SUMMARY OF DEVELOPMENT AND PROCESSING OF ONROAD MOBILE SOURCE INVENTORIES USED FOR PHOTOCHEMICAL MODELING EFFORTS IN TEXAS

Introduction

The purpose of this document is to detail both the development and processing of the onroad mobile source inventories which are used for photochemical modeling efforts by the TCEQ. Specific attention is dedicated to the onroad mobile source inventories used in attainment demonstration State Implementation Plans (SIPs) for the following ozone nonattainment areas in Texas:

- Beaumont/Port Arthur (BPA) area;
- Dallas/Fort Worth (DFW); and
- Houston/Galveston/Brazoria (HGB).

Chapter 3 of the specific attainment demonstration SIP for each area contains a less detailed summary of the information presented in this document. Due to the fact that onroad mobile source inventories are constantly being updated, it is expected that this document will undergo constant revision. As of April 23, 2004, detailed onroad inventory descriptions are provided for the BPA and HGB nonattainment areas for both the 2000 base case and 2007 future case. At a later time, 1999 base case and 2007 future case information will be provided for the DFW area. Additional information will also be provided for other calendar years and areas of the State not mentioned above.

Within the narrative of this document, the discussion of onroad inventory data used for photochemical modeling purposes is divided by nonattainment area. Within the discussion for each nonattainment area, both inventory "development" and "processing" phases are separated. Inventory development work is typically contracted out by the TCEQ to various parties. The inventory processing work is performed by TCEQ staff both to make appropriate adjustments and to convert the data into a binary "gridded" format which is necessary for photochemical model input.

2000 & 2007 Onroad Inventory Data Used for HGB Nonattainment Area

The purpose of this section is to summarize the 8-County HGB area onroad mobile source emission inventory data which were input into the photochemical model for both the 2000 base case and the 2007 future case. For each of these calendar years, emission inventory data were developed for the August 18-September 6 episode days.

8-County HGB Area Onroad Inventory Development

Typically, an onroad mobile source inventory is the mathematical product of emission rates in units of grams-per-mile (gpm) with vehicle miles traveled (VMT) estimates. The emission rates for 28 different vehicle types are obtained from the EPA MOBILE6.2 emissions model for the NO_X, VOC, and CO pollutants. A summary of the 28 MOBILE6 vehicle types can be found in Table 1. For the 8-County HGB area, the VMT data is based on the travel demand modeling work performed by the Houston-Galveston Area Council (HGAC). This travel demand modeling analysis segments the entire roadway network for the 8-County HGB area into "links" and "zones". With the exception of small local streets, each roadway segment is a single link.

Table 1. Summary of MOBILE6.2 Vehicle Types

Vehicle Type Code	*Numeric Code*	*Vehicle Type Description*
LDGV	1	Light-Duty Gasoline Vehicles (Passenger Cars)
LDGT1	2	Light-Duty Gasoline Trucks 1 (0-6,000 lbs. GVWR, 0-3,750 lbs. LVW)
LDGT2	3	Light-Duty Gasoline Trucks 2 (0-6,000 lbs. GVWR, 3,751-5,750 lbs. LVW)
LDGT3	4	Light-Duty Gasoline Trucks 3 (6,001-8,500 lbs. GVWR, 0-5,750 lbs. ALVW)
LDGT4	5	Light-Duty Gasoline Trucks 4 (6,001-8,500 lbs. GVWR, 5,751 lbs. and greater ALVW)
HDGV2b	6	Class 2b Heavy-Duty Gasoline Vehicles (8,501-10,000 lbs. GVWR)
HDGV3	7	Class 3 Heavy-Duty Gasoline Vehicles (10,001-14,000 lbs. GVWR)
HDGV4	8	Class 4 Heavy-Duty Gasoline Vehicles (14,001-16,000 lbs. GVWR)
HDGV5	9	Class 5 Heavy-Duty Gasoline Vehicles (16,001-19,500 lbs. GVWR)
HDGV6	10	Class 6 Heavy-Duty Gasoline Vehicles (19,501-26,000 lbs. GVWR)
HDGV7	11	Class 7 Heavy-Duty Gasoline Vehicles (26,001-33,000 lbs. GVWR)
HDGV8a	12	Class 8a Heavy-Duty Gasoline Vehicles (33,001-60,000 lbs. GVWR)
HDGV8b	13	Class 8b Heavy-Duty Gasoline Vehicles (>60,000 lbs. GVWR)
LDDV	14	Light-Duty Diesel Vehicles (Passenger Cars)
LDDT12	15	Light-Duty Diesel Trucks 1and 2 (0-6,000 lbs. GVWR)
HDDV2b	16	Class 2b Heavy-Duty Diesel Vehicles (8,501-10,000 lbs. GVWR)

HDDV3	17	Class 3 Heavy-Duty Diesel Vehicles (10,001-14,000 lbs. GVWR)
HDDV4	18	Class 4 Heavy-Duty Diesel Vehicles (14,001-16,000 lbs. GVWR)
HDDV5	19	Class 5 Heavy-Duty Diesel Vehicles (16,001-19,500 lbs. GVWR)
HDDV6	20	Class 6 Heavy-Duty Diesel Vehicles (19,501-26,000 lbs. GVWR)
HDDV7	21	Class 7 Heavy-Duty Diesel Vehicles (26,001-33,000 lbs. GVWR)
HDDV8a	22	Class 8a Heavy-Duty Diesel Vehicles (33,001-60,000 lbs. GVWR)
HDDV8b	23	Class 8b Heavy-Duty Diesel Vehicles (>60,000 lbs. GVWR)
MC	24	Motorcycles (Gasoline)
HDGB	25	Gasoline Buses (School, Transit and Urban)
HDDBT	26	Diesel Transit and Urban Buses
HDDBS	27	Diesel School Buses
LDDT34	28	Light-Duty Diesel Trucks 3 and 4 (6,001-8,500 lbs. GVWR)

Under contract to the TCEQ, the Texas Transportation Institute (TTI) obtains the travel demand model output from HGAC and estimates the hourly VMT and average speed which occurs on each roadway link and within each zone. In addition, TTI runs MOBILE6.2 for each episode day with inputs (temperature, humidity, fleet age distribution, etc.) appropriate for the HGB area. For each episode day, county, and hour, MOBILE6.2 runs are performed to estimate both "freeway" and "arterial" NO_X, VOC, and CO emission rates for speeds ranging from 2.5 to 65 mph. Thus, for each combination of county, hour, and episode day, there is both a freeway and an arterial emission rate lookup table for NO_X, VOC, and CO by speed. For each link/zone by hour, the total VMT is broken down into contributions from each of the MOBILE6 28 vehicle types. Then, the VMT for each vehicle type is multiplied by the corresponding emission rate for that vehicle type based on the average hourly speed for the link/zone.

The total output of this effort is referred to as an hourly "link-based" inventory. The links themselves are defined by their beginning and end points, or "nodes". Due to the significant level of effort that is involved in developing the onroad mobile source inventories, TCEQ staff are able to obtain excellent spatial and temporal resolution of the total daily NO_X, VOC, and CO onroad emissions estimated for the 8-County HGB area.

Tables 2 and 3 provide summaries of the total vehicle miles traveled (VMT), NO_x, VOC, and CO MOBILE6.2 emissions for the entire 8-County HGB area for each day of the episode for both the 2000 base case and the 2007 future case, respectively. For each calendar year, the Monday-Thursday episodes have very the same VMT totals and are considered to be "average Weekdays". As expected, the Friday episodes have the highest total VMT of the week, with the Saturday and Sunday episodes having the least amount of VMT. Due to the fact that Labor Day occurred on Monday September 4th in 2000, this holiday episode does not have a typical Weekday VMT. Instead, its overall VMT is similar to that for a typical Sunday. Even though the Friday episodes have the highest VMT of the week, the estimated NO_x emissions are actually

lower on Fridays than on Weekdays. This difference is due to the fact that the relative contribution of VMT from the "18-wheeler" categories (i.e., HDDV8a and HDDV8b) is lower on Fridays that on Weekdays. As expected for onroad mobile source inventories, overall VMT increases with future growth, while total emissions decrease from 2000 to 2007. This decrease is a result of the increased penetration of tighter emissions standards into the onroad fleet, coupled with simultaneous attrition of older more higher-emitting vehicles. Consistent with current Federal and State rules, the onroad inventories from TTI for 2007 include the benefits of Reformulated Gasoline (RFG), the Inspection/Maintenance (I/M) Program in all 8 HGB Counties, and the use of Texas Low Emission Diesel (LED) fuel. In addition, the 2007 onroad emissions inventory was modeled based on a maximum posted speed limit of 65 mph on appropriate freeway segments.

