I/M program emission type as follows:
1, 2, and 3 are exhaust programs for the county/start year: Harris, 1997; Urban, 2003; Rural, 2004;
4, 5, and 6 are evaporative programs for the county/start year: Harris, 1997; Urban and Rural, 2000.
I/M MODEL YEARS command:
The first field is the first model year covered, and the second field is the last model year covered. By program design, vehicles less than two years old and greater than or equal to 25 years old are exempt from testing.
I/M VEHICLES command:
The14 data parameters are on/off toggles (1=no, 2=yes) indicating which vehicle types are subject to inspection. The 14 corresponding vehicle types, in input order are: LDGV, LDGT1, LDGT2, LDGT3, LDGT4; and HDGV2B, HDGV3, HDGV4, HDGV5, HDGV6, HDGV7, HDGV8A, HDGV8B; and GAS BUS.

Fuels – Locality Specific Inputs to MOBILE6
Fuel effects modeling for HGA 2007 includes only the summer RFG. The RVP of gasoline is required input to run MOBILE6, but is not used in the emissions factor calculations. The FUEL RVP input is overridden by the MOBILE6 RFG option modeled.

Fuel Program (FUEL PROGRAM Command)
The MOBILE6 FUEL PROGRAM command provides the user four options for modeling fuels effects. The second option, RFG (with the southern volatility region indicated), was modeled for all eight counties for 2007. This option directs MOBILE6 to model the effects of RFG as defined by the EPA default parameters for the southern volatility region, summer RFG. For this option, EPA default RFG parameter values used in MOBILE6 for 2007 are:

- RVP, South region - 6.8 pounds per square inch;
- Ether Oxygen Content - 2.1 percent by weight;
- Ether Market Share - 100 percent;
- Sulfur Content, average - 30 parts per million; and
- Sulfur Content, maximum experienced by model year:
  2006, 2007: 87 ppm;
  2004, 2005: 303 ppm;
  2000 through 2003: 1000 ppm; and
  1999 and older: N/A.

The selected FUEL PROGRAM option is entered in the MOBILE6 command file.

Gasoline RVP (FUEL RVP Command)
The gasoline RVP input to MOBILE6 is overridden by the selected FUEL PROGRAM command option described above for RFG. The RVP input, however, is required to run MOBILE6. The EPA 2007 summer RFG southern region RVP default value, 6.8 psi, was applied. The RVP value is entered in the MOBILE6 command file.

MOBILE6 Alternative Emissions Regulations and Control Measures Commands
The only user-input value applied (which was not required because the EPA default was input) within this section of MOBILE6 commands, is related to the heavy-duty diesel vehicle 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.

TNRCC obtained information from EPA that lead to the conclusion that the best estimate for the effectiveness rate for the 2000 ozone episode base-case modeling for the low NOx emissions rebuilds program for heavy duty diesels was 1.0 percent. The information provided by EPA showed that number of low NOx rebuild kits supplied (as of January, 2002) to the affected

population was 0.97 percent. However, no information was available to justify a non-default rebuild effects input value for 2007.

Thus, the 2007 effectiveness rate for the low NOx emissions rebuild program was set at the EPA default value (0.90, or 90 percent). This value and its associated command, REBUILD EFFECTS, are inputs to the MOBILE6 command file.

Emissions Factor Post-Processing Requirements and Procedures

There are three limitations of the MOBILE6 model that result in the emissions factors post-processing requirements for this analysis:

- MOBILE6 models only one ATP program per run;
- MOBILE6 assumes a January 1 start for I/M and ATP start year; and
- MOBILE6 does not model user-specified alternate diesel fuel parameters.

For 2007, all HGA counties are to operate two ATPs (see Table 33), the seven non-Harris counties ATP and exhaust I/M programs are to start May 1 of the program start years, and all HGA counties are to use Texas low-emissions diesel fuel.

Thus, to produce the final emissions factor inputs to the emissions estimation process, three emissions factor post-processing steps were performed. To model the full effects of the two-part ATP for each county, emissions factors from three runs were combined. To model the ATP and exhaust I/M programs May 1 start for the seven counties excluding Harris, two emissions factors data sets (each produced from the output of three MOBILE6 runs) were combined. To model the low-emissions diesel effects, no additional MOBILE6 runs were required. An adjustment factor was applied to the NOx emissions factors after the ATP and I/M post-processing steps were completed.

The county groupings for post-processing purposes are that same as those used to develop the ATP and I/M setups. The eight HGA counties were grouped according to their exhaust I/M program start dates as:

- Harris (1997),
- Urban (2003: Brazoria, Fort Bend, Galveston, Montgomery), and
- Rural (2004: Chambers, Liberty, and Waller).

For the Urban and Rural county categories, the ATP start dates coincide with the exhaust I/M program start dates for those counties.

The I/M and ATP modeling setups and post-processing procedures were developed with information from the I/M SIP (TNRCC, December 2000) and in consultation with the TNRCC Technical Analysis Division.

Step 1: Emissions Factor Post-Processing to Combine Effects of Two-Part ATP
This procedure was performed for all eight HGA counties, once for Harris County and twice for the Urban and Rural county categories. For the Urban and Rural county categories, the second set of emissions factors was required for the May 1 post-processing step.

To account for the credits of both parts of the ATP (ATP1 and ATP2 as described in Table 29), the following emissions factor post-processing calculation (taken from the HGA original 1990 base-year emissions inventory as developed and documented by HGAC, 1992) is performed:

$$EF_{ATP1} + EF_{ATP2} - EF_{NO\ ATP} = EF_{FINAL}$$

where:

EF_{ATP1} = emissions factor with ATP1 credits,
EF_{ATP2} = emissions factor with ATP2 credits,
$EF_{NO\ ATP}$ = emissions factor with no ATP credits,
EF_{FINAL} = emissions factor with including estimated credits for both ATP1 and ATP2.

The RATEADJ6 program (see Appendix B) performed this calculation for each county and analysis day. The calculation was performed on the second set of runs for the Urban and Rural county categories, to develop required emissions factor input for the May 1 post-processing step (see $EF_{Start\ Year+1}$ definition in the discussion of Step 2 below). The resulting emissions factors after this step include the full effects of the two-part ATP.

Step 2: Emissions Factor Post-Processing to model May 1 Program Start Effects
To account for the Urban and Rural county categories, ATP and exhaust I/M program May 1 start date, a ratio calculation (from the Technical Supplement to the December 2000 I/M SIP) was performed. These calculations were performed on the Urban and Rural emissions factors output from the first post-processing step. There are two MOBILE6 emissions factors sets required for the calculation, the difference between them being the following exhaust I/M and ATP start year input: 1) actual start year, and 2) one year after actual start year. The emissions factors from these two sets are combined as:

$$\frac{((N-1)12+8)\times EF_{Act.\ Start\ Year}}{12 \times N} + \frac{4 \times EF_{Start\ Year\ +\ 1}}{12 \times N} = EF_{FINAL}$$

where:

N	=	evaluation year - start year
$EF_{Act.\ Start\ Year}$	=	emissions factor with actual exhaust I/M and ATP start year,
$EF_{Start\ Year+1}$	=	emissions factor with an exhaust I/M and ATP start year one year later,
EF_{FINAL}	=	emissions factor with the estimated May 1 start date of the actual I/M start year.

Thus the Urban (N=4) and Rural (N=3) county ratio formulae are:

Urban Counties: $(0.9167)\ EF_{Act.\ Start\ Year} + (0.0833)\ EF_{Start\ Year+1} = EF_{FINAL}$
Rural Counties: $(0.8889)\ EF_{Act.\ Start\ Year} + (0.1111)\ EF_{Start\ Year+1} = EF_{FINAL}$

The RATEADJ6 program was applied to perform this calculation for each county and analysis day. The resulting emissions factors after this step include the full ATP effects and effects of the exhaust I/M and ATP program May 1 start for the program actual start years.

Step 3: Emissions Factor Post-Processing to Account for Low-Emissions Diesel Effects
MOBILE6 does not have an alternate diesel fuel modeling feature. To model the impacts of low-emissions diesel fuel, 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 NOx emissions factors for each county and analysis day. This adjustment corresponds to a reduction in NOx emissions factors of 5.7 percent. Development of this value is documented in the Eastern Research Group report, Revised SIP Modeling Procedures for the HGA Nonattainment Area, included as Appendix G of Houston/Galveston Attainment Demonstration and Post-1999 Rate-of-Progress SIP, TNRCC, December 2000.

Upon completion of this third and last step of the emissions factor post-processing procedures, the emissions factors are ready for input to the IMPSUM6 program to calculate estimated emissions. The modeled emissions factors were provided to TNRCC on CD-ROM. See Appendix A for file names and descriptions.

EMISSIONS CALCULATIONS

Hourly emissions were calculated by county for each of the 11 analysis days using the IMPSUM6 program (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 emission types on each network link (only the MOBILE6 freeway and arterial emissions factors were used). For each day, 195 files were output from the emissions calculations: 192 hourly link emissions files (24 hours multiplied by eight counties), a summary file of county-level and area total hourly and 24-hour emissions estimates cross-classified by vehicle type and road type, a tab-delimited version of the emissions summary file, and the file that logged the execution of the emissions calculation programs. These files were previously provided to TNRCC on CD-ROM (see Appendix A).

Hourly Link Emissions

For each analysis day, the emissions were calculated by hour for each network link (indexed to county and road type) using the following basic inputs:

- MOBILE6 hourly freeway and arterial emissions factors indexed by speed for 28 vehicle types, developed with POLFAC6;
- records associating the MOBILE6 freeway emissions factors to the freeway links, and the MOBILE6 arterial emissions factors to the non-freeway links;
- link data from the assignment results as developed (for each hour) using the PREPIN program including: county number, road type number, VMT on link, operational link-speed estimate, link node (end point) numbers, and link distance; 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 by hour, road type, vehicle type, and 14 speeds (2.5 mph and 5 mph to 65 mph at 5 mph intervals). VMT mix correlated to link VMT (by day-of-week, functional classification group, and hour) were multiplied by the fleet total link VMT to produce link-VMT estimates by the 28 vehicle types. Emissions factors were then matched with link-level VMT (freeway emissions factors to freeway links, and arterial emissions factors to non-freeway links), based on vehicle class and speed. 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, below) using the MOBILE6 interpolation method. 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 applied, respectively. The link VMT were then multiplied by the emissions factors to produce the link-level emissions estimates. County-level, hourly link-emissions files were produced including the following data for each link: link a-node and b-node identification numbers, network functional classification code, pollutant-specific emissions type, and emissions estimates for each of the 28 vehicle types.

Example Emissions Factor Interpolation
To calculate emissions factors for average operational link 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 IMPSUM6 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 link speed of 41.2 mph.

The interpolated emissions factor (EF_{Interp}) is expressed as:

$$EF_{Interp} = EF_{LowSpeed} - FAC_{Interp} \times (EF_{LowSpeed} - EF_{HighSpeed})$$

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

FAC_{Interp} =

Given that:

$EF_{LowSpeed}$ = 0.7413 g/mi,

$$\left(\frac{1}{Speed_{link}} - \frac{1}{Speed_{low}}\right) \Big/ \left(\frac{1}{Speed_{high}} - \frac{1}{Speed_{low}}\right)$$

$EF_{HighSpeed}$ = 0.7274 g/mi,

$Speed_{lnk}$ = 41.2 mph,

$Speed_{low}$ = 40 mph,

$Speed_{high}$ = 45 mph.

$$FAC_{Interp} = \left(\frac{1}{41.2mph} - \frac{1}{40mph}\right) \Big/ \left(\frac{1}{45mph} - \frac{1}{40mph}\right) = \frac{-0.00073}{-0.00278} = 0.26214,$$

EF_{Interp} = 0.7413 g/mi - (0.26214) × (0.7413 g/mi - 0.7274 g/mi)

= 0.7377 g/mi

Episode Day Hourly and 24-hour Emissions Summaries

For each analysis day, by individual county and for all counties, 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 by road type (HGAC network functional classification), vehicle type, road type and vehicle type cross classification. VMT, vehicle hours traveled (VHT), VMT-weighted speeds, and other inventory data are included with the emissions summaries. These files (*.LST and a tab delimited version, *.TAB) were previously provided to TNRCC on CD-ROM (see Appendix A).

