Appendix C.3

Mobile Source Inventory Documentation

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1.0 INTRODUCTION AND SCOPE

Mobile sources comprise about 74% of the nitrogen oxides (NOx) emissions in the Raleigh-Durham-Chapel Hill, NC nonattainment area, often referred to as the Triangle area. The Triangle area nonattainment counties include Durham, Franklin, Granville, Johnston, Orange, Person, and Wake Counties and Baldwin, Center, New Hope and Williams Townships in Chatham County. Mobile sources can be subdivided into two subcategories, highway mobile sources (~55% of the Triangle nonattainment area NOx) and non-highway mobile sources (~19% of the Triangle nonattainment area NOx). Off-road mobile sources are further divided into non-road mobile, railroad locomotives and aircraft engines. The larger contributor to the mobile source emissions is from highway mobile sources.

2.0 OVERALL METHODOLOGY

2.1 SOURCE CATEGORY IDENTIFICATION

Highway mobile sources were identified from the U. S. Environmental Protection Agency (USEPA) highway mobile model MOBILE6.2.

Off-road mobile sources were identified from the USEPA guidance document EPA-450/4-91-016, Procedures for the Preparation of Emissions Inventories for Carbon Monoxide and Precursors of Ozone (Procedures document); EPA-454/R-05-001 Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations; EPA-450/4-81-026d (Revised) Procedures for Emission Inventory Preparation, Volume IV; Mobile Sources (Mobile Source Procedures); and from the USEPA's off-road mobile model NONROAD2005c released March 21, 2006.

2.2 EMISSION ESTIMATION APPROACH

Mobile source emissions are estimated by the methodologies suggested in the USEPA document Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations. The estimation of emissions from mobile sources, like area sources, involves multiplying an activity level by an emission factor.

For highway mobile sources, the USEPA mobile model MOBILE6.2 is used to generate emission factors which are multiplied by the vehicle miles traveled (VMT) to determine the estimated emissions.

The majority of the off-road mobile emissions were estimated by using the USEPA off-road mobile model NONROAD2005c. Direct emissions are generated with this model. For aircraft engine emissions, the Federal Aviation Administration (FAA) Emissions and Dispersion Modeling System (EDMS) model was used. Aircraft operations were inputted into the model and the model predicts the engine emissions based on average landing and take-off practices for the aircraft type. For railroad locomotive emissions, emission factors were obtained from the Mobile Source Procedures document and the activity level was obtained from the various railroad companies.

The USEPA designated only a part of Chatham County as nonattainment for the 8-hour ozone NAAQS. The off-road emissions for Chatham County were apportioned to the nonattainment

area by using the percent population in the four townships designated nonattainment to the whole County. Based on the 2000 census, approximately 43% of Chatham County's population is in the nonattainment area. This percentage was used to estimate the off-road emissions of the nonattainment area for all of the years in the maintenance plan. For the highway mobile sources, the VMT for just the nonattainment portion of the County was used to estimate the emissions, therefore no further adjustment was needed.

3.0 QUALITY ASSURANCE MEASURES

The quality assurance (QA) procedures for the off-road mobile source categories were conducted in the same manner as the area source categories. That is, for each category, the completed emission estimate (including a discussion of the methodology) was given to an individual who was not involved with the compilation of emissions for that category. This individual reviewed the information and commented to the emissions inventory developer on any needed modifications.

The QA for the highway mobile source category can be broken into three components: 1) input files, 2) MOBILE6.2 outputs/summaries, and 3) VMT interpolation. Each of these components are detailed in the paragraphs below.