Table 2. VMT, NO_X, VOC, & CO Summary for 2000 MOBILE6.2 8-County HGB Inventory

Day of Week	***Episode Day***	***8-County VMT Total***	***Total Emissions*** *(tons per day)*		
			NO_X	*VOC*	*CO*
Friday	*August 18, 2000*	139,452,589	311.32	162.07	2232.50
Saturday	*August 19, 2000*	115,955,895	207.74	118.02	1769.99
Sunday	*August 20, 2000*	96,113,092	149.92	98.34	1521.62
Monday	*August 21, 2000*	127,460,894	351.60	146.08	2053.31
Tuesday	*August 22, 2000*	127,460,894	345.11	139.79	1985.04
Wednesday	*August 23, 2000*	127,460,894	344.20	137.87	1934.85
Thursday	*August 24, 2000*	127,460,894	343.68	137.69	1929.69
Friday	*August 25, 2000*	139,452,589	304.29	158.19	2206.81
Saturday	*August 26, 2000*	115,955,895	204.31	117.08	1774.58
Sunday	*August 27, 2000*	96,113,092	148.18	97.36	1519.97
Monday	*August 28, 2000*	127,460,894	350.58	145.55	2051.96
Tuesday	*August 29, 2000*	127,460,894	350.72	147.17	2072.31
Wednesday	*August 30, 2000*	127,460,894	356.70	151.07	2110.85
Thursday	*August 31, 2000*	127,460,894	362.26	156.29	2160.78
Friday	*September 1, 2000*	139,452,589	311.97	168.62	2340.63
Saturday	*September 2, 2000*	115,955,895	209.42	124.27	1903.65
Sunday	*September 3, 2000*	96,113,092	157.81	104.96	1612.41
Monday	*September 4, 2000*	127,460,894	362.85	158.39	2196.76
Tuesday	*September 5, 2000*	127,460,894	359.24	155.38	2167.14
Wednesday	*September 6, 2000*	127,460,894	355.94	142.28	1945.02

Table 3. VMT, NO_X, VOC, & CO Summary for 2007 MOBILE6.2 8-County HGB Inventory

Day of Week	***Episode Day***	***8-County VMT Total***	***Total Emissions*** *(tons per day)*		
			NO_X	*VOC*	*CO*
Friday	*August 18, 2000*	161,609,890	178.30	98.79	1408.25
Saturday	*August 19, 2000*	135,286,294	149.48	71.56	1101.19
Sunday	*August 20, 2000*	107,474,790	85.99	57.19	911.54
Monday	*August 21, 2000*	146,019,214	196.70	88.03	1268.22

Tuesday	*August 22, 2000*	146,019,214	192.25	85.14	1249.56
Wednesday	*August 23, 2000*	146,019,214	191.52	84.48	1229.89
Thursday	*August 24, 2000*	146,019,214	191.26	84.44	1229.15
Friday	*August 25, 2000*	161,609,890	173.70	96.95	1405.37
Saturday	*August 26, 2000*	135,286,294	147.39	71.05	1105.52
Sunday	*August 27, 2000*	107,474,790	84.82	56.63	910.61
Monday	*August 28, 2000*	146,019,214	196.03	87.76	1269.10
Tuesday	*August 29, 2000*	146,019,214	196.19	88.61	1275.31
Wednesday	*August 30, 2000*	146,019,214	200.09	90.44	1282.97
Thursday	*August 31, 2000*	146,019,214	203.81	92.90	1292.42
Friday	*September 1, 2000*	161,609,890	179.12	101.80	1444.25
Saturday	*September 2, 2000*	135,286,294	151.01	74.34	1152.85
Sunday	*September 3, 2000*	107,474,790	91.35	60.34	941.71
Monday	*September 4, 2000*	107,474,790	92.90	61.55	943.68
Tuesday	*September 5, 2000*	146,019,214	201.95	92.36	1298.51
Wednesday	*September 6, 2000*	146,019,214	199.16	86.52	1226.01

For the entire 20-day August 18 - September 6, 2000 ozone episode, a total of 14 days had monitored ozone exceedances. For each day that a one-hour ozone exceedance was monitored in the 8-County HGB area, an eight-hour ozone exceedance also occurred (and vice-versa). Of these 14 ozone exceedance days, a total of 6 occurred during Monday-Thursdays (excluding the Monday September 4th Labor Day ozone exceedance). For the purposes of detailing onroad mobile source emissions, it is often desirable to choose a single representative "average Weekday". As Tables 4 and 5 indicate, if both the 2000 and 2007 VMT, NO_X, VOC, and CO from the Monday-Thursday ozone exceedance episode days are averaged together, the Wednesday August 30th episode day is the one which ends up most closely conforming to the average for each of these parameters. Therefore, for the purposes of this documentation, the Wednesday August 30th episode day has been selected as the representative "average Weekday" for detailing the on-road mobile source inventory in the 8-County HGB area. By coincidence, both the highest monitored 1-hour ozone value (200.5 ppb) and the highest 8-hour ozone value (135.4 ppb) of this episode occurred on Wednesday August 30, 2000.

Table 4. HGB "Average Weekday" VMT, NO_X, VOC, & CO MOBILE6.2 Emissions for 2000

Comparison of Each Ozone Exceedance Weekday to Average		***8-County VMT Total***	***Total Emissions*** *(tons per day)*		
			NO_X	*VOC*	*CO*
Average of 6 Weekdays		127,460,894	356.08	149.71	2,084.90
Monday	*August 21st*	0.0%	-1.26%	-2.42%	-1.52%
Tuesday	*August 29th*	0.0%	-1.50%	-1.70%	-0.60%
Wednesday	*August 30th*	0.0%	0.17%	0.91%	1.24%
Thursday	*August 31st*	0.0%	1.74%	4.39%	3.64%
Tuesday	*September 5th*	0.0%	0.89%	3.79%	3.94%
Wednesday	*September 6th*	0.0%	-0.04%	-4.97%	-6.71%

Table 5. HGB "Average Weekday" VMT, NO_X, VOC, & CO MOBILE6.2 Emissions for 2007

Comparison of Each Ozone Exceedance Weekday to Average		***8-County VMT Total***	***Total Emissions*** *(tons per day)*		
			NO_X	*VOC*	*CO*
Average of 4 Weekdays		146,019,214	199.65	89.81	1273.91
Monday	*August 21st*	0.0%	-1.48%	-1.98%	-0.45%
Tuesday	*August 29th*	0.0%	-1.73%	-1.34%	0.11%
Wednesday	*August 30th*	0.0%	0.22%	0.70%	0.71%
Thursday	*August 31st*	0.0%	2.08%	3.44%	1.45%
Tuesday	*September 5th*	0.0%	1.15%	2.84%	1.93%
Wednesday	*September 6th*	0.0%	-0.24%	-3.67%	-3.76%

Tables 6 and 7 present summaries of the 2000 and 2007 VMT, NO_X, VOC, & CO MOBILE6.2 emissions for the entire 8-County HGB area by each of the 28 MOBILE6 vehicle types for the Wednesday August 30, 2000 episode day.