Impact of Speed Limit Changes

In the application of the speed model, speed limits are used to estimate the operational speeds for a given V/C ratio on various types of roadways. In the same way, speed limits, revised per the proposed speed limit control, were used to estimate the freeflow and LOS E speed information needed to prepare the freeflow speed factors and the LOS E speed factors for each functional classification and area type. These factors are required inputs to the Houston Speed Model used to

estimate the operational speeds and travel by time-of-day time periods as discussed in the speed model section. This analysis was performed by post processing the output of the travel model.

Consequently the VMT is the same for all analyses. The assumption explicit in this approach is that travelers will not change their travel patterns as a result of changes in speed limits. A more comprehensive approach to this analysis would be to revise the highway and transit system networks to reflect the increases in travel time and then to rerun the trip distribution, mode split, and trip distribution steps of the travel model. Time and staff resources were not available to perform this more comprehensive analysis procedure.

One alternate speed limit scenario was evaluated. This scenario reduced the speed limit to 55 mph for all links that have a speed limit greater than 55 mph. The resulting freeflow speeds and LOS E speeds for each functional class and area type for the this 55 mph maximum speed limit scenario are shown in Tables 10 and 11 in the speed model discussion section (the current speed limit scenario freeflow and LOS E speeds are included in Tables 8 and 9).

With the freeflow speed factor, LOS E speed limit factor, and speed reduction factor, the Houston Speed Model estimates the operational speed for each link. The resulting operational speed estimates and VMT estimates for each link in the 2007 network for each time period were used to estimate emissions for the current speed limit and 55 mph maximum speed scenarios. The speed factors for each scenario are shown in Appendix D.

The analysis shows that:

- the 55 mph speed limit case has a greater impact on NOx emissions than on VOC emissions.

- the 55 mph speed limit case has the lower NOx emissions; however the current speed limit scenario has slightly lower VOC emissions.

The resulting NOx and VOC emissions estimates for the two speed scenarios for the August 30th 2007 episode day forecast are compared in Table 35.

Table 35
Speed Limit Impacts on the Eight County HGAC Area for August 30, 2007
(tons per day)

	Current Speed Limits			55 mph Maximum Speed Limit		
	VMT	**VOC**	**NOx**	**VMT**	**VOC**	**NOx**
Harris	96,442,269	59.71	101.48	96,442,269	60.02	98.08
Brazoria	5,567,884	3.47	6.62	5,567,884	3.50	6.26
Ft. Bend	9,062,875	5.01	9.97	9,062,875	5.04	9.51
Waller	1,569,857	1.22	2.10	1,569,857	1.23	1.97
Montgomery	10,265,784	6.15	12.69	10,265,784	6.21	11.92
Liberty	2,282,493	1.64	2.99	2,282,493	1.66	2.79
Chambers	2,853,985	1.82	4.14	2,853,985	1.83	3.89
Galveston	5,229,558	3.42	6.04	5,229,558	3.45	5.77
Totals	**133,274,706**	**82.43**	**146.04**	**133,274,706**	**82.94**	**140.17**

The detailed emissions inventory summaries for the current speed limit scenario and for the maximum 55 mph speed limit scenario were provided to TNRCC on CD-ROM. Appendix A lists the electronic data files and contents.

APPENDIX A
ELECTRONIC SUBMITTAL DATASET NAMES AND DESCRIPTIONS

ELECTRONIC SUBMITTAL DATA SET NAMES AND DESCRIPTIONS

This appendix provides the HGA 2007 modeling emissions inventory electronic data submittal CD-ROM volume names, and the names and descriptions of the data sets contained on each.

TTI provided 24 CD-ROMs containing the 2007 modeling emissions inventories data to TNRCC on March 28, 2002. The number of CDs by data content category are: 1) 11 CDs containing the Current Speed Model link-emissions files and inventory summary report files, 2) 11 CDs containing the 55 mph Speed Model link-emissions files and inventory summary report files, 3) one CD containing the HGAC 2007 travel model network node coordinates, and 4) one CD with the HGA 2007 MOBILE6 input files (command and external data) and output files (MOBILE6 emissions factors produced with POLFAC6, RATEADJ6, RATEADJV6).

The CDs and contents by data category (current speed model emissions, 55 mph speed model emissions, coordinates, emissions factors) are described below. The file format for the link emissions files is included (see tables at end of Appendix A).

Current Speed Model Emissions (11 CD-ROMs)
One CD for each analysis day contains the following (195) files in a ZIP file:

- county level hourly link-emissions files (192 ASCII files with .y07 extension);
- IMPSUM6 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; IMPSUM6 hourly "all counties" emissions inventory data summaries; SUMALL6 county-level and "all counties" 24-hour emissions inventory data summaries (one ASCII file with .lst extension);
- a tab-delimited version of second bullet above (one ASCII file with .tab extension); and
- a log of the emissions estimation program runs (one ASCII file with .log extension).

The CD-ROM names, zip file names and data set file names follow the convention:

H***ddmmm***07CSM (CD-ROM name)
hg***ddmmm***07CSM.zip
hga***ddmmm***07CSM.tab
hga***ddmmm***07CSM.lst
hga***ddmmm***07CSM.log
countyname.t***hr***.lnkemis.CSM.***mmmdd***.y07

where:

dd is the day date for each of the 11 days for the period 22AUG through 01SEP;
mmm is the month, AUG or SEP, corresponding to the episode day date (***dd***);
countyname is brazoria, chambers, fortbend, galveston, harris, liberty, montgomery, waller; and
hr is 01... 24 representing the hours 12 a.m. through 11 p.m.

55 mph Speed Model Emissions (11 CD-ROMs)
See Current Speed Model Emissions data set descriptions above. The CD and file naming convention for the 55 mph Speed Model Emissions data sets is the same as for the Current Speed Model Emissions, except that "CSM" in the data set names is replaced by "55S."

Coordinates (one CD-ROM)
The CD name is XY2007_HGAC. The CD contains one file named XY07NEW.UTM that contains UTM zone 15 X-Y coordinates in meters for the HGA 2007 network nodes (link endpoints and zone centroids). The order of the data is: network node number, X-coordinate, Y-coordinate.

- UTM Zone 15 X-Y coordinates for the 2007 network nodes (one file, XY07NEW.UTM)

Emissions Factors (one CD-ROM)
The CD name is HG07M6. The MOBILE6 input and output files on the CD are in the ZIP file named HG07M6.zip. The ZIP file contents are described below:

Number of Files:
The MOBILE6 input and output files consist of:

- MOBILE6 command input files (495);
- MOBILE6 external data input files (78);
- MOBILE6 hourly emissions factor output files (825); and
- MOBILE6 daily emissions factor output files (825).

Additionally, the following files were included:

- diesel fractions files which are included in the MOBILE6 command files (8).

This totals 2,231 files.

File Naming Conventions:

CTY7 is the first four letters of county name for each of the seven non-Harris HGA counties;
CTY8 is the first four letters of county name for each of the eight HGA counties;
ddmmm is the day/month date for the 11 days (22AUG... 01SEP);
HARR is Harris County;
is 0, 1, 2 for no ATP, ATP1 and ATP2, respectively;
% is 1, 2 for I/M with actual start year, and I/M with start year plus one, respectively; and
kk is wk, fr, sa, su which represents the four days-of-week.

MOBILE6 command input files (495):

ddmmm07***CTY7***_I***%***A***#***.in (462 files); and
ddmmm07HARR_A***#***.in (33 files).

MOBILE6 external data input files:

HARR07.im (one I/M file for Harris county);
RURA07.im (one I/M file for Chambers, Liberty, Waller);
RURA07B.im (one I/M [start yr. + 1] file for Chambers, Liberty, Waller);
URBA07.im (one I/M file for [start yr. + 1] Brazoria, Fort Bend, Galveston, Montgomery);
URBA07B.im (one I/M file for Brazoria, Fort Bend, Galveston, Montgomery);
hgaSIP.tld (one regional trip length distributions file);
CTY8 07.rgd (eight registration distributions files);
CTY8 07***kk***.vfc (32 VMT BY FACILITY files); and
CTY8 07***kk***.vhr (32 VMT BY HOUR files).

Files containing the diesel fractions:

Dsf_***CTY8***.y07 (eight files - not input files - diesel fractions data are command file input).

Final MOBILE6 Emissions Factors Files (hourly [.rat] and 24-hr [.rtd] output):

ddmmm07***CTY8***_ALLadj.rat (88 files adjusted for I/M, ATP, Low Emissions Diesel); and
ddmmm07***CTY8***_ALLadj.rtd (88 files adjusted for I/M, ATP, Low Emissions Diesel).

Interim MOBILE6 Emissions Factors Files (hourly [.rat] and 24-hr [.rtd] output):

ddmmm07***CTY7***_IMATPadj.rat (77 files);
ddmmm07***CTY7***_IMATPadj.rtd (77 files);

ddmmm07HARR_ATPadj.rat (11 files);
ddmmm07***CTY7***_I***%***ATPadj.rat (154 files);

ddmmm07HARR_ATPadj.rtd (11 files);
ddmmm07***CTY7***_I***%***ATPadj.rtd (154 files);

ddmmm07HARR_A***#***.rat (33 files);
ddmmm07***CTY7***_I***%***A***#***.rat (462 files);
ddmmm07HARR_A***#***.rtd (33 files); and
ddmmm07***CTY7***_I***%***A***#***.rtd (462 files).

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 of Link
EMISS	17 - 19	A3	"VOC," or "CO," or "NOx"
ETYPE	21 - 31	A11	See Emissions Sub-Component Type table (below)
LDGV	32 - 41	F10.?[1]	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

Emissions Sub-Component Type

Sub-Component Abbreviation	Comments
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

APPENDIX B
EMISSIONS ESTIMATION PROGRAMS AND PROCESSES

EMISSIONS ESTIMATION METHODOLOGY

The following is a summary of the series of programs developed by TTI for developing link-based, time-of-day, on-road mobile source emissions estimates for air quality analyses.

These programs produce emissions factors with the latest version of EPA's MOBILE emissions factor model, and apply them to travel model-based activity estimates to calculate emissions at user-specified temporal and spatial scales. The location of emissions by grid, or travel network link coordinates, may also be specified.

The emissions estimation programs are: PREPIN, POLFAC6, RATEADJ6, RATEADJV6, IMPSUM6, and SUMALL6. PREPIN prepares activity input, POLFAC6 prepares emissions factor input, the RATEADJ programs make special adjustments to emissions factors when required, IMPSUM6 calculates emissions by time period, and SUMALL6 summarizes emissions at various levels by 24-hour period.

PREPIN

The PREPIN 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 PREPIN 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, PREPIN reads a travel demand model traffic assignment data set from a directional four period time-of-day assignment (another common assignment read by PREPIN is the nondirectional or directional 24-hour assignment). PREPIN 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 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.

POLFAC6

The POLFAC6 program is used to apply the EPA's MOBILE6 program to obtain the on-road mobile emissions factors. The MOBILE6 emissions factors are obtained for each of 15 emissions types (i.e., the composite, exhaust running, and exhaust start for VOC, CO, and NOx rates plus the six VOC evaporative rates), 28 vehicle types, four MOBILE6 functional classifications (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. These emissions factors are tabulated individually by county and analysis day for the evaluation year. These emissions factors are output to an ASCII file for subsequent input to the IMPSUM6 program. The IMPSUM6 program is then used to apply the

hourly emissions factors to hourly VMT estimates by link. (POLFAC6 also optionally produces a set of daily emissions factors.)

RATEADJ6
RATEADJ6 is a special utility program that produces a new set of emissions factors by linearly combining the emissions factors from multiple applications of POLFAC6. There is one set of linear factors. Each factor is applied to all emissions rates in a single data set.

RATEADJV6
RATEADJV6 is a special utility program that produces a new set of emissions factors by linearly combining the emissions factors from multiple applications of POLFAC6, RATEADJ6, or RATEADJV6. There are 420 linear equations; one for each of 15 emissions types and 28 vehicle types.

IMPSUM6
The IMPSUM6 program applies the emissions factors obtained from POLFAC6 (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 IMPSUM6 are:

- MOBILE6 emissions factors developed with POLFAC6 (or a RATEADJ6, if used);
- abbreviated assignment results by link (for the subject time period), developed using the PREPIN program. (The PREPIN program allows the user to estimate the VMT and speed on each link by time period.) For each link, the following information is input to IMPSUMA: 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; and
- data records associating the MOBILE6 roadway type (Freeway, Arterial, Local, Ramp) emissions factors (or percentages thereof) to specific travel model functional classifications. These MOBILE6 roadway type 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 emissions factor-specific road types and the 28 vehicle types. The MOBILE6 emissions factors matched to link-VMT by road type and vehicle type are interpolated (for the link speed that falls between the 14 MOBILE6 speeds; following the MOBILE6 interpolation methodology) 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 (i.e., cross classified by roadway type and vehicle type) for each of the subject time periods. A data set is produced for subsequent input to the SUMALLA6 program. X-Y coordinates are optionally used to produce gridded emissions. Also, link emissions may be written by county. The link emissions are for 15 emissions types and 28 vehicle types and include the "a" node and "b" node (endpoints) of the links for which X-Y coordinates may be obtained.