After the speed and VMT information is acquired from the North Carolina Department of Transportation (NCDOT), the speed information is checked for reasonableness against previous sets of speeds for the area. Once comfortable with the speeds, the North Carolina Division of Air Quality (NCDAQ) enters the speed information into MOBILE6.2 input files. In addition to the speed information, the following inputs are included in the input files: pollutants, fuel Reid Vapor Pressure (RVP), 24-hour temperature and relative humidity profiles, barometric pressure, inspection and maintenance program, anti-tampering program, calendar year, evaluation month, and the vehicle mix per road type. All input files are printed and checked by hand against a "key" with the original source of the information. This QA step is always performed by a person other than the one who generated the files. If any discrepancies are found, they are marked on the hard copy and supplied by to the person who generated the input files for correction. Vehicle age distribution is another input referenced in the actual MOBILE6.2 input file. This file is checked against the original spreadsheet from which it is generated. Again, if any discrepancies are found, they are noted and returned to the person responsible for generating those files.

Once the input files have passed through the QA procedure, MOBILE6.2 is run to generate emission factors. The emission factors are output into two forms from the MOBILE6.2 model. One set of outputs is formatted for importing into a spreadsheet. Once in the spreadsheet, data can easily be formatted into summary tables. An additional step in the spreadsheet is to multiply the emission factors by the daily VMT to get daily emissions. The next step is then performed by comparing the summary tables containing emission factors to the other MOBILE6.2 "descriptive" output file (also referred to as the "text output").

A final step is to check the VMT used in the preceding step in the summary spreadsheets against the original source of the VMT. If VMT was not provided for the specific years requested, then the NCDAQ performs a linear interpolation to calculate the exact year needed. This linear interpolation is checked by a person other than the one who generated the file to ensure no errors were introduced.

4.0 DISCUSSION OF MOBILE SOURCE CATEGORIES

Mobile sources produce volatile organic compounds (VOCs) and NOx. Emissions of these pollutants are estimated in the mobile source inventory required for the maintenance plan. There are two major source categories comprising of a number of individual mobile source types. Sections 4.1 and 4.2 addresses highway mobile sources and off-road mobile sources, respectively. The objective of each section is to describe the source category and the emissions estimation procedures. Each section also includes tables summarizing the estimated emissions for a typical summer day by county. In Section 5 are copies of the data used in the calculation of the estimated emissions, such as the MOBILE6.2 mobile model input and output files and the NONROAD2005c model input files.

4.1 HIGHWAY MOBILE SOURCE EMISSIONS

4.1.1 Introduction and Scope

Highway mobile sources are considered those vehicles that travel on the roadways. Mobile sources comprise over 50 percent of the emissions of NOx emissions in North Carolina. In the Triangle nonattainment area highway mobile sources contribute 55% of the 2005 NOx inventory. Emissions from motor vehicles occur throughout the day while the vehicle is in motion, at idle, parked, and during refueling. All of these emissions processes need to be estimated in order to properly reflect the total emissions from this source category. In its simplest terms, emissions from highway mobile sources are calculated by multiplying an activity level, in this case daily VMT as provided by the NCDOT, by an emission factor.

The USEPA developed the MOBILE model to estimate emission factors based on information on the way vehicles are driven in a particular area. The newest version of the MOBILE model (MOBILE6.2) was used. This model was released by the USEPA in 2002 and differs significantly from previous versions of the model. Key inputs for MOBILE6.2 include information on the age of vehicles on the roads, the average speed of those vehicles, what types of roads those vehicles are traveling on, any control technologies in place in an area to reduce emissions for motor vehicles (e.g., emissions inspection programs), and ambient temperature.

A very important component of the highway mobile emission estimation process is interagency consultation. The primary transporation partners involved in the Triangle redesignation interagency consultation process included: NCDOT, USEPA, Federal Highway Administration (FHWA), Capital Area Metropolitan Planning Organization (CAMPO), Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO), and the Burlington-Graham Metropolitan Planning Organization (BGMPO). Specifically the NCDOT was consulted for

input data such as speeds and VMT for the rural counties where the Triangle Regional Model (TRM), the urban travel demand model, did not cover. The rural areas include Franklin, Granville, Johnston, and Person Counties. Also, an interagency consulation conference call was held to discuss the specific details of the MOBILE6.2 model inputs used to estimate the highway mobile source emissions, as well as issues concerning the setting motor vehicle emissions budguts (MVEBs).