Table 6. HGB Vehicle Type Summary of 2000 Onroad Wednesday August 30th Inventory

MOBILE6 Vehicle Type	***8-County VMT***		***Total Emissions*** *(tons per day)*		
	Total	***Distribution***	*NO_X*	*VOC*	*CO*
LDGV	78,272,281	61.41%	91.71	94.27	1,310.58
LDGT1	7,163,256	5.62%	7.71	9.40	135.81
LDGT2	23,846,279	18.71%	31.33	32.16	470.12
LDGT3	4,314,780	3.39%	4.80	3.70	67.07
LDGT4	1,984,208	1.56%	2.79	1.77	31.33
HDGV2b	1,193,712	0.94%	6.19	1.18	16.24
HDGV3	449,095	0.35%	2.71	0.62	9.79
HDGV4	207,094	0.16%	1.16	0.27	3.70
HDGV5	88,426	0.07%	0.62	0.23	3.34
HDGV6	214,077	0.17%	1.56	0.57	8.55
HDGV7	86,099	0.07%	0.67	0.21	3.34
HDGV8a	79,114	0.06%	0.73	0.40	6.73
HDGV8b	9,307	0.01%	0.11	0.03	0.43
LDDV	179,325	0.14%	0.40	0.13	0.31
LDDT12	28,290	0.02%	0.11	0.07	0.12
HDDV2b	1,092,328	0.86%	5.69	0.23	1.03
HDDV3	568,835	0.45%	3.67	0.16	0.62
HDDV4	333,883	0.26%	2.53	0.11	0.42
HDDV5	214,343	0.17%	1.76	0.08	0.32
HDDV6	688,374	0.54%	8.68	0.35	1.26
HDDV7	453,418	0.36%	7.16	0.30	1.11
HDDV8a	770,812	0.60%	20.97	0.64	3.93
HDDV8b	4,551,818	3.57%	145.68	2.83	18.64
MC	127,461	0.10%	0.15	0.45	2.82
HDGB	81,444	0.06%	0.71	0.57	11.74

HDDBT	129,578	0.10%	3.55	0.13	0.83
HDDBS	187,286	0.15%	3.31	0.15	0.53
LDDT34	145,972	0.11%	0.23	0.07	0.13
Total	127,460,894	100.00%	356.70	151.07	2,110.85

Table 7. HGB Vehicle Type Summary of 2007 Onroad Wednesday August 30th Inventory

MOBILE6	***8-County VMT***		***Total Emissions*** *(tons per day)*		
Vehicle Type	***Total***	***Distribution***	NO_X	*VOC*	*CO*
LDGV	87,968,726	60.24%	51.12	56.02	812.39
LDGT1	8,255,410	5.65%	4.45	5.21	76.44
LDGT2	27,481,679	18.82%	21.41	18.22	274.31
LDGT3	6,068,332	4.16%	3.86	2.49	44.87
LDGT4	2,790,670	1.91%	2.58	1.25	21.54
HDGV2b	1,272,053	0.87%	4.01	0.86	9.99
HDGV3	475,487	0.33%	1.88	0.36	4.68
HDGV4	230,390	0.16%	0.79	0.16	2.08
HDGV5	83,333	0.06%	0.39	0.15	1.54
HDGV6	223,038	0.15%	1.18	0.37	3.38
HDGV7	78,432	0.05%	0.52	0.14	1.23
HDGV8a	78,432	0.05%	0.54	0.16	1.50
HDGV8b	9,805	0.01%	0.11	0.02	0.15
LDDV	78,411	0.05%	0.07	0.03	0.11
LDDT12	6,295	0.00%	0.02	0.02	0.03
HDDV2b	1,362,692	0.93%	4.01	0.21	1.10
HDDV3	656,838	0.45%	2.54	0.13	0.68
HDDV4	397,042	0.27%	1.83	0.09	0.48
HDDV5	259,794	0.18%	1.31	0.07	0.34
HDDV6	823,496	0.56%	5.79	0.31	1.17
HDDV7	499,981	0.34%	4.45	0.23	0.87
HDDV8a	901,925	0.62%	12.34	0.46	2.59
HDDV8b	5,214,739	3.57%	68.03	2.50	13.72
MC	146,019	0.10%	0.17	0.45	2.74
HDGB	44,295	0.03%	0.40	0.23	3.68
HDDBT	154,051	0.11%	2.71	0.06	0.58
HDDBS	277,248	0.19%	3.43	0.19	0.68
LDDT34	180,599	0.12%	0.13	0.05	0.12
Total	146,019,214	100.00%	200.09	90.44	1,282.97

Tables 8 and 9 present summaries of the VMT, NO_X, VOC, and CO MOBILE6 emissions for each of the eight counties in the HGB area. As expected, Harris County accounts for roughly 70-75% of the estimated VMT, NO_X, VOC, and CO from the entire HGB nonattainment area.

Table 8. Summary of 2000 HGB Onroad Wednesday August 30th Inventory by County

County	***8-County VMT***		***Total Emissions*** *(tons per day)*		
	Total	***Distribution***	NO_X	*VOC*	*CO*
Brazoria	5,591,008	4.39%	14.92	6.79	101.41
Chambers	2,202,239	1.73%	7.76	3.09	50.90
Fort Bend	6,790,771	5.33%	18.91	8.73	124.38
Galveston	6,160,053	4.83%	16.27	7.55	110.07
Harris	95,707,669	75.09%	265.46	110.49	1,503.35
Liberty	2,034,665	1.60%	6.18	2.89	42.36
Montgomery	7,253,818	5.69%	21.34	8.98	137.52
Waller	1,720,671	1.35%	5.85	2.54	40.86
Total	127,460,894	100.00%	356.70	151.07	2,110.85

Table 9. Summary of 2007 HGB Onroad Wednesday August 30th Inventory by County

County	***VMT***		***Total Emissions*** *(tons per day)*		
	Total	***Distribution***	NO_X	*VOC*	*CO*
Brazoria	6,216,326	4.26%	8.86	3.81	58.22
Chambers	2,689,680	1.84%	4.70	1.65	29.90
Fort Bend	10,110,632	6.92%	13.66	5.63	85.65
Galveston	5,839,485	4.00%	7.94	3.68	53.49
Harris	105,704,622	72.39%	141.21	65.62	906.16
Liberty	2,398,364	1.64%	3.86	1.71	24.53
Montgomery	10,742,491	7.36%	15.74	6.52	97.72
Waller	2,317,615	1.59%	4.13	1.80	27.30
Total	146,019,214	100.00%	200.09	90.44	1282.97

8-County HGB Area Onroad Inventory Processing

The link-based emissions provided by TTI were prepared for input into the photochemical model using the 2x version of the Emissions Preprocessor System (EPS2x). When input into the EPS2x system, the inventory data are in a "readable" text-based format. However, once within the EPS2x system, the emissions data are in a binary format. Table 10 summarizes the EPS2x modules which were used to process the 8-County HGB link-based inventories.

Table 10. EPS2x Modules Used to Process 8-County HGB Onroad Emissions Data

EPS2x Module	***Description***
LBASE	"Link-Base" - Spatially allocate link emissions among grid cells
CHMSPL	"Chemistry Split" - Speciate emissions into NO, NO_2, Parrafins, Olefins, etc.
CNTLEM	"Control Emissions" - Apply controls to model strategies, adjustments, etc.

CNTLHR	"Control Hourly" - Apply adjustments that vary by hour per vehicle type
GRDEM	"Grid Emissions" - Sum emissions by grid cell for photochemical model input
MRGUAM	Merge and adjust multiple gridded emission files for photochemical model input

As described in Table 10, adjustments to the inventory are made with either the CNTLEM or CNTLHR modules. The CNTLEM module was used to:

- remove 3.4% of the HDDV8a and HDDV8b ("18-wheeler") emissions for separate processing as "extended idling" emissions in accordance with the January 2004 EPA *Guidance for Quantifying and Using Long Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity*;

- apply benefits to accrue from January 15, 2004 EPA *Final Rule for Control of Emissions From Highway Motorcycles*; and

- remove benefits to accrue from Inspection/Maintenance (I/M) Program for Chambers, Liberty, and Waller Counties.

2007 HGB Area Motorcycle Benefits

According to the January 15, 2004 motorcycle rule referenced above, new NO_X and VOC emission standards for motorcycles are scheduled to take place beginning with the 2006 model year. According to EPA staff, these benefits have not been included in the emission rate output from MOBILE6.2. Table 11 is based on data obtained from EPA and summarizes the appropriate NO_X and VOC adjustments by calendar year to make to the motorcycle (MC) emission rates estimated with MOBILE6.2.