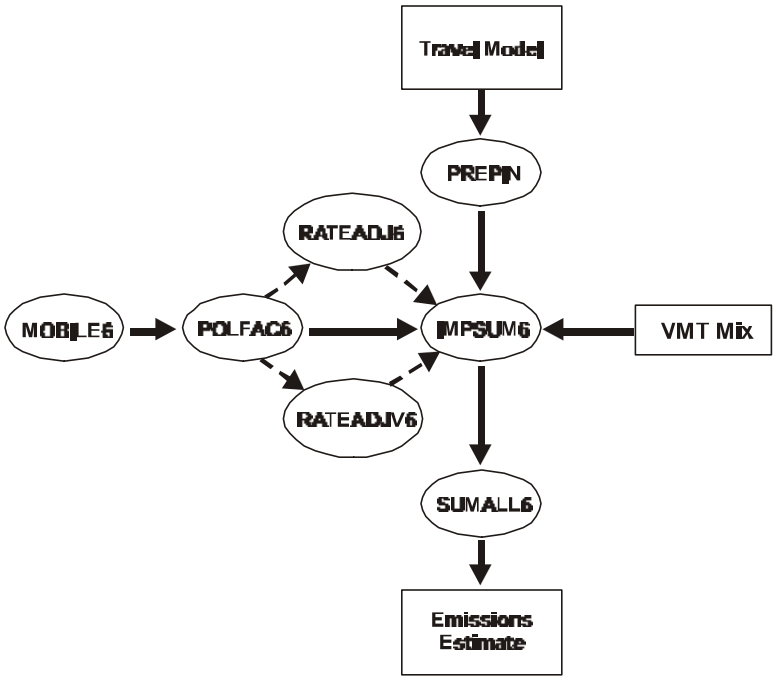
A tab-delimited output is optionally produced. This output has all 28 vehicle types (or eight vehicle types in the compressed format) across a single output line. Each field in the output is separated by a tab character.

SUMALL6

The SUMALL6 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 process overall emissions estimate process flow is shown in the diagram below.



APPENDIX C
HOURLY VOLUME FACTORS

Weekday HGA Hourly Volume Factors
Freeways, Interstate

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.302055914	0.225632139	0.324597644	0.322400903
	07:00	0.391873901	0.456962542	0.358319391	0.359297162
	08:00	0.306070185	0.317405319	0.317082966	0.318301935
Midday	09:00	0.158978411	0.140704491	0.152370360	0.159575180
	10:00	0.157050538	0.152643762	0.157726685	0.157032997
	11:00	0.165865452	0.168161125	0.165206547	0.162696432
	12:00	0.165685682	0.171929802	0.168822374	0.165763594
	13:00	0.170973392	0.177241611	0.174393200	0.171127945
	14:00	0.181446526	0.189319210	0.181480834	0.183803853
PM Peak	15:00	0.239373748	0.230505625	0.240582574	0.228155595
	16:00	0.271320441	0.271091032	0.254713427	0.254734230
	17:00	0.284788273	0.295613115	0.264894118	0.274629456
	18:00	0.204517538	0.202790228	0.239809882	0.242480719
Overnight	19:00	0.203863566	0.224047230	0.207782628	0.219489308
	20:00	0.161840473	0.182633853	0.164377778	0.164340464
	21:00	0.146819307	0.157694255	0.144263436	0.139186685
	22:00	0.126333231	0.134805356	0.115186163	0.107246956
	23:00	0.087673161	0.097483633	0.082998298	0.068630074
	00:00	0.049374812	0.048218183	0.049417020	0.037755605
	01:00	0.031572310	0.029167641	0.035011579	0.025375902
	02:00	0.028732316	0.025110084	0.031269852	0.022855537
	03:00	0.023482484	0.018397827	0.027876479	0.023666951
	04:00	0.033864833	0.022801225	0.039290180	0.044437291
	05:00	0.106443506	0.059640713	0.102526587	0.147015226

Weekday HGA Hourly Volume Factors
Arterials, Major Collectors

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.242861810	0.240506246	0.359462008	0.322400903
	07:00	0.395512755	0.386812073	0.380406843	0.359297162
	08:00	0.361625435	0.372681681	0.260131149	0.318301935
Midday	09:00	0.154046951	0.140688905	0.159906308	0.159575180
	10:00	0.146773744	0.130783258	0.155516686	0.157032997
	11:00	0.169958745	0.165747780	0.164081480	0.162696432
	12:00	0.177038157	0.184755749	0.165532402	0.165763594
	13:00	0.171929000	0.186493743	0.168946926	0.171127945
	14:00	0.180253402	0.191530565	0.186016198	0.183803853
PM Peak	15:00	0.236708196	0.228844435	0.224988384	0.228155595
	16:00	0.272666422	0.258867808	0.268548642	0.254734230
	17:00	0.278413548	0.276744346	0.284933411	0.274629456
	18:00	0.212211834	0.235543411	0.221529563	0.242480719
Overnight	19:00	0.228914550	0.234232509	0.209361757	0.219489308
	20:00	0.178506543	0.193810969	0.160667124	0.164340464
	21:00	0.158917116	0.164785465	0.133880558	0.139186685
	22:00	0.132517321	0.123066744	0.098643335	0.107246956
	23:00	0.088185784	0.082027084	0.064052138	0.068630074
	00:00	0.045501668	0.046750737	0.034344181	0.037755605
	01:00	0.029894791	0.030065860	0.021228790	0.025375902
	02:00	0.025111624	0.026657496	0.016184044	0.022855537
	03:00	0.016284321	0.017006995	0.018511658	0.023666951
	04:00	0.021796254	0.021760422	0.053530375	0.044437291
	05:00	0.074370028	0.059835719	0.189596040	0.147015226

Weekday HGA Hourly Volume Factors
Collectors, Locals

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.268323895	0.268323895	0.268323895	0.332178880
	07:00	0.391369115	0.391369115	0.391369115	0.391796017
	08:00	0.340306990	0.340306990	0.340306990	0.276025103
Midday	09:00	0.145691334	0.145691334	0.145691334	0.169614239
	10:00	0.141057850	0.141057850	0.141057850	0.163719094
	11:00	0.151990562	0.151990562	0.151990562	0.150472611
	12:00	0.168267255	0.168267255	0.168267255	0.148227195
	13:00	0.199352059	0.199352059	0.199352059	0.162689017
	14:00	0.193640940	0.193640940	0.193640940	0.205277844
PM Peak	15:00	0.219198029	0.219198029	0.219198029	0.200150392
	16:00	0.248822411	0.248822411	0.248822411	0.265447509
	17:00	0.282155142	0.282155142	0.282155142	0.299180856
	18:00	0.249824419	0.249824419	0.249824419	0.235221244
Overnight	19:00	0.271429147	0.271429147	0.271429147	0.230213047
	20:00	0.203102383	0.203102383	0.203102383	0.164065915
	21:00	0.150354742	0.150354742	0.150354742	0.134619139
	22:00	0.101488442	0.101488442	0.101488442	0.100685369
	23:00	0.046737393	0.046737393	0.046737393	0.053127879
	00:00	0.025049411	0.025049411	0.025049411	0.034570785
	01:00	0.017421196	0.017421196	0.017421196	0.024727294
	02:00	0.017353968	0.017353968	0.017353968	0.023629956
	03:00	0.018940566	0.018940566	0.018940566	0.024852837
	04:00	0.037652555	0.037652555	0.037652555	0.046757740
	05:00	0.110470196	0.110470196	0.110470196	0.162750039

Friday HGA Hourly Volume Factors
Freeways, Interstate

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.297131911	0.223883714	0.315342382	0.321128804
	07:00	0.394236840	0.451744674	0.359900816	0.359431094
	08:00	0.308631249	0.324371612	0.324756802	0.319440102
Midday	09:00	0.151885595	0.131565910	0.143100799	0.147112900
	10:00	0.155020667	0.150129144	0.155806465	0.153781341
	11:00	0.165688412	0.167140769	0.164658623	0.163917121
	12:00	0.170092079	0.174827157	0.170684271	0.171089848
	13:00	0.172595888	0.180644137	0.179024444	0.177207023
	14:00	0.184717358	0.195692883	0.186725398	0.186891768
PM Peak	15:00	0.250312361	0.238352884	0.247168193	0.231656829
	16:00	0.274476752	0.268979235	0.251998134	0.251802146
	17:00	0.271549078	0.280666802	0.256950448	0.267068852
	18:00	0.203661809	0.212001079	0.243883226	0.249472173
Overnight	19:00	0.204212165	0.225567348	0.215469826	0.234794832
	20:00	0.163222524	0.185730905	0.170905018	0.176599484
	21:00	0.144546826	0.162711820	0.146774509	0.144376227
	22:00	0.129709686	0.134269438	0.118580837	0.112070283
	23:00	0.102397235	0.117584664	0.103509302	0.082170543
	00:00	0.048778554	0.042398399	0.045967609	0.037097674
	01:00	0.031355981	0.025747842	0.031251552	0.023714730
	02:00	0.028961539	0.023117457	0.027146346	0.019518347
	03:00	0.022593449	0.014760101	0.024038776	0.019477004
	04:00	0.030573363	0.019413531	0.033273576	0.035133848
	05:00	0.093648678	0.048698495	0.083082649	0.115047029

Friday HGA Hourly Volume Factors
Arterials, Major Collectors

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.235534471	0.245972563	0.353278084	0.321128804
	07:00	0.397641106	0.368797415	0.383437805	0.359431094
	08:00	0.366824423	0.385230022	0.263284111	0.319440102
Midday	09:00	0.147016673	0.134035817	0.145777782	0.147112900
	10:00	0.149636042	0.146320837	0.155312524	0.153781341
	11:00	0.173491308	0.167846400	0.165351204	0.163917121
	12:00	0.180594538	0.183970842	0.168795325	0.171089848
	13:00	0.175412558	0.185555095	0.173527655	0.177207023
	14:00	0.173848882	0.182271009	0.191235510	0.186891768
PM Peak	15:00	0.252060518	0.235562992	0.233250661	0.231656829
	16:00	0.271763054	0.261421808	0.269978894	0.251802146
	17:00	0.263024060	0.270428250	0.271897813	0.267068852
	18:00	0.213152368	0.232586950	0.224872632	0.249472173
Overnight	19:00	0.209693450	0.224150550	0.215790771	0.234794832
	20:00	0.164523918	0.188068206	0.163948365	0.176599484
	21:00	0.152178356	0.162582658	0.140358412	0.144376227
	22:00	0.143014399	0.138132669	0.112374433	0.112070283
	23:00	0.115945193	0.111815346	0.084797637	0.082170543
	00:00	0.051444496	0.042100229	0.037161329	0.037097674
	01:00	0.033297723	0.027689747	0.021607713	0.023714730
	02:00	0.030380866	0.023148262	0.018846904	0.019518347
	03:00	0.018365072	0.013811605	0.017289750	0.019477004
	04:00	0.021374828	0.017438138	0.039591023	0.035133848
	05:00	0.059781700	0.051062592	0.148233663	0.115047029