4.1.2 MOBILE6.2 Input Assumptions

The MOBILE6.2 input files and output files are compiled in Section 5 – Data.

Speed Assumptions

Emissions from motor vehicles vary with the manner in which the vehicle is operated. Vehicles traveling at 65 miles per hour (mph) emit a very different mix of pollutants than the car that is idling at a stoplight. In order to estimate emissions from vehicles for a typical day, NCDOT, on behalf of the Rural Planning Organizations (RPOs) and the Triangle Metropolitan Planning Orgranizations (MPOs) provided speeds for their respective counties.

The speeds for the urban area covered by the MPOs were generated from the TRM and are further differenciated into the morning rush hours (AM), the evening rush hours (PM) and off-peak (OP) speeds. The TRM output did not provide urban local speeds for Johnston County. Therefore, upon the recommendation of the Triangle transportation partners, the urban local speeds for Wake and Chatham Counties were averaged and used for Johnston County. The TRM does not cover the entire Triangle nonattainment area, only the more urbanized counties including Chatham, Durham, Franklin (partial), Granville (partial), Johnston (partial), Orange, and Wake Counties. For the remaining areas, Franklin (partial), Granville (partial), Johnston (partial), and Person Counties, the latest speeds were obtained from the NCDOT via e-mail on February 9, 2007. The speeds provided are based on a daily average and were generated by a spreadsheet used to calculate speeds by the NCDOT.

The MOBILE6.2 model was utilized to generate emission factors for the entire nonattainment area that included separate modeling runs for the speeds from the TRM and the speeds for the rural area. The speeds were provided for the years 2005, 2008, 2011, 2014 and 2017.

Tables 4.1.2-1 and 4.1.2-2 provide a summary of the speeds. The column headings in these tables represent the road types used in the modeling and are listed below.

RI	Rural Interstate	UI	Urban Interstate
RPA	Rural Other Principle Arterial	UF	Urban Freeway & Expressway
RMA	Rural Minor Arterial	UPA	Urban Other Principal Arterial
RMjC	Rural Major Collector	UMiA	Urban Minor Arterial
RMiC	Rural Minor Collector	UC	Urban Collector
RL	Rural Local	UL	Urban Local

Table 4.1.2-1 Triangle Regional Model Speeds for the Triangle Area

County	Yr	Period	RI	RPA	RMA	RMjC	RMiC	RL	UI	UF	UPA	UMiA	UC	UL
Chatham		AM	na	54	46	48	45	45	na	na	na	na	na	na
	2005	OP	na	55	46	48	44	46	na	na	na	na	na	na
		PM	na	53	45	48	45	46	na	na	na	na	na	na
		AM	na	55	48	47	47	45	na	na	na	na	na	na
	2008	OP	na	56	49	48	44	46	na	na	na	na	na	na
		PM	na	55	48	48	45	45	na	na	na	na	na	na
		AM	na	54	44	48	45	37	na	na	na	na	na	na
	2011	OP	na	54	44	48	44	35	na	na	na	na	na	na
		PM	na	54	44	48	44	36	na	na	na	na	na	na
		AM	na	56	48	47	45	44	na	na	na	na	na	na
	2014	OP	na	57	49	48	45	45	na	na	na	na	na	na
		PM	na	56	48	48	45	41	na	na	na	na	na	na
		AM	na	56	48	47	45	44	na	na	na	na	na	na
	2017	OP	na	57	49	48	45	45	na	na	na	na	na	na
		PM	na	56	48	48	45	41	na	na	na	na	na	na
Durham		AM	65	55	48	47	48	41	51	48	35	34	37	34
	2005	OP	66	55	52	48	48	43	64	57	42	38	39	35
		PM	64	54	50	47	48	42	51	47	36	35	38	34
		AM	65	55	47	46	45	42	55	46	35	34	37	34
	2008	OP	66	55	52	47	45	43	64	57	42	38	39	35
		PM	63	54	49	47	45	42	53	47	36	35	38	34
		AM	64	54	47	46	45	41	53	47	34	34	37	34
	2011	OP	66	55	52	47	46	43	59	53	38	37	39	35
		PM	62	54	49	46	46	41	53	46	35	35	38	34
		AM	60	52	48	46	41	42	51	46	36	34	35	34
	2014	OP	63	53	52	48	46	45	58	52	42	38	40	35
		PM	55	51	48	47	44	43	53	47	37	35	35	33
		AM	60	52	48	46	41	42	51	46	36	34	35	34
	2017	OP	63	53	52	48	46	45	58	52	42	38	40	35
		PM	55	51	48	47	44	43	53	47	37	35	35	33