Table 11. NO_X & VOC Adjustments Made to MOBILE6.2 Motorcycle Emissions

Calendar Year	*Motorcycle NO_X*		*Motorcycle VOC*	
	Benefit	*Adjustment*	*Benefit*	*Adjustment*
2006	1.27%	0.9873	0.80%	0.9920
2007	3.74%	0.9626	2.61%	0.9739
2008	6.51%	0.9349	4.93%	0.9507
2009	8.91%	0.9109	7.16%	0.9284
2010	11.81%	0.8819	9.35%	0.9065
2011	16.79%	0.8321	13.36%	0.8664
2012	22.08%	0.7792	18.01%	0.8199
2013	27.02%	0.7298	22.85%	0.7715
2014	30.91%	0.6909	27.20%	0.7280
2015	35.31%	0.6469	32.21%	0.6779
2016	38.58%	0.6142	35.87%	0.6413
2017	41.89%	0.5811	39.74%	0.6026

2018	45.34%	0.5466	43.94%	0.5606
2019	48.43%	0.5157	47.89%	0.5211
2020	50.11%	0.4989	50.13%	0.4987
2021	51.61%	0.4839	52.18%	0.4782
2022	52.86%	0.4714	53.91%	0.4609
2023	53.91%	0.4609	55.36%	0.4464
2024	54.74%	0.4526	56.53%	0.4347
2025	55.44%	0.4456	57.51%	0.4249
2026	56.01%	0.4399	58.31%	0.4169
2027	56.41%	0.4359	58.89%	0.4111
2028	56.69%	0.4331	59.28%	0.4072
2029	56.88%	0.4312	59.55%	0.4045
2030	56.99%	0.4301	59.71%	0.4029

For the Wednesday August 30th episode day in the 8-County area, the adjustments made by the CNTLEM module for the 2007 onroad inventory to account for the January 15, 2004 motorcycle rule are summarized below in Table 12. Due to the fact that the NO_X and VOC benefits are so small, both tons-per-day and pounds-per-day units are reported. Due to the fact that the motorcycle rule does not go into effect until the 2006 model year, this correction does not apply to the 2000 onroad inventory.

Table 12. 8-County HGB NO_X & VOC Benefits from New Motorcycle Rule for August 30th

Calendar Year	*Units Reported*	*NO_X Emissions*	*VOC Emissions*
2007	*Tons Per Day*	0.006	0.011
	Pounds Per Day	12.800	21.800

2007 Inspection/Maintenance Program Benefits for Chambers, Liberty, & Waller Counties

For each of the 8 counties within the HGB nonattainment area, the 2007 onroad mobile source inventories received from TTI included the effects of the I/M program which was either already in place or scheduled to be implemented. The TCEQ has recently proposed a rule which would repeal the I/M program which was scheduled to begin in Chambers, Liberty, and Waller Counties starting in May of 2005. In order to remove the I/M program benefits for these three counties from the 2007 onroad inventory, TCEQ staff performed "with I/M" and "without I/M" MOBILE6.2 scenarios. By comparing these two scenarios, the net change in NO_X, VOC, and CO emission rates for each county and affected vehicle type was determined. These differences were used as adjustment factors with the EPS2x CNTLEM module. Table 13 contains a summary of the 2007 I/M benefits removed from Chambers, Liberty, and Waller Counties.

Table 13. 2007 Chambers, Liberty, & Waller County I/M Program Benefits for August 30th

I/M Program County	***Emissions Benefits*** *(tons per day)*		
	NO_X	***VOC***	***CO***
Chambers	0.28	0.22	4.79
Liberty	0.30	0.23	4.46
Waller	0.29	0.23	4.47
3-County Total	0.87	0.68	13.72

Application of NO_X Correction to Diesel & Heavy-Duty Gasoline Vehicles

The MOBILE6.2 model accounts for the effects that changes in hourly temperature and humidity have on NO_X emissions for only 6 of the 28 total vehicle types. These vehicle types are the LDGV, LDGT1-4, and MC classes referenced above in Table 1. There is no temperature/humidity NO_X correction for the remaining 22 vehicle classes, which include all 13 of the diesel-powered vehicles and the 9 heavy-duty gasoline vehicles referenced in Table 1. Under contract to the Houston Advanced Research Center (HARC), the Environ Corporation worked with the Southwest Research Institute (SwRI) to develop temperature/humidity NO_X correction equations to apply to both the 13 diesel and 9 heavy-duty gasoline vehicle classes in MOBILE6.2. These equations reflect the fact that as ambient temperature increases, tailpipe NO_X emissions increases. However, as ambient humidity increases, tailpipe NO_X emissions decrease.

Part of Environ's work was to develop the CNTLHR module referenced above in Table 10, which allows the user to apply a different NO_X, VOC, and/or CO correction for each different hour, episode day, county, and vehicle type combination. The CNTLEM module is similar, but does not allow the correction factor to vary by hour. TCEQ staffed developed custom SAS code which calculates the appropriate CNTLHR adjustment factors for each vehicle type by obtaining hourly inputs for temperature, relative humidity, and barometric pressure data for each county and episode day combination. The net result is that the CNTLHR adjustment factors file contains a total of 4,224 unique NO_X corrections for each episode day in the 8-County HGB area. 4,224 is the mathematical product of 22 vehicle types, 8 counties, and 24 hours. The hourly temperature, relative humidity, and barometric pressure inputs used by the SAS code are the same ones used by TTI in its development of both the 2000 and 2007 HGB onroad inventories. These meteorological data were obtained from National Weather Service and TCEQ monitors in the HGB area during the August 18-September 6, 2000 time period.

Provided in Tables 14 and 15 are summaries of the temperature/humidity NO_X corrections performed by the CNTLHR module for the 8-County HGB area. The observed hourly temperature and relative humidity data for the entire area were averaged to develop representative 8-County hourly figures per episode day. Included in the tables are the 8-County peak hourly average temperature and relative humidity per episode day, along with the 8-County averages for the entire episode day. These inputs are included to demonstrate that on relatively "hot and dry" days such as Thursday August 31st and Tuesday September 5th, the overall 24-hour NO_X emissions are reduced around 1%. Conversely, on relatively "cool and humid" days such as Tuesday August 22nd through Thursday August 24th, the overall 24-hour NO_X emissions are

reduced as much as 7-8%.

In general, weekday episodes have the most VMT and NO_X from diesel vehicles due to the relatively high contribution of the HDDV8a and HDDV8b "18-wheeler" classes. Therefore, the impact of this correction procedure tends to be more significant on those days. Fridays tend to have a lower contribution of VMT from these vehicle classes, and therefore less NO_X prior to application of the correction. Saturdays and Sundays tend not only to have lower VMT overall, but also lower relative contributions of VMT from the 18-wheeler categories. Consequently, in cases where the temperature and humidity profiles are similar, a Monday-Thursday episode will have a more significant temperature/humidity NO_X correction than a Friday, Saturday, or Sunday.

Due to the fact that different hourly temperature and humidity inputs are used for each county, the temperature/humidity NO_X correction varies geographically as well. Tables 16 and 17 are summaries of this correction procedure by county for the Wednesday August 30th episode day. In general, the relatively cooler and more humid counties such as Galveston and Chambers have a greater amount of NO_X emissions reduced on a 24-hour basis. Conversely, the relatively hotter and drier counties such as Liberty and Montgomery have very slight changes to 24-hour NO_X emission totals. Within each county, more NO_X is reduced during the overnight and early morning hours when the temperature is at its minimum and the relatively humidity is at its maximum. However, during the hottest hours of the afternoon when the relatively humidity is at its lowest, the temperature/humidity NO_X correction either decreases NO_X very slightly or increases it somewhat, depending upon the specific conditions for that hour. Overall, the temperature/humidity NO_X correction procedure allows not only for improved estimates of the total onroad NO_X emissions, but also for improved spatial and temporal allocation of those emissions.