Friday HGA Hourly Volume Factors
Collectors, Locals

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.248252236	0.248252236	0.248252236	0.309883735
	07:00	0.390755605	0.390755605	0.390755605	0.395197627
	08:00	0.360992159	0.360992159	0.360992159	0.294918638
Midday	09:00	0.143587863	0.143587863	0.143587863	0.153460733
	10:00	0.148623871	0.148623871	0.148623871	0.157794209
	11:00	0.158205879	0.158205879	0.158205879	0.161225019
	12:00	0.186063567	0.186063567	0.186063567	0.165879008
	13:00	0.176804016	0.176804016	0.176804016	0.170670364
	14:00	0.186714804	0.186714804	0.186714804	0.190970667
PM Peak	15:00	0.233490515	0.233490515	0.233490515	0.225803004
	16:00	0.239308852	0.239308852	0.239308852	0.263357581
	17:00	0.265154297	0.265154297	0.265154297	0.268116520
	18:00	0.262046336	0.262046336	0.262046336	0.242722895
Overnight	19:00	0.273021852	0.273021852	0.273021852	0.240980422
	20:00	0.197259242	0.197259242	0.197259242	0.170723111
	21:00	0.142940348	0.142940348	0.142940348	0.127253819
	22:00	0.102001222	0.102001222	0.102001222	0.101406864
	23:00	0.068966082	0.068966082	0.068966082	0.073162137
	00:00	0.031086830	0.031086830	0.031086830	0.038531945
	01:00	0.021759548	0.021759548	0.021759548	0.030298733
	02:00	0.018494592	0.018494592	0.018494592	0.025245365
	03:00	0.019864560	0.019864560	0.019864560	0.025155126
	04:00	0.035090095	0.035090095	0.035090095	0.044045104
	05:00	0.089515629	0.089515629	0.089515629	0.123197372

Saturday HGA Hourly Volume Factors
Freeways, Interstate

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.268109383	0.272595665	0.248561171	0.256676195
	07:00	0.335639259	0.326493966	0.332514491	0.326379684
	08:00	0.396251358	0.400910369	0.418924338	0.416944122
Midday	09:00	0.141881335	0.109105642	0.138860838	0.140115422
	10:00	0.157094066	0.144538058	0.160311921	0.163468429
	11:00	0.169826221	0.175150133	0.171240228	0.174544365
	12:00	0.179293716	0.186661227	0.177204017	0.175245241
	13:00	0.175814211	0.190920999	0.177975334	0.175047226
	14:00	0.176090451	0.193623941	0.174407663	0.171579317
PM Peak	15:00	0.262857141	0.251292942	0.256056699	0.253633313
	16:00	0.251928000	0.258083976	0.256013387	0.257040868
	17:00	0.248307149	0.254122246	0.252556355	0.254439856
	18:00	0.236907710	0.236500836	0.235373560	0.234885963
Overnight	19:00	0.171051909	0.199654652	0.192636098	0.207482860
	20:00	0.152069439	0.173289350	0.157857370	0.167130266
	21:00	0.145476107	0.155934039	0.143334013	0.152360430
	22:00	0.132176004	0.133707988	0.122093563	0.121990207
	23:00	0.105173601	0.109294499	0.100120811	0.092650344
	00:00	0.078759024	0.062285696	0.076096130	0.063036240
	01:00	0.053007905	0.042109928	0.049822502	0.040423113
	02:00	0.048308697	0.036658918	0.041272792	0.032466208
	03:00	0.030687522	0.023439341	0.029871940	0.025657199
	04:00	0.029666553	0.022331555	0.032291878	0.032470126
	05:00	0.053623240	0.041294034	0.054602902	0.064333006

Saturday HGA Hourly Volume Factors
Arterials, Major Collectors

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.212583118	0.189222972	0.303641691	0.256676195
	07:00	0.332081279	0.325851957	0.315939346	0.326379684
	08:00	0.455335603	0.484925072	0.380418963	0.416944122
Midday	09:00	0.137136956	0.123892879	0.143450590	0.140115422
	10:00	0.156638485	0.146702463	0.161238842	0.163468429
	11:00	0.172838489	0.168945567	0.172510445	0.174544365
	12:00	0.179065247	0.184578831	0.173173803	0.175245241
	13:00	0.177554564	0.189368414	0.173241769	0.175047226
	14:00	0.176766260	0.186511846	0.176384551	0.171579317
PM Peak	15:00	0.265631077	0.263238522	0.248779946	0.253633313
	16:00	0.249548720	0.257061307	0.246898836	0.257040868
	17:00	0.242532899	0.245297543	0.263660960	0.254439856
	18:00	0.242287304	0.234402628	0.240660258	0.234885963
Overnight	19:00	0.176654879	0.191306371	0.196834267	0.207482860
	20:00	0.148245048	0.171522309	0.164075571	0.167130266
	21:00	0.141519211	0.152740621	0.145812322	0.152360430
	22:00	0.139339482	0.132316819	0.123066341	0.121990207
	23:00	0.119618581	0.110757220	0.093642641	0.092650344
	00:00	0.079456868	0.074863328	0.062317647	0.063036240
	01:00	0.056316388	0.053926365	0.042462254	0.040423113
	02:00	0.053263431	0.045859476	0.034010767	0.032466208
	03:00	0.028576477	0.023536978	0.022440692	0.025657199
	04:00	0.023453774	0.018066684	0.032530692	0.032470126
	05:00	0.033555861	0.025103830	0.082806805	0.064333006

Saturday HGA Hourly Volume Factors
Collectors, Locals

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.210087071	0.210087071	0.210087071	0.241936066
	07:00	0.314870519	0.314870519	0.314870519	0.330359400
	08:00	0.475042410	0.475042410	0.475042410	0.427704533
Midday	09:00	0.145501909	0.145501909	0.145501909	0.152719021
	10:00	0.168577753	0.168577753	0.168577753	0.167874565
	11:00	0.174772675	0.174772675	0.174772675	0.176980527
	12:00	0.175292205	0.175292205	0.175292205	0.172726339
	13:00	0.171099058	0.171099058	0.171099058	0.166034418
	14:00	0.164756400	0.164756400	0.164756400	0.163665130
PM Peak	15:00	0.256302790	0.256302790	0.256302790	0.242371488
	16:00	0.246663563	0.246663563	0.246663563	0.255782935
	17:00	0.258415396	0.258415396	0.258415396	0.255647231
	18:00	0.238618251	0.238618251	0.238618251	0.246198345
Overnight	19:00	0.233217161	0.233217161	0.233217161	0.212267133
	20:00	0.193068465	0.193068465	0.193068465	0.167043760
	21:00	0.157101239	0.157101239	0.157101239	0.152836153
	22:00	0.115580826	0.115580826	0.115580826	0.112579279
	23:00	0.086480483	0.086480483	0.086480483	0.086732807
	00:00	0.058072217	0.058072217	0.058072217	0.065614251
	01:00	0.039775716	0.039775716	0.039775716	0.042308686
	02:00	0.024102476	0.024102476	0.024102476	0.032407499
	03:00	0.022917243	0.022917243	0.022917243	0.026884307
	04:00	0.023853826	0.023853826	0.023853826	0.035119391
	05:00	0.045830347	0.045830347	0.045830347	0.066206732

Sunday HGA Hourly Volume Factors
Freeways, Interstate

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.270650692	0.305443509	0.245145125	0.257235112
	07:00	0.318853329	0.312888758	0.318681698	0.313467190
	08:00	0.410495979	0.381667733	0.436173177	0.429297698
Midday	09:00	0.119473515	0.083786651	0.104212824	0.105814252
	10:00	0.144050654	0.129360917	0.132181075	0.130693362
	11:00	0.157104331	0.173123620	0.158867089	0.159123892
	12:00	0.184486852	0.195127027	0.190787287	0.191776696
	13:00	0.195526632	0.208504316	0.203723193	0.205360811
	14:00	0.199358015	0.210097470	0.210228531	0.207230987
PM Peak	15:00	0.251304809	0.265397551	0.250575963	0.251090537
	16:00	0.245764900	0.257186407	0.255651622	0.254832324
	17:00	0.255617314	0.250085326	0.260465480	0.259151795
	18:00	0.247312977	0.227330715	0.233306935	0.234925344
Overnight	19:00	0.180508962	0.217030220	0.216669628	0.220749894
	20:00	0.164338459	0.182607268	0.179398041	0.177223663
	21:00	0.152579788	0.140551268	0.151496918	0.149379377
	22:00	0.124296175	0.097456171	0.114482705	0.107920047
	23:00	0.081810126	0.060576112	0.085483223	0.067961238
	00:00	0.086719418	0.090698145	0.074786040	0.069149150
	01:00	0.064156576	0.060947217	0.051343582	0.050734631
	02:00	0.058780917	0.053318071	0.042491491	0.070748975
	03:00	0.031274581	0.030793932	0.026915142	0.023489823
	04:00	0.022954590	0.025715647	0.023330081	0.023044814
	05:00	0.032580408	0.040305949	0.033603148	0.039598388

Sunday HGA Hourly Volume Factors
Arterials, Major Collectors

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.237771856	0.209537026	0.322375601	0.257235112
	07:00	0.318421728	0.311848127	0.292835442	0.313467190
	08:00	0.443806416	0.478614847	0.384788957	0.429297698
Midday	09:00	0.110579005	0.105368333	0.108105532	0.105814252
	10:00	0.141015870	0.135447126	0.136473015	0.130693362
	11:00	0.162414627	0.162079160	0.164329190	0.159123892
	12:00	0.191797866	0.194703540	0.183764671	0.191776696
	13:00	0.194785551	0.202027218	0.198312395	0.205360811
	14:00	0.199407081	0.200374622	0.209015198	0.207230987
PM Peak	15:00	0.254878924	0.261357313	0.237304169	0.251090537
	16:00	0.252374074	0.259230869	0.245219456	0.254832324
	17:00	0.253096059	0.250175976	0.268299275	0.259151795
	18:00	0.239650942	0.229235842	0.249177100	0.234925344
Overnight	19:00	0.171852812	0.166032015	0.227880479	0.220749894
	20:00	0.156044328	0.154884220	0.189065952	0.177223663
	21:00	0.141553991	0.142532050	0.148016946	0.149379377
	22:00	0.121963943	0.112435601	0.109856412	0.107920047
	23:00	0.090433415	0.075560881	0.066423962	0.067961238
	00:00	0.095273816	0.105793671	0.068309644	0.069149150
	01:00	0.073022781	0.082832592	0.048282903	0.050734631
	02:00	0.068395383	0.074574005	0.037884403	0.070748975
	03:00	0.033487683	0.038361529	0.023191344	0.023489823
	04:00	0.022109033	0.023490226	0.024960760	0.023044814
	05:00	0.025862815	0.023503211	0.056127195	0.039598388

Sunday HGA Hourly Volume Factors
Collectors, Locals

	Hour	CBD and Urban	Urban Fringe	Suburban	Rural
AM Peak	06:00	0.185789757	0.185789757	0.185789757	0.251447327
	07:00	0.309437056	0.309437056	0.309437056	0.307790001
	08:00	0.504773187	0.504773187	0.504773187	0.440762671
Midday	09:00	0.121971310	0.121971310	0.121971310	0.116055969
	10:00	0.132695544	0.132695544	0.132695544	0.132904325
	11:00	0.158371223	0.158371223	0.158371223	0.158857861
	12:00	0.198316691	0.198316691	0.198316691	0.188206959
	13:00	0.194771136	0.194771136	0.194771136	0.204791007
	14:00	0.193874097	0.193874097	0.193874097	0.199183878
PM Peak	15:00	0.246623018	0.246623018	0.246623018	0.247278418
	16:00	0.246871380	0.246871380	0.246871380	0.235632427
	17:00	0.263307852	0.263307852	0.263307852	0.269491221
	18:00	0.243197750	0.243197750	0.243197750	0.247597933
Overnight	19:00	0.263884591	0.263884591	0.263884591	0.251976111
	20:00	0.217267432	0.217267432	0.217267432	0.198233529
	21:00	0.151333883	0.151333883	0.151333883	0.157833037
	22:00	0.095099353	0.095099353	0.095099353	0.101295260
	23:00	0.050807035	0.050807035	0.050807035	0.059481896
	00:00	0.069964417	0.069964417	0.069964417	0.063468485
	01:00	0.047704380	0.047704380	0.047704380	0.044833854
	02:00	0.030871836	0.030871836	0.030871836	0.034848288
	03:00	0.021022415	0.021022415	0.021022415	0.023591138
	04:00	0.019157383	0.019157383	0.019157383	0.023518585
	05:00	0.032887275	0.032887275	0.032887275	0.040919818

APPENDIX D
CAPACITY FACTORS, SPEED FACTORS, AND SPEED REDUCTION FACTORS

Capacity Factors

Time of Day Assignment	Capacity Factor[1]
AM Peak (three hours)	0.3333333
Midday (six hours)	0.1666667
PM Peak (four hours)	0.2500000
Overnight (11 hours)	0.0909091

Freeflow (Volume=1) Speed Factors for Houston-Galveston Speed Model
Current Speed Limit Scenario

Functional Group	Area Type				
	CBD	Urban	Urban Fringe	Suburban	Rural
Freeways, Interstates	1.4295	1.3363	1.2332	1.2301	1.2083
Principal Arterials	1.3059	0.9203	1.0213	1.1480	1.2877
Other Arterials, Major Collectors	1.4189	0.9048	0.9170	1.1285	1.2830
Collectors	1.0655	0.7844	0.7921	1.3045	1.3867
Locals	1.0000	1.0000	1.0000	1.0000	1.0000

[1] To obtain hourly capacities, a single capacity factor for each time-of-day assignment is used for all area types and function classes.