Table 4.1.2-1 Triangle Regional Model Speeds for the Triangle Area (Continued)

County	Yr	Period	RI	RPA	RMA	RMjC	RMiC	RL	UI	UF	UPA	UMiA	UC	UL
Franklin		AM	na	53	54	43	48	44	na	na	na	na	na	na
	2005	OP	na	55	55	42	48	43	na	na	na	na	na	na
		PM	na	52	54	42	48	44	na	na	na	na	na	na
		AM	na	52	54	42	48	43	na	na	na	na	na	na
	2008	OP	na	55	55	42	48	43	na	na	na	na	na	na
		PM	na	51	53	41	48	43	na	na	na	na	na	na
		AM	na	53	53	43	48	43	na	na	na	na	na	na
	2011	OP	na	53	54	41	48	43	na	na	na	na	na	na
		PM	na	50	52	42	48	43	na	na	na	na	na	na
		AM	na	48	50	45	48	44	na	na	na	na	na	na
	2014	OP	na	54	53	41	48	45	na	na	na	na	na	na
		PM	na	45	46	43	48	45	na	na	na	na	na	na
		AM	na	48	50	45	48	44	na	na	na	na	na	na
	2017	OP	na	54	53	41	48	45	na	na	na	na	na	na
		PM	na	45	46	43	48	45	na	na	na	na	na	na
Granville		AM	65	na	na	38	43	47	na	na	na	na	na	na
	2005	OP	65	na	na	40	45	47	na	na	na	na	na	na
		PM	65	na	na	38	44	48	na	na	na	na	na	na
		AM	65	na	na	39	44	47	na	na	na	na	na	na
	2008	OP	66	na	na	41	46	47	na	na	na	na	na	na
		PM	65	na	na	38	45	47	na	na	na	na	na	na
		AM	66	na	na	41	45	47	na	na	na	na	na	na
	2011	OP	65	na	na	41	45	28	na	na	na	na	na	na
		PM	66	na	na	41	46	46	na	na	na	na	na	na
		AM	64	na	na	38	43	46	na	na	na	na	na	na
	2014	OP	66	na	na	42	46	47	na	na	na	na	na	na
		PM	63	na	na	40	45	47	na	na	na	na	na	na
		AM	64	na	na	38	43	46	na	na	na	na	na	na
	2017	OP	66	na	na	42	46	47	na	na	na	na	na	na
		PM	63	na	na	40	45	47	na	na	na	na	na	na
Johnston		AM	64	39	49	47	44	42	na	na	na	na	na	na
	2005	OP	65	40	51	48	43	42	na	na	na	na	na	na
		PM	63	38	47	45	43	42	na	na	na	na	na	na
		AM	65	39	48	46	43	43	na	na	na	na	na	na
	2008	OP	66	40	51	48	42	42	na	na	na	na	na	na
		PM	64	38	46	44	42	43	na	na	na	na	na	na
		AM	66	39	45	40	46	47	na	na	na	na	na	na
	2011	OP	65	40	49	46	43	42	na	na	na	na	na	na
		PM	63	38	43	42	42	42	na	na	na	na	na	na
		AM	64	37	39	39	42	35	na	na	na	na	na	na
	2014	OP	66	37	48	43	44	40	na	na	na	na	na	na
		PM	62	35	37	38	42	37	na	na	na	na	na	na
		AM	64	37	39	39	42	35	na	na	na	na	na	na
	2017	OP	66	37	48	43	44	40	na	na	na	na	na	na
		PM	62	35	37	38	42	37	na	na	na	na	na	na