Table 14. Summary of Temperature/Humidity NO_X Correction by Episode Day for 2000 Onroad Inventory

Day Type	Episode Day	NO_X Emissions (tons per day)				Temperature (Fahrenheit)		Relative Humidity	
		Input	Output	Difference	Change	Maximum	Average	Maximum	Average
Friday	*August 18*	309.43	298.38	-11.04	-3.57%	96.0	84.9	95.9%	68.9%
Saturday	*August 19*	206.16	199.33	-6.83	-3.31%	95.0	84.4	94.2%	70.0%
Sunday	*August 20*	149.64	144.63	-5.01	-3.35%	95.3	84.7	93.7%	72.3%
Monday	*August 21*	349.62	330.23	-19.39	-5.55%	95.4	85.4	95.0%	70.9%
Tuesday	*August 22*	343.12	314.78	-28.34	-8.26%	87.3	82.4	92.2%	78.9%
Wednesday	*August 23*	342.22	314.16	-28.06	-8.20%	86.4	81.0	93.8%	82.1%
Thursday	*August 24*	341.32	311.33	-29.99	-8.79%	88.4	80.5	95.8%	85.4%
Friday	*August 25*	302.45	285.68	-16.77	-5.55%	92.4	83.1	97.9%	76.6%
Saturday	*August 26*	202.75	193.85	-8.90	-4.39%	93.6	84.0	96.2%	73.4%
Sunday	*August 27*	147.90	142.15	-5.76	-3.89%	93.4	84.4	94.8%	74.8%
Monday	*August 28*	348.59	327.94	-20.65	-5.92%	94.4	85.0	94.8%	72.3%
Tuesday	*August 29*	348.74	327.68	-21.06	-6.04%	96.2	85.5	95.1%	72.1%
Wednesday	*August 30*	354.72	340.24	-14.48	-4.08%	100.1	87.5	95.2%	66.7%
Thursday	*August 31*	359.96	355.41	-4.55	-1.26%	103.5	90.2	86.3%	54.4%
Friday	*September 1*	310.05	299.43	-10.62	-3.43%	101.5	88.0	79.8%	61.2%
Saturday	*September 2*	207.86	200.39	-7.47	-3.59%	100.9	88.9	92.6%	65.0%
Sunday	*September 3*	157.48	155.25	-2.22	-1.41%	102.6	90.0	88.3%	57.7%
Monday	*September 4*	149.47	148.45	-1.03	-0.69%	105.5	91.2	81.6%	53.7%
Tuesday	*September 5*	363.03	355.89	-7.15	-1.97%	103.6	90.2	82.1%	53.5%
Wednesday	*September 6*	349.59	347.84	-1.75	-0.50%	92.2	83.2	86.0%	61.5%

Table 15. Summary of Temperature/Humidity NO_X Correction by Episode Day for 2007 Onroad Inventory

Day Type	Episode Day	NO_X Emissions (tons per day)				Temperature (Fahrenheit)		Relative Humidity	
		Input	Output	Difference	Change	Maximum	Average	Maximum	Average
Friday	August 18	178.91	172.90	-6.01	-3.36%	96.0	84.9	95.9%	68.9%
Saturday	August 19	147.73	142.23	-5.49	-3.72%	95.0	84.4	94.2%	70.0%
Sunday	August 20	84.82	82.25	-2.57	-3.02%	95.3	84.7	93.7%	72.3%
Monday	August 21	195.63	185.38	-10.26	-5.24%	95.4	85.4	95.0%	70.9%
Tuesday	August 22	191.17	175.74	-15.44	-8.08%	87.3	82.4	92.2%	78.9%
Wednesday	August 23	190.46	175.13	-15.33	-8.05%	86.4	81.0	93.8%	82.1%
Thursday	August 24	189.95	173.62	-16.33	-8.60%	88.4	80.5	95.8%	85.4%
Friday	August 25	174.32	165.00	-9.31	-5.34%	92.4	83.1	97.9%	76.6%
Saturday	August 26	145.69	138.24	-7.45	-5.12%	93.6	84.0	96.2%	73.4%
Sunday	August 27	83.64	80.65	-2.99	-3.57%	93.4	84.4	94.8%	74.8%
Monday	August 28	194.95	183.98	-10.97	-5.63%	94.4	85.0	94.8%	72.3%
Tuesday	August 29	195.12	183.98	-11.14	-5.71%	96.2	85.5	95.1%	72.1%
Wednesday	August 30	199.03	191.64	-7.39	-3.71%	100.1	87.5	95.2%	66.7%
Thursday	August 31	202.53	200.69	-1.85	-0.91%	103.5	90.2	86.3%	54.4%
Friday	September 1	179.74	174.14	-5.59	-3.11%	101.5	88.0	79.8%	61.2%
Saturday	September 2	149.28	143.28	-6.00	-4.02%	100.9	88.9	92.6%	65.0%
Sunday	September 3	90.84	89.87	-0.97	-1.06%	102.6	90.0	88.3%	57.7%
Monday	September 4	91.61	91.26	-0.35	-0.39%	105.5	91.2	81.6%	53.7%
Tuesday	September 5	200.96	197.73	-3.23	-1.61%	103.6	90.2	82.1%	53.5%
Wednesday	September 6	197.99	192.21	-5.77	-2.92%	92.2	83.2	86.0%	61.5%

Table 16. Summary of Temperature/Humidity NO_X Correction by County for 2000 Inventory

County	***NO_X Emissions*** *(tons per day)*			
	Input	***Output***	***Difference***	***Change***
Brazoria	14.63	13.86	-0.77	-5.25%
Chambers	7.58	7.01	-0.57	-7.58%
Fort Bend	18.55	18.04	-0.51	-2.76%
Galveston	15.95	14.19	-1.76	-11.01%
Harris	264.62	254.02	-10.61	-4.01%
Liberty	6.07	6.10	0.03	0.43%
Montgomery	21.19	21.10	-0.09	-0.44%
Waller	6.14	5.94	-0.20	-3.22%
8-County Total	354.72	340.24	-14.48	-4.08%

Table 17. Summary of Temperature/Humidity NO_X Correction by County for 2007 Inventory

County	***NO_X Emissions*** *(tons per day)*			
	Input	***Output***	***Difference***	***Change***
Brazoria	8.70	8.25	-0.45	-5.19%
Chambers	4.60	4.26	-0.34	-7.45%
Fort Bend	13.41	13.05	-0.36	-2.69%
Galveston	7.80	6.94	-0.86	-11.03%
Harris	140.89	135.63	-5.25	-3.73%
Liberty	3.79	3.82	0.02	0.63%
Montgomery	15.59	15.56	-0.03	-0.19%
Waller	4.25	4.13	-0.11	-2.61%
8-County Total	199.03	191.64	-7.39	-3.71%

2007 HGB Area Low Emission Diesel Fuel Benefits

Based on a September 27, 2001 EPA Memorandum entitled *Texas Low Emission Diesel (LED) Fuel Benefits*, a 4.8% NO_X LED benefit should be claimed for 2002-and-newer diesel vehicles, while a 6.2% NO_X LED benefit should be claimed for 2001-and-older diesel vehicles. In order to determine the specific LED adjustment factors which should apply to each of the 13 diesel vehicle types described in Table 1, TCEQ staff performed MOBILE6.2 runs for the HGB area to determine both VMT and NO_X emission rates by model year. By using these data, the 4.8% and 6.2% reduction factors were weighted according to NO_X model year contributions for each vehicle type. The resulting LED adjustment factors for 2007 are summarized in Table 18. These LED factors were incorporated by TTI into the onroad inventories by post-processing the MOBILE6.2 diesel NO_X emission rates. Please note that the LED rule does not go into effect until 2005 and thus, does not apply to the 2000 onroad inventory.

Table 18. LED Fuel NO_X Adjustments Applied to 2007 Onroad HGB Inventory

Diesel Vehicle Type	2007 LED Adjustments	
	NO_X Reduction	Adjustment Factor
LDDV	6.09%	0.9391
LDDT12	6.20%	0.9380
LDDT34	5.40%	0.9460
HDDV2b	5.09%	0.9491
HDDV3	5.29%	0.9471
HDDV4	5.37%	0.9463
HDDV5	5.27%	0.9473
HDDV6	5.43%	0.9457
HDDV7	5.53%	0.9447
HDDV8a	5.84%	0.9416
HDDV8b	5.61%	0.9439
HDDBT	5.81%	0.9419
HDDBS	5.82%	0.9418

In order to determine the specific magnitude of LED benefits for the HGB area, the LED benefits were removed from the onroad inventories with the CNTLEM module. The LED removal step was intentionally performed after the temperature/humidity NO_X correction referenced above. The results of this analysis were extracted from the CNTLEM message file and are summarized in Table 19.