LOS E (V/C=1.0) Speed Factors for Houston-Galveston Speed Model
Current Speed Limit Scenario

Functional Group	Area Type				
	CBD	Urban	Urban Fringe	Suburban	Rural
Freeways, Interstates	0.8841	0.7687	0.7887	0.9021	0.8536
Principal Arterials	0.8000	0.6668	0.7905	0.8939	1.0500
Other Arterials, Major Collectors	0.9140	0.6814	0.7066	0.8652	1.0767
Collectors	0.6320	0.5615	0.6283	1.0132	1.1857
Locals	1.0000	1.0000	1.0000	1.0000	1.0000

Freeflow (Volume=1) Speed Factors for Houston-Galveston Speed Model
Max 55 mph Speed Limit Scenario

Area Type	Functional Group				
	1	2	3	4	5
	Freeways	Principal Arterials	Other Arterial	Collectors	Locals
CDB	1.387230	1.305848	1.418919	1.065489	1.000000
Urban	1.258277	0.920245	0.904467	0.784347	1.000000
Urban Fringe	1.130168	1.015065	0.915786	0.790870	1.000000
Suburban	1.064563	1.121049	1.107459	1.296490	1.000000
Rural	1.027745	1.127370	1.174356	1.346870	1.000000

LOS E (V/C=1.0) Speed Factors for Houston-Galveston Speed Model
Max 55 mph Speed Limit Scenario

Area Type	Functional Group				
	1	2	3	4	5
	Freeways	Principal Arterials	Other Arterial	Collectors	Locals
CDB	0.884140	0.800000	0.914005	0.632017	1.000000
Urban	0.768691	0.666774	0.681443	0.561517	1.000000
Urban Fringe	0.788328	0.786526	0.706007	0.627699	1.000000
Suburban	0.901161	0.875610	0.851381	1.008621	1.000000
Rural	0.853617	0.936414	0.996467	1.155717	1.000000