Table 19. LED Fuel NO_X Benefits for 2007 Wednesday August 30th Onroad Inventory

Diesel Vehicle	NO_X Emissions *(tons per day)*		
	Input	Output	Difference
LDDV	0.067	0.071	0.004
LDDT12	0.018	0.019	0.001
HDDV2b	3.807	4.010	0.204
HDDV3	2.408	2.542	0.135
HDDV4	1.741	1.840	0.099
HDDV5	1.242	1.311	0.069
HDDV6	5.491	5.807	0.316
HDDV7	4.217	4.464	0.247
HDDV8a	11.642	12.364	0.722
HDDV8b	63.655	67.438	3.783
HDDBT	2.534	2.690	0.157
HDDBS	3.206	3.404	0.198
LDDT34	0.122	0.129	0.007
Total Diesel	100.148	106.088	5.940

HGB Area Extended Idling Emission from Diesel-Fueled 18-Wheeler Vehicles

EPA issued a document in January 2004 entitled *Guidance for Quantifying and Using Long Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity.* This EPA guidance states that "extended idling" emissions account for 3.4% of the total emissions calculated with MOBILE6.2 for the HDDV8a and HDDV8b vehicle classes. As previously stated, TCEQ staff used the CNTLEM module to remove 3.4% of the hourly NO_X, VOC, and CO emissions from the link-based "running" emissions prepared for photochemical model input from the HDDV8a and HDDV8b classes. Using a combination of custom written SAS and UNIX code, these extended idling emissions from each hour were grouped into an 8-County 24-hour total and spatially assigned to known truck stop locations. The extended idling emissions are then processed through EPS2x as if they were stationary low-level point sources. The emissions are temporally allocated as the inverse of HDDV8a/HDDV8b VMT. Consequently, more of the extended idling emissions get allocated during overnight hours than daytime hours. The extended idling emissions are also run through the CNTLHR module to receive a temperature/humidity NO_X correction. Provided in Tables 20 and 21 are summaries of the total NO_X, VOC, and CO extended idling emissions for both the 2000 and 2007 Wednesday August 30th episode days, respectively.

Table 20. 2000 HDDV8a & HDDV8b "Extended Idling" Emissions for 8-County HGB Area

County	***Total Emissions*** *(tons per day)*		
	NO_X	***VOC***	***CO***
Harris	4.321	0.104	0.677
Montgomery	0.237	0.005	0.035
Waller	0.348	0.009	0.055
8-County Total	4.906	0.118	0.767

Table 21. 2007 HDDV8a & HDDV8b "Extended Idling" Emissions for 8-County HGB Area

County	***Total Emissions*** *(tons per day)*		
	NO_X	***VOC***	***CO***
Harris	2.080	0.089	0.489
Montgomery	0.114	0.005	0.026
Waller	0.168	0.007	0.040
8-County Total	2.363	0.101	0.555

HGB Area Final Onroad Inventory Inputs Into Photochemical Model

Provided in Table 22 is a summary of the onroad emissions inventory input into the photochemical model for the 2000 Wednesday August 30th episode day. This onroad inventory is a combination of both idling emissions (as summarized above in Table 20) and "running" emissions. The temperature/humidity NOX correction has been applied as summarized in Tables 14 and 16.

Table 22. 2000 Onroad Mobile Source Inventory for Wednesday August 30th

County	***Total Emissions*** *(tons per day)*		
	NO_X	***VOC***	***CO***
Brazoria	13.92	6.78	101.33
Chambers	7.04	3.09	50.90
Fort Bend	18.12	8.71	124.34
Galveston	14.25	7.54	110.00
Harris	255.14	109.99	1,501.08
Liberty	6.12	2.89	42.33
Montgomery	21.19	8.97	137.46
Waller	5.96	2.55	40.89
8-County Total	341.75	150.52	2,108.32

For the 2007 inventory, additional post-processing adjustments were necessary to model the TCM, TERP, and VMEP benefits, which are summarized in Table 23. HGB SIP Appendix F.6 is an Excel spreadsheet from HGAC summarizing the 2007 onroad TCM benefits for the 8-County HGB area. HGB SIP Appendix F.7 is a report from HGAC summarizing the 2007 VMEP benefits for the 8-County HGB area. For additional information on the TERP program benefits, refer to HGB SIP Section 5.3.17.

Table 23. 2007 Onroad TCM, TERP, & VMEP Benefits for 8-County HGB Area

8-County HGB Area	***Total Emissions*** *(tons per day)*		
	NO_X	***VOC***	***CO***
TCM	0.47	0.77	3.13
TERP	14.00	0.00	0.00
VMEP	3.60	0.60	0.00
8-County Total	18.07	1.37	3.13

The TCM, TERP, and VMEP benefits were incorporated into the "running" portion of the onroad inventory with the EPS2x MRGUAM module, which allows for application of adjustment factors by pollutant type. Table 24 summarizes development of the TCM/TERP/VMEP onroad adjustment factors for the 2007 Wednesday August 30th episode day.

Table 24. Development of 2007 Onroad TCM/TERP/VMEP Adjustment Factors

8-County HGB Area	***"Running" Emissions*** *(tons per day)*		
	NO_X	***VOC***	***CO***
Brazoria	8.28	3.80	58.17
Chambers	4.56	1.87	34.67
Fort Bend	13.11	5.62	85.58
Galveston	6.97	3.67	53.45
Harris	134.11	65.22	904.29
Liberty	4.13	1.94	28.96
Montgomery	15.51	6.51	97.62

Waller	4.27	2.03	31.75
8-County Total	190.95	90.66	1,294.51
TCM, TERP, & VMEP	18.07	1.37	3.13
Revised 8-County Total	172.88	89.30	1,291.38
Adjustment Factor	0.9054	0.9849	0.9976

The NO_X, VOC, and CO adjustment factors shown above were multiplied by the listed running emissions. As a final step, the TCM/TERP/VMEP adjusted running emissions were added to the idling emissions summarized in Table 21 to obtain the final 2007 Wednesday August 30th onroad emissions which were input into the photochemical model. The final 2007 onroad inventory for the Wednesday August 30th episode day is summarized in Table 25. A similar approach was taken to apply the TCM, TERP, and VMEP benefits to all of the episode days. The 2007 NOX, VOC, and CO totals for the 8-County area for each of the August 18th - September 6th episode days in summarized in Table 26.

Table 25. Final 2007 Onroad Inventory by County for Wednesday August 30th Episode Day

8-County HGB Area	***Total Emissions*** *(tons per day)*		
	NO_X	***VOC***	***CO***
Brazoria	7.50	3.74	58.03
Chambers	4.13	1.84	34.59
Fort Bend	11.87	5.53	85.38
Galveston	6.31	3.62	53.32
Harris	123.51	64.32	902.61
Liberty	3.74	1.91	28.89
Montgomery	14.16	6.41	97.42
Waller	4.04	2.01	31.72
8-County Total	175.24	89.39	1,291.95

Table 26. Final 2007 Onroad Inventory Summary by Episode Day

Day Type	***Episode Day***	***Total Emissions*** *(tons per day)*		
		NO_X	***VOC***	***CO***
Friday	*August 18*	158.32	97.70	1426.27
Saturday	*August 19*	130.14	70.50	1107.79
Sunday	*August 20*	75.45	56.46	909.52
Monday	*August 21*	169.55	87.02	1276.99
Tuesday	*August 22*	160.78	84.13	1257.98
Wednesday	*August 23*	160.22	83.47	1238.36
Thursday	*August 24*	158.85	83.55	1237.53
Friday	*August 25*	151.10	95.91	1423.54
Saturday	*August 26*	126.46	70.01	1112.74
Sunday	*August 27*	73.98	55.90	908.17
Monday	*August 28*	168.29	86.73	1277.70
Tuesday	*August 29*	168.29	87.58	1284.06

Wednesday	*August 30*	175.24	89.39	1291.95
Thursday	*August 31*	183.44	91.94	1302.03
Friday	*September 1*	159.47	100.66	1463.22
Saturday	*September 2*	131.11	73.27	1160.41
Sunday	*September 3*	82.41	59.65	948.27
Monday	*September 4*	83.67	60.74	940.09
Tuesday	*September 5*	180.77	91.27	1306.92
Wednesday	*September 6*	175.77	85.48	1234.60

2000 & 2007 Onroad Mobile Source Emission Inventories for 3-County BPA Area

The purpose of this section is to provide a brief overview of the 3-County Beaumont/Port Arthur (BPA) nonattainment area onroad mobile source emission inventory data which were input into the photochemical model for both the 2000 base case and the 2007 future case. These inventory data were developed under contract to TCEQ by the Texas Transportation Institute (TTI). TTI couples MOBILE6.2 emission rate output with travel demand model vehicle miles traveled (VMT) data. The net result is referred to as a "link-based" inventory due to the fact that both hourly VMT and emissions estimates are developed for each roadway segment or "link". For the 2000 base case, onroad inventories were developed in June of 2003 for Weekday, Friday, Saturday, and Sunday "day types". For the 2007 future case, separate inventories were developed in February of 2004 for each of the following ozone episode time periods from 2000:

- August 10th to August 13th;
- August 18th to August 21st; and
- August 29th to September 6th.

Greater detail covering both the development and processing of these inventory data can be found in the following BPA SIP Appendices:

- Appendix F - *2000 On-Road Mobile Source Modeling Emissions Inventories for the Beaumont/Port Arthur Ozone Nonattainment Area, TTI Report*
- Appendix G - *2007 On-Road Mobile Source Modeling Emissions Inventories for the Beaumont/Port Arthur Ozone Nonattainment Area, TTI Report*

Tables 27 and 28 provide summaries of the total vehicle miles traveled (VMT), NO_x, VOC, and CO MOBILE6.2 emissions for the entire 3-County BPA for both the 2000 base case and the 2007 future case, respectively. For the 2007 future case, the Monday-Thursday episodes have very the same VMT totals and are considered to be "average Weekdays". As expected, the Friday episodes have the highest total VMT of the week, with the Saturday and Sunday episodes having the least amount of VMT. Due to the fact that Labor Day occurred on Monday September 4th in 2000, this holiday episode does not have a typical Weekday VMT. Instead, its overall VMT is similar to that for a typical Sunday. Even though the Friday episodes have the highest VMT of the week, the estimated NO_x emissions are actually lower on Fridays than on Weekdays. This is due to the fact that the relative contribution of VMT from the "18-wheeler"

categories (i.e., HDDV8a and HDDV8b classes from MOBILE6.2) is lower on Fridays that on Weekdays. As expected for onroad mobile source inventories, total emissions decrease from 2000 to 2007. This is a result of the increased penetration of tighter emissions standards into the onroad fleet, coupled with simultaneous attrition of older more higher-emitting vehicles. Consistent with current State rules, the onroad inventories from TTI for 2007 include the benefits of Texas Low Emission Diesel (LED) fuel.

Table 27. VMT, NO_X, VOC, & CO Summary for 2000 MOBILE6.2 3-County BPA Inventory

Day Type	***3-County VMT Total***	***Total Emissions*** *(tons per day)*		
		NO_X	*VOC*	*CO*
Weekday	11,963,973	54.07	20.03	258.16
Friday	13,921,965	49.46	21.89	284.73
Saturday	11,796,603	32.23	16.78	232.65
Sunday	10,095,432	22.78	14.77	209.41

Table 28. VMT, NO_X, VOC, & CO Summary for 2007 MOBILE6.2 3-County BPA Inventory

Day of Week	***Episode Day***	***3-County VMT Total***	***Total Emissions*** *(tons per day)*		
			NO_X	*VOC*	*CO*
Thursday	*August 10, 2000*	11,885,906	25.27	10.03	130.42
Friday	*August 11, 2000*	14,106,027	23.86	11.91	156.59
Saturday	*August 12, 2000*	11,780,788	16.37	9.09	127.32
Sunday	*August 13, 2000*	9,825,913	12.05	7.54	107.44
Friday	*August 18, 2000*	14,106,027	24.30	12.17	158.25
Saturday	*August 19, 2000*	11,780,788	16.21	8.96	126.19
Sunday	*August 20, 2000*	9,825,913	11.57	7.59	109.56
Monday	*August 21, 2000*	11,885,906	25.10	9.95	131.28
Tuesday	*August 29, 2000*	11,885,906	25.31	10.13	131.65
Wednesday	*August 30, 2000*	11,885,906	25.74	10.56	132.94
Thursday	*August 31, 2000*	11,885,906	25.90	10.88	134.47
Friday	*September 1, 2000*	14,106,027	24.32	12.38	161.00
Saturday	*September 2, 2000*	11,780,788	16.31	9.31	127.81
Sunday	*September 3, 2000*	9,825,913	11.74	7.89	111.48
Monday	*September 4, 2000*	9,825,913	12.00	8.23	111.60
Tuesday	*September 5, 2000*	11,885,906	25.86	10.73	133.53
Wednesday	*September 6, 2000*	11,885,906	25.66	9.99	129.28

For onroad inventory descriptive purposes, Wednesday August 30th was selected as the most representative "average Weekday". For both the 2000 and 2007 Wednesday August 30th inventories, Tables 29 and 30 present respective summaries of the VMT, NO_X, VOC, and CO MOBILE6 emissions for each of the three counties in the BPA area. As expected, Jefferson County accounts for roughly 60-65% of the estimated VMT, NO_X, VOC, and CO from the entire BPA nonattainment area.

Table 29. Summary of 2000 BPA Onroad Wednesday August 30th Inventory by County

County	***VMT***		***Total Emissions*** *(tons per day)*		
	Total	***Distribution***	*NO_X*	*VOC*	*CO*
Hardin	1,417,616	11.85%	4.22	2.43	31.10
Jefferson	7,626,266	63.74%	36.33	12.72	163.22
Orange	2,920,091	24.41%	13.51	4.88	63.84
Total	11,963,973	100.00%	54.07	20.03	258.16

Table 30. Summary of 2007 BPA Onroad Wednesday August 30th Inventory by County

County	***VMT***		***Total Emissions*** *(tons per day)*		
	Total	***Distribution***	*NO_X*	*VOC*	*CO*
Hardin	1,521,745	12.80%	2.37	1.34	16.74
Jefferson	7,388,358	62.16%	16.58	6.52	81.64
Orange	2,975,803	25.04%	6.80	2.70	34.55
Total	11,885,906	100.00%	25.74	10.56	132.94

The onroad emissions inventory data provided by TTI were prepared for input into the photochemical model using the 2x version of the Emissions Preprocessor System (EPS2x). When input into the EPS2x system, the inventory data are in a "readable" text-based format. However, once within the EPS2x system, the emissions data are in a binary format. Table 31 summarizes the EPS2x modules which were used to process the 3-County BPA link-based inventories.

Table 31. EPS2x Modules Used to Process 3-County BPA Onroad Emissions Data

EPS2x Module	***Description***
LBASE	"Link-Base" - Spatially allocate link emissions among grid cells
PREPNT	"Pre-Point" - Prepare stationary extended idling emissions for further processing
CHMSPL	"Chemistry Split" - Speciate emissions into NO, NO_2, Parrafins, Olefins, etc.
TMPRL	"Temporal" - Apply temporal profile to extended idling emissions
CNTLEM	"Control Emissions" - Apply controls to model strategies, adjustments, etc.
CNTLHR	"Control Hourly" - Apply adjustments that vary by hour per vehicle type
GRDEM	"Grid Emissions" - Sum emissions by grid cell for photochemical model input
MRGUAM	Merge and adjust multiple gridded emission files for photochemical model input

As described in above in Table 31, adjustments to the inventory are made with either the CNTLEM or CNTLHR modules. The CNTLEM module was used to:

- remove 3.4% of the HDDV8a and HDDV8b ("18-wheeler") emissions for separate processing as "extended idling" emissions in accordance with the January 2004 EPA

Guidance for Quantifying and Using Long Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity; and

- apply benefits to accrue from January 15, 2004 EPA *Final Rule for Control of Emissions From Highway Motorcycles*.

According to the January 15, 2004 motorcycle rule referenced above, new NO_X and VOC emission standards for motorcycles are scheduled to take place beginning with the 2006 model year. According to EPA staff, these benefits have not been included in MOBILE6.2, but are expected to yield a 3.47% NO_X reduction and 2.61% VOC reduction from the 2007 motorcycle (MC) emission rate output from MOBILE6.2. Due to the fact that total motorcycle emissions are relatively low, the overall NO_X and VOC benefits for 2007 from this motorcycle rule are in the 1-2 pound range for both NO_X and VOC.