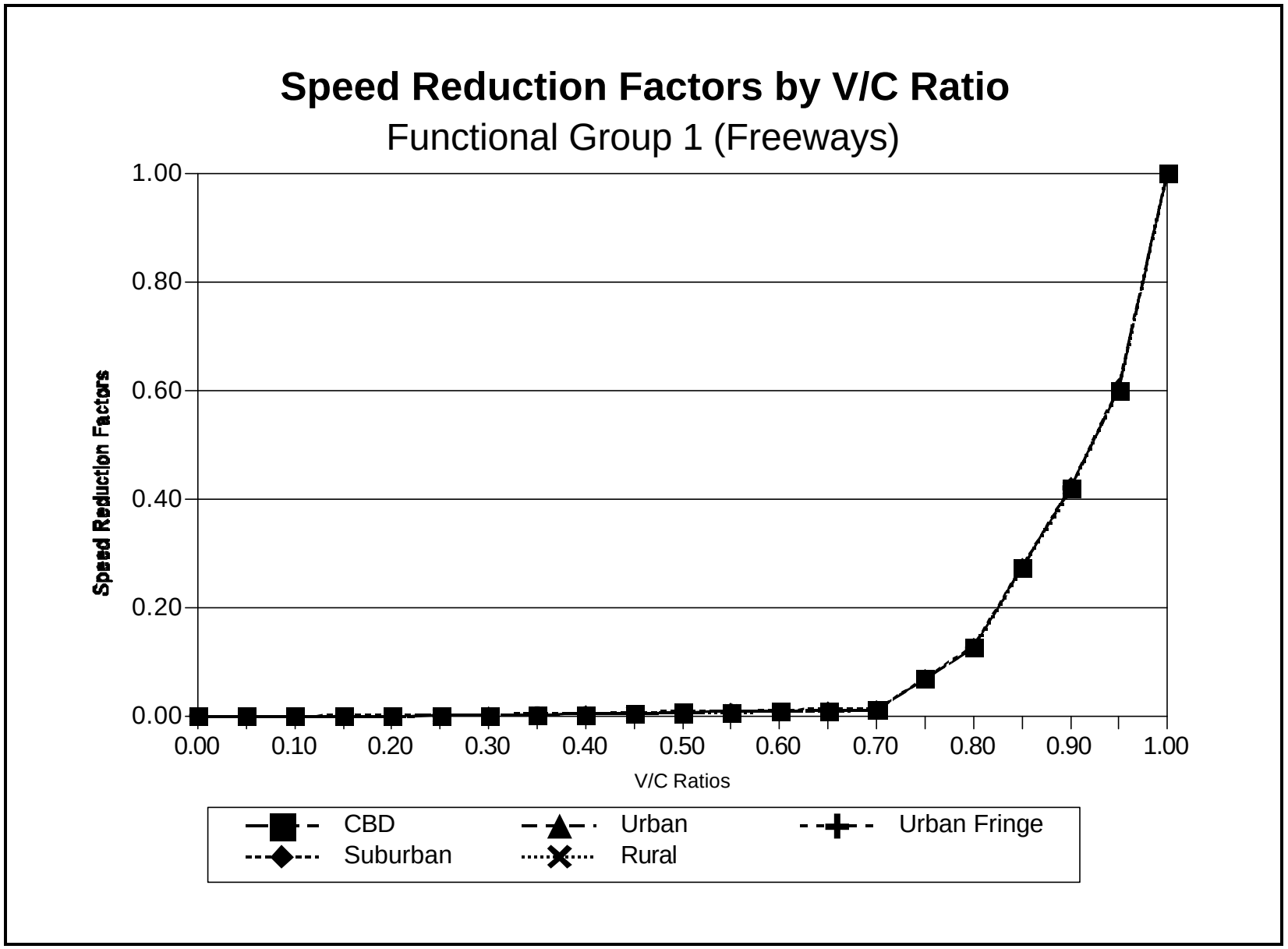


FIGURE 1. Freeway Speed Reduction Factors by V/C Ratio

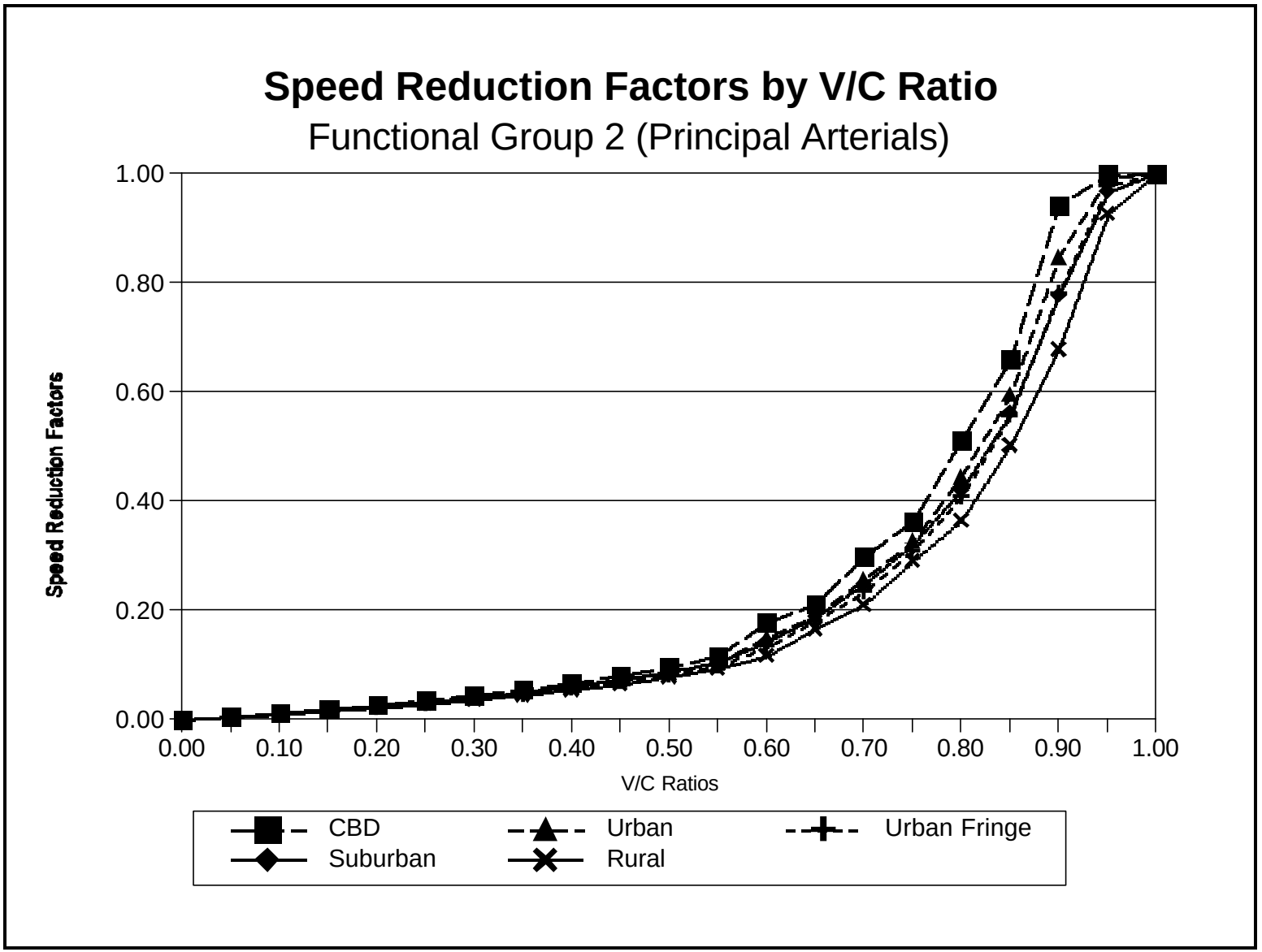


FIGURE 2. Principal Arterial Speed Reduction Factors by V/C Ratio

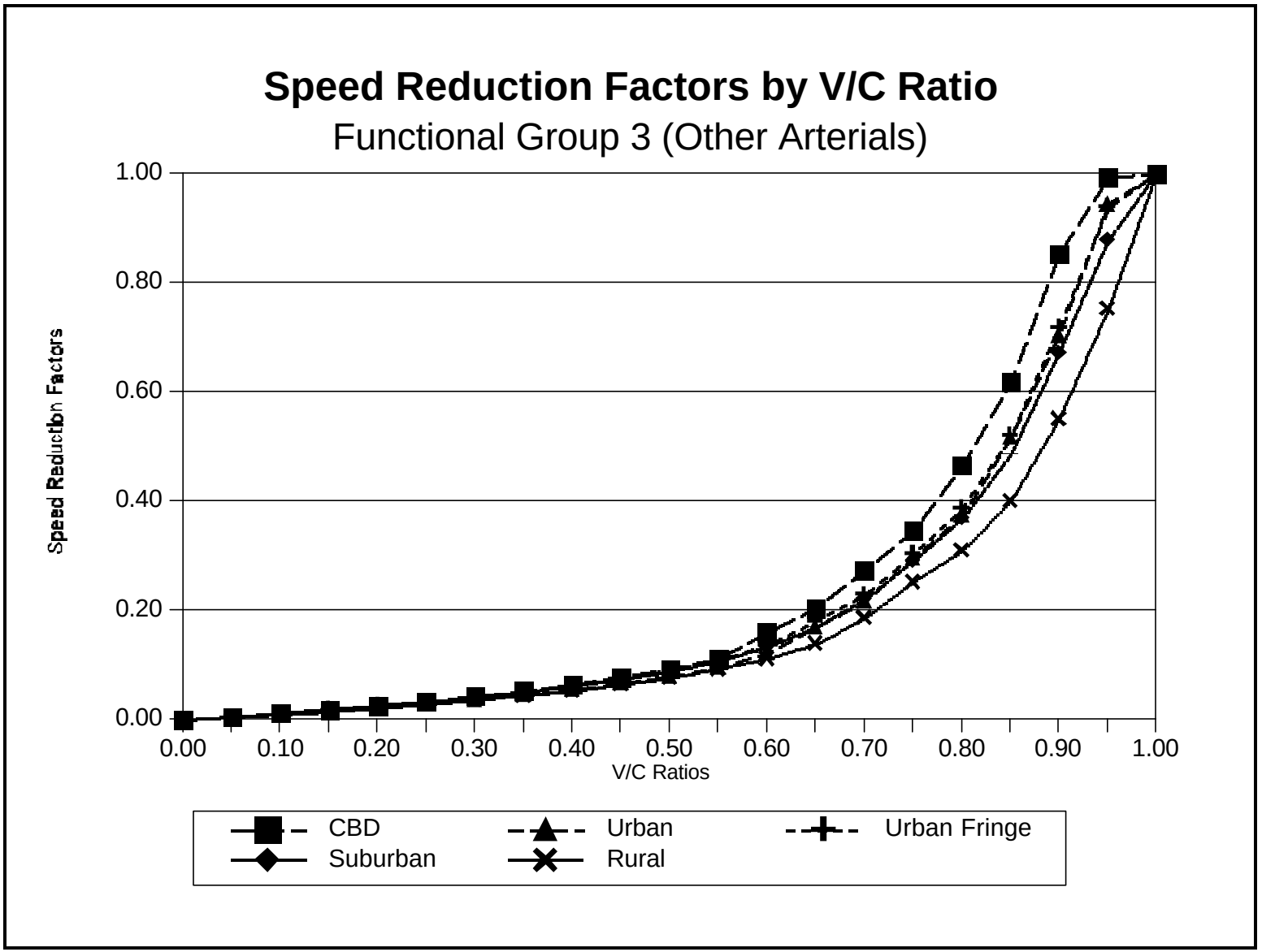


FIGURE 3. Other Arterial Speed Reduction Factors by V/C Ratio

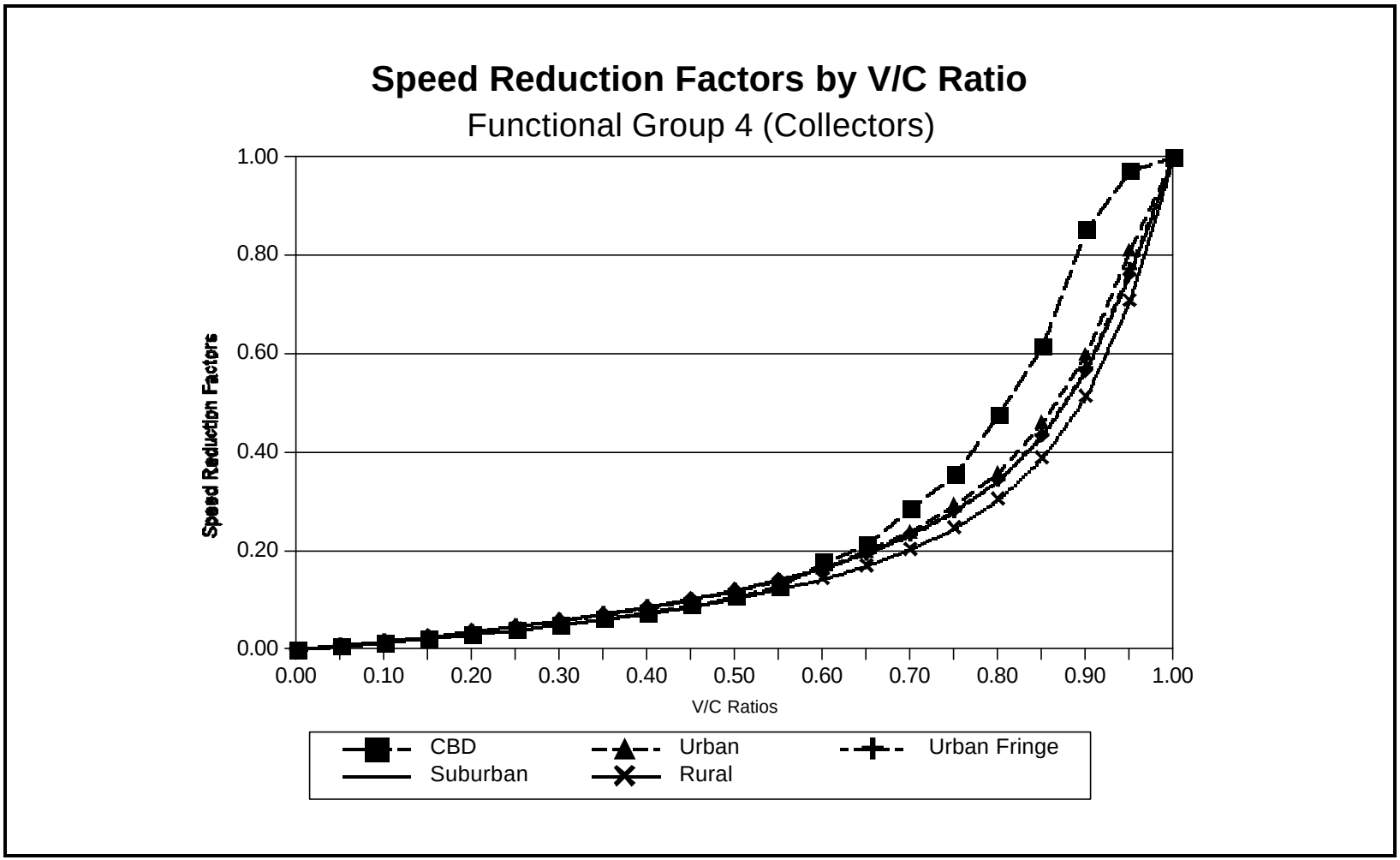


FIGURE 4. Collector Speed Reduction Factors by V/C Ratio

APPENDIX E
HGA COUNTY AUGUST 2000 EPISODE DAY HOURLY TEMPERATURES INPUT TO MOBILE6

HGA County August 2000 Episode Day Hourly Temperatures (degrees F) Input to MOBILE6
Central Daylight (Local) Time (calendar day temperatures; ordered as 6am to 12am, 12am to 6am)

BRAZ = Brazoria
CHAM = Chambers
FORT = Fort Bend
GALV = Galveston
HARR = Harris
LIBE = Liberty
MONT = Montgomery
WALL = Waller

AUG22

BRAZ
HOURLY TEMPERATURES: 79.2 80.6 81.8 81.2 83.2 85.7 88.5 89.4 89.9 89.8 88.8 87.5 85.3 83.5 81.5 80.6 79.7 78.7 79.1 77.8 78.1 77.8 77.0 77.3

CHAM
HOURLY TEMPERATURES: 76.9 77.6 80.7 84.7 85.6 85.7 84.0 81.3 83.4 86.3 88.9 89.0 87.1 85.2 82.9 81.8 80.9 79.8 78.5 80.6 79.7 79.1 77.9 77.3

FORT
HOURLY TEMPERATURES: 77.4 78.8 82.5 85.1 87.3 86.4 80.2 83.2 87.9 89.7 89.8 89.2 88.7 87.4 85.7 83.9 82.5 81.3 80.0 80.4 79.5 78.9 78.2 77.7

GALV
HOURLY TEMPERATURES: 83.3 82.7 84.0 84.9 85.4 85.7 85.4 85.3 86.0 86.7 86.9 86.5 86.1 85.5 85.0 84.6 84.7 84.8 84.5 84.4 84.2 84.1 84.0 83.8

HARR
HOURLY TEMPERATURES: 78.8 79.7 82.1 84.6 85.6 84.6 82.9 83.5 85.7 87.3 88.5 88.9 88.2 86.3 84.6 83.5 82.8 81.8 80.9 81.2 80.4 79.9 79.3 79.0

LIBE
HOURLY TEMPERATURES: 74.0 75.1 78.9 83.2 85.4 85.0 81.5 78.8 78.7 81.5 84.2 85.8 85.2 83.4 80.8 79.5 79.1 77.5 76.3 77.1 76.4 75.4 74.6 74.4

MONT
HOURLY TEMPERATURES: 73.3 77.3 81.4 84.4 86.5 88.9 80.6 77.3 74.0 77.1 80.2 82.1 81.1 79.8 78.4 76.6 76.7 75.8 74.3 76.7 74.7 73.8 72.5 72.1

WALL
HOURLY TEMPERATURES: 78.4 78.3 80.9 85.5 87.7 90.0 92.4 87.7 89.0 89.2 89.8 90.4 91.8 89.6 86.9 84.5 83.9 82.5 80.6 79.8 78.8 77.9 77.4 77.5

AUG23

BRAZ
HOURLY TEMPERATURES: 77.1 79.2 83.3 84.4 81.9 80.5 83.0 83.9 86.8 88.2 88.0 86.1 84.3 82.1 80.4 78.9 78.2 77.8 77.7 79.9 79.3 78.8 76.8 76.7

CHAM
HOURLY TEMPERATURES: 74.2 75.2 78.1 81.8 78.6 76.0 77.1 78.9 80.7 83.1 85.7 85.6 85.3 83.9 82.6 82.1 81.3 79.5 77.8 77.2 76.1 75.3 74.5 74.0

FORT
HOURLY TEMPERATURES: 76.9 77.4 80.5 81.6 82.3 85.8 85.7 84.1 85.5 87.5 89.5 89.9 88.5 87.2 85.3 83.6 82.1 80.6 79.7 79.0 78.3 77.7 77.0 76.6

GALV
HOURLY TEMPERATURES: 81.0 79.2 80.2 82.3 83.6 82.0 80.0 80.5 82.1 83.3 84.4 85.4 85.4 84.4 83.8 83.6 83.8 83.8 83.7 84.4 84.3 84.0 83.9 83.4

HARR
HOURLY TEMPERATURES: 76.8 77.2 79.5 81.6 80.8 81.6 82.6 83.4 84.4 85.6 86.7 87.0 86.2 84.8 83.2 82.5 81.6 80.7 80.1 80.3 79.4 78.9 78.1 77.2

LIBE
HOURLY TEMPERATURES: 74.1 74.2 75.9 79.0 80.8 81.4 82.6 79.2 79.1 83.0 84.9 84.9 83.6 82.6 81.4 80.1 78.4 77.0 76.1 75.7 74.8 74.6 74.1 73.8

MONT
HOURLY TEMPERATURES: 72.3 73.0 76.8 79.8 83.8 86.0 82.0 80.2 80.3 82.6 82.7 82.2 80.5 79.1 76.8 74.5 72.8 71.1 69.9 76.6 75.1 74.7 72.4 71.8

WALL
HOURLY TEMPERATURES: 78.7 77.9 79.8 84.4 85.5 87.0 89.9 90.8 89.7 88.9 89.8 90.3 89.0 86.7 84.2 82.9 81.0 80.1 79.6 79.1 77.8 77.5 77.4 78.1

AUG24

BRAZ

HOURLY TEMPERATURES: 75.7 79.8 83.4 86.1 86.9 87.5 85.0 81.7 79.5 79.0 79.6 80.2 80.3 79.2 78.7 77.4 76.8 76.4 75.7 77.4 76.7 77.2 76.8 75.2

CHAM

HOURLY TEMPERATURES: 75.2 75.8 78.7 83.7 86.2 87.2 88.0 84.2 77.9 74.3 76.2 77.9 78.5 78.5 77.3 76.6 75.7 75.6 75.3 76.8 76.2 75.8 75.6 75.2

FORT

HOURLY TEMPERATURES: 76.3 77.4 81.5 85.2 87.2 88.6 90.9 93.3 91.6 85.8 85.2 83.3 82.3 81.6 80.4 79.9 78.9 78.0 77.3 79.0 78.1 77.6 77.0 76.6

GALV

HOURLY TEMPERATURES: 79.9 79.3 80.8 82.9 84.1 81.0 83.6 86.3 84.1 82.3 81.3 80.3 80.4 81.2 81.2 81.2 81.2 81.5 81.4 83.9 83.8 83.6 83.0 81.6

HARR

HOURLY TEMPERATURES: 77.7 78.6 81.2 84.2 86.1 88.2 89.5 89.3 84.3 81.3 80.2 80.0 80.0 79.6 78.8 78.2 77.7 77.3 77.3 79.5 78.8 78.2 77.4 77.5

LIBE

HOURLY TEMPERATURES: 73.9 74.4 77.3 81.5 84.6 86.0 86.4 86.5 83.1 82.2 79.5 79.9 79.6 78.9 77.5 76.8 76.1 75.4 74.7 75.5 75.4 74.9 74.6 74.3

MONT

HOURLY TEMPERATURES: 68.0 70.9 73.7 78.8 81.2 88.0 90.1 92.5 91.2 89.6 84.8 84.0 81.5 79.1 77.4 76.3 74.7 73.3 72.9 70.2 69.0 68.7 68.5 67.3