Table 32. 3-County BPA NO_X & VOC Benefits from New Motorcycle Rule for August 30th

Calendar Year	***Units Reported***	***NO_X Emissions***	***VOC Emissions***
2007	*Tons Per Day*	0.0005	0.0011
	Pounds Per Day	1.0	2.2

The MOBILE6.2 model accounts for the effects that changes in hourly temperature and humidity have on NO_X emissions for only 6 of the 28 total vehicle types. These vehicle types are the MOBILE6.2 LDGV, LDGT1-4, and MC classes. There is no temperature/humidity NO_X correction for the remaining 22 vehicle classes, which include all 13 of the diesel-powered vehicles and the 9 heavy-duty gasoline vehicle classes. Under contract to the Houston Advanced Research Center (HARC), the Environ Corporation worked with the Southwest Research Institute (SwRI) to develop temperature/humidity NO_X correction equations to apply to both the 13 diesel and 9 heavy-duty gasoline vehicle classes in MOBILE6.2. These equations reflect the fact that as ambient temperature increases, tailpipe NO_X emissions increases. However, as ambient humidity increases, tailpipe NO_X emissions decrease. Greater detail on the development of these correction equations can be found in the following Appendices:

- Appendix H - *Humidity and Temperature Correction Factors for NO_X Emissions From Diesel Engines, June 2003, Environ/SwRI Report*
- Appendix I - *Humidity and Temperature Correction Factors for NO_X Emissions From Spark Ignited Engines, October 2003, Environ/SwRI Report*

Part of Environ's work was to develop the CNTLHR module referenced above in Table 31, which allows the user to apply a different NO_X, VOC, and/or CO correction for each different hour, episode day, county, and vehicle type combination. TCEQ staffed developed custom SAS code which calculates the appropriate CNTLHR adjustment factors for each vehicle type by obtaining hourly inputs for temperature, relative humidity, and barometric pressure data for each county and episode day combination. The hourly temperature, relative humidity, and barometric pressure inputs used by the SAS code are the same ones used by TTI in its development of both the 2000 and 2007 BPA onroad inventories. These meteorological data were obtained from

National Weather Service and TCEQ monitors in the BPA area during the August 10-September 6, 2000 time period.

Tables 33 and 34 are 2000 and 2007 summaries, respectively, of this correction procedure by county for the Wednesday August 30th episode day. Within each county, more NO_X is reduced during the overnight and early morning hours when the temperature is at its minimum and the relatively humidity is at its maximum. However, during the hottest hours of the afternoon when the relatively humidity is at its lowest, the temperature/humidity NO_X correction either decreases NO_X very slightly or increases it somewhat, depending upon the specific conditions for that hour. Overall, the temperature/humidity NO_X correction procedure allows not only for improved estimates of the total onroad NO_X emissions, but also for improved spatial and temporal allocation of those emissions.

Table 33. Summary of Temperature/Humidity NO_X Correction by County for 2000 Inventory

County	***NO_X Emissions*** *(tons per day)*			
	Input	***Output***	***Difference***	***Change***
Hardin	4.22	4.03	-0.19	-4.46%
Jefferson	36.31	34.13	-2.18	-6.01%
Orange	13.51	12.63	-0.88	-6.51%
3-County Total	54.04	50.79	-3.25	-6.02%

Table 34. Summary of Temperature/Humidity NO_X Correction by County for 2007 Inventory

County	***NO_X Emissions*** *(tons per day)*			
	Input	***Output***	***Difference***	***Change***
Hardin	2.33	2.24	-0.09	-3.99%
Jefferson	16.42	15.54	-0.89	-5.40%
Orange	6.97	6.54	-0.43	-6.18%
3-County Total	25.73	24.32	-1.41	-5.48%

Based on a September 27, 2001 EPA Memorandum entitled *Texas Low Emission Diesel (LED) Fuel Benefits*, a 4.8% NO_X LED benefit should be claimed for 2002-and-newer diesel vehicles, while a 6.2% NO_X LED benefit should be claimed for 2001-and-older diesel vehicles. In order to determine the specific LED adjustment factors which should apply to each of the 13 diesel vehicle types from MOBILE6.2, TCEQ staff performed MOBILE6.2 runs for the BPA area to determine both VMT and NO_X emission rates by model year. By using these data, the 4.8% and 6.2% reduction factors were weighted according to NO_X model year contributions for each vehicle type. The resulting LED adjustment factors and benefits for 2007 are summarized in Table 35. These LED factors were incorporated by TTI into the onroad inventories by post-processing the MOBILE6.2 diesel NO_X emission rates. Please note that the LED rule does not go into effect until 2005 and thus, does not apply to the 2000 onroad inventory.

Table 35. LED Fuel NO_X Adjustments Applied to 2007 Onroad BPA Inventory

Diesel Vehicle Type	2007 LED Adjustments		
	NO_X Reduction	Adjustment Factor	Benefit (tons per day)
LDDV	6.11%	0.9389	0.0004
LDDT12	6.20%	0.9380	0.0002
HDDV2b	5.43%	0.9457	0.0208
HDDV3	5.05%	0.9495	0.0106
HDDV4	5.28%	0.9472	0.0075
HDDV5	5.47%	0.9453	0.0053
HDDV6	5.37%	0.9463	0.0263
HDDV7	5.50%	0.9450	0.0185
HDDV8a	5.67%	0.9433	0.0823
HDDV8b	5.99%	0.9401	0.6862
HDDBT	5.57%	0.9443	0.0146
HDDBS	5.82%	0.9418	0.0185
LDDT34	5.82%	0.9418	0.0006
Total Diesel	5.59%	0.9441	0.8918

EPA issued a document in January 2004 entitled *Guidance for Quantifying and Using Long Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity.* This EPA guidance states that "extended idling" emissions account for 3.4% of the total emissions calculated with MOBILE6.2 for the HDDV8a and HDDV8b vehicle classes. As previously stated, TCEQ staff used the CNTLEM module to remove 3.4% of the hourly NO_X, VOC, and CO emissions from the link-based "running" emissions prepared for photochemical model input from the HDDV8a and HDDV8b classes. Using a combination of custom written SAS and UNIX code, these extended idling emissions from each hour were grouped into a 3-County 24-hour total and spatially assigned to known truck stop locations. The extended idling emissions were then processed through EPS2x as if they were stationary low-level point sources. The emissions were temporally allocated as the inverse of HDDV8a/HDDV8b VMT. Consequently, more of the extended idling emissions were allocated during overnight hours rather than daytime hours. The extended idling emissions were also run through the CNTLHR module to receive a temperature/humidity NO_X correction. Provided in Tables 36 and 37 are summaries of the total NO_X, VOC, and CO extended idling emissions for both the 2000 and 2007 Wednesday August 30th episode days, respectively.

Table 36. 2000 HDDV8a & HDDV8b "Extended Idling" Emissions for 3-County BPA Area

County	Total Emissions (tons per day)		
	NO_X	VOC	CO
Hardin	0.00	0.00	0.00
Jefferson	0.38	0.01	0.03
Orange	0.66	0.01	0.05
3-County Total	1.04	0.02	0.08

Table 37. 2007 HDDV8a & HDDV8b "Extended Idling" Emissions for 3-County BPA Area

County	***Total Emissions*** *(tons per day)*		
	NO_X	***VOC***	***CO***
Hardin	0.00	0.00	0.00
Jefferson	0.15	0.01	0.03
Orange	0.26	0.01	0.05
3-County Total	0.41	0.02	0.08

Provided in Tables 38 and are summaries of the Wednesday August 30th onroad emissions inventories input into the photochemical model for both 2000 and 2007, respectively. These onroad inventories are combinations of both idling emissions (as summarized above in Tables 36 and 37) and "running" emissions. The temperature/humidity NO_X correction has been applied as summarized in Tables 33 and 34.

Table 38. 2000 Onroad Mobile Source Inventory for Wednesday August 30th Episode Day

3-County BPA Area	***Total Emissions*** *(tons per day)*		
	NO_X	***VOC***	***CO***
Hardin	4.03	2.43	31.09
Jefferson	34.13	12.71	163.15
Orange	12.63	4.88	63.83
3-County Total	50.79	20.02	258.08

Table 39. Final 2007 Onroad Inventory by County for Wednesday August 30th Episode Day

3-County BPA Area	***Total Emissions*** *(tons per day)*		
	NO_X	***VOC***	***CO***
Hardin	2.24	1.34	16.74
Jefferson	15.54	6.51	81.63
Orange	6.54	2.70	34.60
3-County Total	24.32	10.55	132.98