WALL

HOURLY TEMPERATURES: 77.6 77.7 79.2 84.5 87.5 91.3 93.0 95.3 96.3 97.3 83.1 83.9 82.8 82.0 81.7 81.8 82.6 82.8 82.7 78.1 78.2 78.1 77.5 77.5

AUG25

BRAZ

HOURLY TEMPERATURES: 75.6 79.8 82.9 84.9 87.1 84.6 87.2 88.5 89.8 89.4 88.7 86.3 84.3 81.8 79.8 78.3 77.5 76.4 75.7 75.5 75.8 75.1 74.1 73.5

CHAM

HOURLY TEMPERATURES: 73.1 73.4 76.3 79.8 83.4 85.8 87.8 89.8 91.1 91.3 90.7 89.1 87.4 85.1 83.2 82.0 80.2 79.2 78.6 74.6 74.1 73.5 73.3 73.3

FORT

HOURLY TEMPERATURES: 74.9 76.4 80.6 84.8 86.5 88.4 90.5 93.0 94.6 94.5 93.0 93.1 92.2 89.2 86.3 84.1 82.2 80.6 79.2 76.6 75.9 75.3 75.2 74.9

GALV

HOURLY TEMPERATURES: 78.5 78.7 80.8 81.5 82.8 84.6 85.8 86.5 87.4 87.8 87.7 87.4 86.7 85.4 84.3 83.9 83.5 83.2 83.1 81.4 80.6 79.5 78.9 78.7

HARR

HOURLY TEMPERATURES: 76.3 77.4 79.8 82.8 84.9 87.3 88.8 90.4 91.6 92.7 92.4 91.3 89.5 87.1 84.9 83.2 81.7 80.6 79.5 77.1 76.4 76.0 75.7 75.9

LIBE

HOURLY TEMPERATURES: 72.3 72.7 75.2 79.1 82.4 84.9 86.8 89.0 90.8 91.6 91.4 90.6 89.0 86.4 83.6 81.5 79.9 78.7 77.7 73.9 73.3 72.7 72.6 72.3

MONT

HOURLY TEMPERATURES: 70.7 72.9 78.0 82.7 85.6 88.0 90.7 92.8 94.5 95.3 94.8 93.9 91.4 88.1 84.9 82.9 80.9 79.0 77.3 72.0 71.9 70.8 70.6 70.3

WALL

HOURLY TEMPERATURES: 82.3 82.3 79.7 83.8 87.1 87.8 92.5 94.8 95.3 97.6 97.5 97.0 95.0 92.0 89.0 86.7 84.5 82.1 80.8 83.1 82.1 82.2 82.4 82.1

AUG26

BRAZ

HOURLY TEMPERATURES: 75.4 79.4 83.3 85.4 86.9 89.8 90.9 91.0 91.2 90.4 89.7 88.2 85.6 83.4 82.0 81.3 79.2 78.6 78.4 75.9 75.8 75.2 74.8 73.9

CHAM

HOURLY TEMPERATURES: 74.4 74.6 77.9 82.1 84.9 87.0 88.0 90.4 92.1 92.6 92.1 90.4 88.1 85.7 84.1 82.7 81.7 79.9 78.5 78.4 78.0 77.5 76.3 75.1

FORT

HOURLY TEMPERATURES: 74.4 75.4 81.0 85.0 87.5 89.7 92.0 93.3 93.7 96.4 96.8 94.9 93.0 89.9 86.5 83.9 81.9 80.3 78.9 78.2 77.5 76.8 75.5 74.9

GALV

HOURLY TEMPERATURES: 79.0 79.0 79.6 82.4 84.1 85.0 85.8 86.7 87.6 88.6 88.7 88.2 87.2 85.8 84.7 84.3 84.1 83.8 83.6 82.8 82.0 80.3 79.7 78.8

HARR

HOURLY TEMPERATURES: 76.3 77.3 80.5 84.0 86.6 88.7 90.5 92.1 93.3 93.9 93.5 92.4 90.6 87.9 85.1 83.1 81.7 80.5 79.5 78.5 77.7 77.2 76.5 76.0

LIBE

HOURLY TEMPERATURES: 72.5 72.9 76.6 80.7 83.7 86.3 88.4 90.2 92.0 92.7 92.8 92.0 90.0 86.8 84.0 82.0 80.3 78.4 77.3 76.7 75.7 74.8 73.7 72.9

MONT

HOURLY TEMPERATURES: 70.9 75.1 79.1 83.9 86.9 90.2 91.6 94.6 96.3 96.2 96.7 95.2 92.1 89.0 86.2 83.3 81.1 78.5 76.6 75.3 74.1 73.1 71.5 70.7

WALL

HOURLY TEMPERATURES: 79.9 77.9 79.3 84.4 88.8 91.2 93.3 95.2 97.7 98.7 99.4 99.6 98.1 93.3 89.6 87.4 84.8 82.7 81.2 79.9 79.0 78.3 79.0 79.7

AUG27

BRAZ
HOURLY TEMPERATURES: 78.6 82.3 85.1 87.0 88.2 90.9 91.0 92.1 91.0 89.9 89.0 87.2 84.8 82.7 81.5 80.0 79.3 77.9 77.9 77.7 77.9 77.6 78.1 77.5

CHAM
HOURLY TEMPERATURES: 75.7 76.2 78.8 82.6 85.8 87.8 90.7 91.8 91.6 91.4 90.6 89.5 87.7 85.5 84.1 83.5 82.7 82.6 82.3 77.5 77.5 77.2 76.8 76.3

FORT
HOURLY TEMPERATURES: 75.1 76.1 81.6 85.7 88.0 90.7 92.9 94.9 96.1 95.4 95.8 93.8 91.7 89.2 86.4 84.1 82.4 81.1 79.8 78.1 77.2 76.4 76.0 75.3

GALV
HOURLY TEMPERATURES: 82.7 81.2 82.0 84.4 86.0 87.3 88.4 88.7 89.2 89.1 88.8 88.1 87.0 85.8 85.0 84.5 84.3 84.3 84.2 83.4 83.4 83.3 83.3 83.0

HARR
HOURLY TEMPERATURES: 76.9 78.2 81.4 84.4 87.2 89.8 91.6 93.0 93.3 93.4 93.0 91.7 89.8 87.3 85.0 83.3 82.2 81.4 80.4 78.9 78.4 78.0 77.6 77.0

LIBE
HOURLY TEMPERATURES: 71.9 72.7 77.0 81.9 84.9 87.7 90.3 92.0 92.4 92.9 92.5 91.3 88.9 86.1 83.7 82.2 80.7 79.7 78.9 76.3 75.1 74.1 73.4 72.4

MONT
HOURLY TEMPERATURES: 70.3 75.3 80.7 85.7 88.2 91.3 93.6 95.9 96.1 96.6 96.5 94.1 90.6 87.5 85.1 83.0 80.5 79.0 77.2 74.5 72.1 70.6 70.2 69.2

WALL
HOURLY TEMPERATURES: 78.1 76.7 80.4 86.4 88.5 92.1 94.3 96.1 98.1 99.9 100.8 97.2 95.6 92.0 89.3 87.1 84.8 83.1 82.2 79.7 78.9 78.3 78.2 78.0

AUG28

BRAZ

HOURLY TEMPERATURES: 77.0 82.1 85.2 87.7 90.0 91.0 91.8 92.2 92.4 91.5 89.7 88.1 85.2 82.7 81.1 80.0 79.0 78.3 77.2 76.9 76.5 76.5 76.2 75.6

CHAM

HOURLY TEMPERATURES: 76.9 76.7 80.2 84.3 85.7 87.9 89.3 90.8 92.5 92.9 91.6 90.1 88.1 85.5 83.7 82.5 82.1 79.9 78.8 81.7 80.4 79.0 78.1 77.8

FORT

HOURLY TEMPERATURES: 75.7 76.8 81.7 86.0 88.8 91.1 93.0 94.9 96.2 97.9 98.2 96.6 93.8 90.6 87.1 84.6 82.7 81.2 80.1 78.8 78.1 77.2 76.8 76.2

GALV

HOURLY TEMPERATURES: 82.3 81.5 81.9 83.0 85.2 87.0 88.4 89.6 90.2 89.9 89.4 88.4 87.5 86.0 85.0 84.6 84.3 84.2 84.0 84.2 84.0 83.8 83.7 83.3

HARR

HOURLY TEMPERATURES: 77.4 78.8 82.3 85.5 87.8 90.2 92.1 93.8 94.6 95.0 94.7 93.3 91.1 88.2 85.3 83.4 82.3 81.2 80.2 79.8 79.2 78.7 78.1 77.5

LIBE

HOURLY TEMPERATURES: 72.9 73.5 77.7 82.6 85.6 88.0 89.6 91.2 92.7 93.5 93.3 91.9 89.9 86.7 83.8 81.7 80.3 78.5 77.6 78.2 76.7 75.1 74.2 73.5

MONT

HOURLY TEMPERATURES: 71.5 76.1 81.1 85.1 88.6 90.6 92.7 96.3 95.5 96.9 96.6 95.4 92.7 89.0 85.6 83.9 81.2 79.7 77.9 75.6 74.7 72.5 72.1 70.4

WALL

HOURLY TEMPERATURES: 81.6 80.9 81.1 87.1 89.9 92.8 95.2 96.4 99.0 99.0 99.1 100.6 98.8 93.9 90.0 87.6 85.3 83.6 82.5 81.2 80.6 80.2 80.4 80.8

AUG29

BRAZ

HOURLY TEMPERATURES: 77.8 82.6 85.4 87.3 89.6 91.7 92.7 94.4 93.5 92.3 91.0 88.6 85.8 82.9 82.0 80.1 77.8 78.0 76.9 76.6 76.6 76.1 75.7 75.7

CHAM

HOURLY TEMPERATURES: 75.3 74.8 78.4 82.6 86.3 89.0 91.3 93.4 94.5 95.1 94.6 93.1 90.6 87.1 84.5 82.3 80.6 79.8 79.2 78.6 78.4 77.5 76.3 75.3

FORT

HOURLY TEMPERATURES: 75.3 76.1 81.3 85.9 88.3 90.7 93.4 95.8 97.7 99.2 99.5 98.4 94.6 91.0 87.8 85.7 83.8 82.3 81.0 79.0 78.3 77.7 76.5 75.7

GALV

HOURLY TEMPERATURES: 80.4 79.1 81.3 83.8 85.6 87.7 87.9 88.5 89.5 89.6 89.5 89.3 88.5 87.0 86.0 85.1 84.8 84.2 83.5 83.9 83.8 83.8 82.9 81.5

HARR

HOURLY TEMPERATURES: 76.9 78.0 81.4 85.1 88.0 90.6 92.8 94.7 96.2 97.3 96.9 95.1 92.6 89.4 86.3 84.5 83.0 81.7 80.5 79.2 78.5 77.9 77.3 76.9

LIBE

HOURLY TEMPERATURES: 72.7 72.8 77.2 81.7 85.1 87.9 90.4 92.7 94.4 95.8 96.4 95.3 93.1 89.2 85.8 83.2 81.1 79.8 79.3 76.8 76.2 75.2 73.6 73.0

MONT

HOURLY TEMPERATURES: 71.0 76.1 80.9 85.2 88.2 91.9 94.9 96.2 98.3 99.6 100.0 99.1 96.1 92.9 88.8 86.4 84.1 82.6 82.0 76.4 75.3 73.5 71.2 70.4

WALL

HOURLY TEMPERATURES: 79.7 79.8 79.0 85.9 89.7 93.6 95.8 97.2 99.2 101.9 102.5 102.1 100.9 96.4 91.7 89.0 86.8 84.9 82.9 81.4 80.8 80.6 80.8 80.3

AUG30

BRAZ
HOURLY TEMPERATURES: 76.5 79.7 83.4 86.5 89.7 92.8 95.7 97.9 99.4 98.2 95.2 91.9 88.7 85.9 84.4 82.7 80.9 79.1 78.8 76.3 75.3 74.2 75.4 75.2

CHAM
HOURLY TEMPERATURES: 75.5 75.8 78.9 83.1 86.7 90.2 93.3 96.2 98.6 100.2 100.3 99.5 97.1 91.7 87.9 84.9 83.5 83.2 82.2 78.8 78.2 78.1 77.8 76.8

FORT
HOURLY TEMPERATURES: 76.7 77.2 80.0 83.1 86.9 90.1 93.9 97.7 100.3 101.8 102.5 103.3 101.8 98.3 93.2 90.1 87.9 86.1 84.3 80.2 79.3 78.2 77.8 77.3

GALV
HOURLY TEMPERATURES: 77.8 77.2 78.4 81.1 85.0 88.7 91.5 92.9 93.3 94.0 93.9 93.2 91.2 88.2 86.3 85.5 84.6 84.0 82.8 82.0 81.1 79.8 78.7 78.4

HARR
HOURLY TEMPERATURES: 78.1 78.8 81.1 84.3 87.9 91.1 94.4 97.2 99.3 100.9 101.6 101.1 98.9 94.6 90.3 88.0 86.4 85.2 83.8 79.8 79.1 78.3 78.0 77.9

LIBE
HOURLY TEMPERATURES: 74.8 75.0 77.8 81.5 85.4 89.0 92.5 95.7 98.1 100.0 100.8 100.5 98.8 93.8 88.9 86.6 84.9 83.7 82.4 78.7 77.8 76.5 75.8 75.4

MONT
HOURLY TEMPERATURES: 76.8 78.2 82.0 85.6 88.7 92.7 96.2 99.5 100.7 102.2 102.8 102.5 97.2 92.9 91.5 87.4 87.1 86.3 84.6 80.2 78.8 77.7 76.6 76.5

WALL
HOURLY TEMPERATURES: 81.8 81.6 80.3 83.5 89.1 93.7 97.6 100.8 103.5 105.5 105.6 105.7 104.8 100.7 95.8 93.1 91.2 88.6 85.8 81.3 80.5 80.3 79.9 80.2

AUG31

BRAZ

HOURLY TEMPERATURES: 77.4 80.2 84.4 89.2 92.5 96.3 99.3 100.9 102.0 102.4 100.9 97.6 92.9 89.2 86.5 84.0 82.6 80.9 79.9 77.8 77.4 76.8 76.3 76.0

CHAM

HOURLY TEMPERATURES: 78.3 78.5 81.9 86.2 90.9 95.4 98.9 101.2 103.2 104.1 104.0 103.2 100.4 95.1 92.0 90.0 88.6 87.1 84.0 79.9 79.5 79.9 79.6 78.3

FORT

HOURLY TEMPERATURES: 78.0 78.0 80.9 85.4 90.2 95.2 99.7 102.5 103.7 104.9 105.7 105.8 104.1 101.2 97.9 94.7 91.4 88.7 86.5 82.7 81.5 80.3 79.6 78.9

GALV

HOURLY TEMPERATURES: 78.4 77.9 78.8 82.7 87.2 92.1 96.1 98.5 98.9 98.6 97.9 96.8 94.8 91.9 89.9 88.7 87.7 86.1 84.8 81.0 79.8 80.5 79.6 79.1

HARR

HOURLY TEMPERATURES: 78.7 79.8 83.4 87.5 92.2 96.5 100.0 102.2 103.6 104.5 104.6 104.3 102.1 98.6 95.4 92.8 90.7 88.4 86.5 82.7 81.7 80.8 80.3 79.5

LIBE

HOURLY TEMPERATURES: 76.0 76.4 80.6 85.8 91.2 95.6 98.6 100.9 102.7 103.5 103.9 103.8 101.6 96.5 91.6 90.0 88.4 86.5 84.5 81.2 80.1 79.4 78.2 76.8

MONT

HOURLY TEMPERATURES: 74.7 81.3 86.6 92.0 96.6 100.3 102.7 102.7 104.7 104.4 104.5 103.8 98.6 93.8 91.4 89.8 86.8 88.8 87.1 83.5 80.5 78.0 76.1 74.4

WALL

HOURLY TEMPERATURES: 76.2 76.6 81.5 89.4 95.3 99.7 102.5 105.1 107.4 107.9 108.1 108.5 107.3 103.8 99.0 94.9 92.3 89.2 86.9 83.2 81.2 80.2 78.7 77.3

SEP01

BRAZ

HOURLY TEMPERATURES: 77.0 80.3 84.4 88.4 91.4 94.7 96.9 98.4 98.0 97.7 96.1 93.3 89.5 86.7 86.3 83.7 83.2 82.1 83.0 79.2 78.4 77.8 77.4 76.8

CHAM

HOURLY TEMPERATURES: 77.7 78.5 82.6 86.1 90.8 94.2 96.7 99.6 101.5 102.9 104.0 95.0 87.2 84.6 82.7 81.8 80.8 81.1 82.0 82.3 80.9 79.0 77.3 76.5

FORT

HOURLY TEMPERATURES: 79.8 80.0 82.2 85.5 89.0 92.9 96.6 100.0 102.2 102.8 102.6 103.6 99.2 88.4 84.7 84.0 84.1 82.7 82.0 84.9 83.7 82.5 81.4 80.3

GALV

HOURLY TEMPERATURES: 80.7 79.5 80.5 83.3 86.6 89.8 92.3 93.6 93.4 92.8 92.5 92.9 93.1 91.2 90.1 89.8 88.1 86.1 85.4 83.6 82.1 80.8 80.4 81.4

HARR

HOURLY TEMPERATURES: 80.5 81.2 83.9 87.5 91.0 94.2 97.5 100.5 102.5 103.4 102.3 100.0 90.4 86.2 85.8 85.3 84.4 83.4 83.3 85.1 83.6 82.3 81.4 80.6

LIBE

HOURLY TEMPERATURES: 77.6 78.1 81.9 86.2 90.2 93.9 96.8 99.3 101.1 101.7 101.3 90.0 85.4 85.1 82.6 81.4 80.8 80.2 80.8 82.5 82.1 80.2 78.4 76.9

MONT

HOURLY TEMPERATURES: 78.7 83.2 87.4 92.2 96.2 100.0 102.8 104.1 104.7 104.5 96.3 90.1 87.9 86.1 84.1 82.3 80.0 80.4 80.2 83.1 81.4 79.4 77.9 76.9

WALL

HOURLY TEMPERATURES: 79.7 78.8 83.2 89.9 95.2 98.7 102.4 104.3 106.4 107.8 107.4 104.6 88.0 86.6 87.5 88.2 86.7 85.1 83.5 85.6 83.8 81.9 81.2 80.8

APPENDIX F
HGA COUNTY AUGUST 2000 EPISODE DAY ABSOLUTE HUMIDITY INPUTS TO MOBILE 6

Daily Absolute Humidity (grains water per pound dry air)

Highest hourly value which will not allow a relative humidity to exceed 100 for any hour of the 24-hour period (calculated by TNRCC).

County Codes Key:

BRAZ	=	Brazoria
CHAM	=	Chambers
FORT	=	Fort Bend
GALV	=	Galveston
HARR	=	Harris
LIBE	=	Liberty
MONT	=	Montgomery
WALL	=	Waller

AUG22

BRAZ
ABSOLUTE HUMIDITY : 138.3
CHAM
ABSOLUTE HUMIDITY : 137.6
FORT
ABSOLUTE HUMIDITY : 140.1
GALV
ABSOLUTE HUMIDITY : 167.6
HARR
ABSOLUTE HUMIDITY : 147.1
LIBE
ABSOLUTE HUMIDITY : 124.4
MONT
ABSOLUTE HUMIDITY : 116.5
WALL
ABSOLUTE HUMIDITY : 140.0

AUG23
BRAZ
ABSOLUTE HUMIDITY : 136.5
CHAM
ABSOLUTE HUMIDITY : 124.5
FORT
ABSOLUTE HUMIDITY : 136.4
GALV
ABSOLUTE HUMIDITY : 148.7
HARR
ABSOLUTE HUMIDITY : 137.2
LIBE
ABSOLUTE HUMIDITY : 123.6
MONT
ABSOLUTE HUMIDITY : 112.5
WALL
ABSOLUTE HUMIDITY : 140.0

AUG24
BRAZ
ABSOLUTE HUMIDITY : 129.8
CHAM
ABSOLUTE HUMIDITY : 126.1
FORT
ABSOLUTE HUMIDITY : 134.9
GALV
ABSOLUTE HUMIDITY : 149.4
HARR
ABSOLUTE HUMIDITY : 139.8
LIBE
ABSOLUTE HUMIDITY : 124.4
MONT
ABSOLUTE HUMIDITY : 98.5
WALL
ABSOLUTE HUMIDITY : 140.6

AUG25
BRAZ
ABSOLUTE HUMIDITY : 122.6
CHAM
ABSOLUTE HUMIDITY : 121.0
FORT
ABSOLUTE HUMIDITY : 128.4
GALV
ABSOLUTE HUMIDITY : 145.2
HARR
ABSOLUTE HUMIDITY : 132.3
LIBE
ABSOLUTE HUMIDITY : 117.6
MONT
ABSOLUTE HUMIDITY : 109.5
WALL
ABSOLUTE HUMIDITY : 151.5

AUG26
BRAZ
ABSOLUTE HUMIDITY : 124.3
CHAM
ABSOLUTE HUMIDITY : 126.2
FORT
ABSOLUTE HUMIDITY : 126.5
GALV
ABSOLUTE HUMIDITY : 146.9
HARR
ABSOLUTE HUMIDITY : 133.7
LIBE
ABSOLUTE HUMIDITY : 118.1
MONT
ABSOLUTE HUMIDITY : 111.0
WALL
ABSOLUTE HUMIDITY : 142.5

AUG27
BRAZ
ABSOLUTE HUMIDITY : 140.4
CHAM
ABSOLUTE HUMIDITY : 132.1
FORT
ABSOLUTE HUMIDITY : 129.3
GALV
ABSOLUTE HUMIDITY : 159.5
HARR
ABSOLUTE HUMIDITY : 137.5
LIBE
ABSOLUTE HUMIDITY : 115.8
MONT
ABSOLUTE HUMIDITY : 105.3
WALL
ABSOLUTE HUMIDITY : 136.7

AUG28
BRAZ
ABSOLUTE HUMIDITY : 131.8
CHAM
ABSOLUTE HUMIDITY : 136.8
FORT
ABSOLUTE HUMIDITY : 132.1
GALV
ABSOLUTE HUMIDITY : 160.8
HARR
ABSOLUTE HUMIDITY : 140.2
LIBE
ABSOLUTE HUMIDITY : 119.8
MONT
ABSOLUTE HUMIDITY : 109.8
WALL
ABSOLUTE HUMIDITY : 154.1

AUG29
BRAZ
ABSOLUTE HUMIDITY : 132.1
CHAM
ABSOLUTE HUMIDITY : 128.3
FORT
ABSOLUTE HUMIDITY : 130.2
GALV
ABSOLUTE HUMIDITY : 148.3
HARR
ABSOLUTE HUMIDITY : 137.5
LIBE
ABSOLUTE HUMIDITY : 119.2
MONT
ABSOLUTE HUMIDITY : 109.8
WALL
ABSOLUTE HUMIDITY : 147.9

AUG30
BRAZ
ABSOLUTE HUMIDITY : 125.6
CHAM
ABSOLUTE HUMIDITY : 131.4
FORT
ABSOLUTE HUMIDITY : 136.9
GALV
ABSOLUTE HUMIDITY : 139.1
HARR
ABSOLUTE HUMIDITY : 142.4
LIBE
ABSOLUTE HUMIDITY : 128.0
MONT
ABSOLUTE HUMIDITY : 135.7
WALL
ABSOLUTE HUMIDITY : 152.5

AUG31
BRAZ
ABSOLUTE HUMIDITY : 133.3
CHAM
ABSOLUTE HUMIDITY : 144.4
FORT
ABSOLUTE HUMIDITY : 143.0
GALV
ABSOLUTE HUMIDITY : 142.5
HARR
ABSOLUTE HUMIDITY : 146.7
LIBE
ABSOLUTE HUMIDITY : 133.3
MONT
ABSOLUTE HUMIDITY : 126.2
WALL
ABSOLUTE HUMIDITY : 134.5

SEP01
BRAZ
ABSOLUTE HUMIDITY : 137.0
CHAM
ABSOLUTE HUMIDITY : 136.0
FORT
ABSOLUTE HUMIDITY : 152.1
GALV
ABSOLUTE HUMIDITY : 150.6
HARR
ABSOLUTE HUMIDITY : 155.8
LIBE
ABSOLUTE HUMIDITY : 137.9
MONT
ABSOLUTE HUMIDITY : 137.7
WALL
ABSOLUTE HUMIDITY : 146.9

1. 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.