Table 4.1.2-1 Triangle Regional Model Speeds for the Triangle Area (Continued)

County	Yr	Period	RI	RPA	RMA	RMjC	RMiC	RL	UI	UF	UPA	UMiA	UC	UL
Orange		AM	64	na	50	43	42	44	62	22	34	32	27	25
	2005	OP	64	na	51	44	42	45	65	40	38	34	29	26
		PM	64	na	50	43	42	44	63	27	35	33	28	25
		AM	64	na	50	43	42	44	60	23	34	33	27	25
	2008	OP	65	na	51	44	42	45	66	40	38	34	29	26
		PM	63	na	50	43	42	45	62	29	35	33	27	25
		AM	63	na	50	43	42	44	58	25	33	33	26	24
	2011	OP	64	na	51	43	42	45	65	29	37	34	28	25
		PM	63	na	50	43	42	44	61	29	35	33	27	25
		AM	63	na	50	43	43	45	59	21	33	33	29	25
	2014	OP	64	na	51	44	43	45	64	28	36	35	31	25
		PM	62	na	50	44	43	45	60	21	34	33	30	25
		AM	63	na	50	43	43	45	59	21	33	33	29	25
	2017	OP	64	na	51	44	43	45	64	28	36	35	31	25
		PM	62	na	50	44	43	45	60	21	34	33	30	25
Wake		AM	60	56	44	44	42	43	53	55	35	37	34	36
	2005	OP	66	58	50	46	44	44	61	60	42	42	37	38
		PM	56	55	44	43	42	43	53	56	36	38	35	37
		AM	56	55	44	44	42	43	53	55	35	38	33	36
	2008	OP	66	59	49	45	43	44	62	59	42	42	37	38
		PM	50	55	44	43	42	43	53	55	36	38	35	37
		AM	54	54	42	43	42	43	52	54	34	38	34	36
	2011	OP	59	56	45	43	42	43	58	58	38	40	36	37
		PM	46	54	43	41	41	42	52	54	35	38	35	36
		AM	54	55	36	42	40	41	51	51	36	36	34	34
	2014	OP	57	58	43	44	42	42	58	58	41	40	37	36
		PM	53	54	37	42	41	41	52	53	36	36	34	34
		AM	54	55	36	42	40	41	51	51	36	36	34	34
	2017	OP	57	58	43	44	42	42	58	58	41	40	37	36
		PM	53	54	37	42	41	41	52	53	36	36	34	34

Table 4.1.2-2 Rural Area Speeds for the Triangle Area

County	Year	RI	RPA	RMA	RMjC	RMiC	RL	UI	UF	UPA	UMiA	UC	UL
Franklin	2005	na	46	43	43	42	42	na	na	28	31	31	30
	2008	na	46	43	42	42	42	na	na	27	31	31	30
	2011	na	46	43	42	42	42	na	na	27	31	31	30
	2014	na	46	43	42	42	42	na	na	27	31	31	30
	2017	na	45	43	42	42	42	na	na	27	31	31	30
Granville	2005	65	46	44	42	42	42	62	na	29	31	31	31
	2008	64	46	44	41	42	42	62	na	29	31	31	31
	2011	64	46	44	41	42	42	62	na	29	31	31	31
	2014	64	46	44	41	42	42	62	na	29	31	31	31
	2017	64	46	44	41	42	42	62	na	29	31	31	31
Johnston	2005	65	45	44	43	42	42	62	na	29	32	30	29
	2008	65	44	44	43	42	42	62	na	28	32	29	28
	2011	65	44	44	43	42	42	62	na	28	32	29	28
	2014	65	44	44	43	42	42	62	na	28	32	29	28
	2017	64	43	43	43	42	42	62	na	28	32	28	27
Person	2005	na	46	43	43	42	42	na	na	28	31	31	30
	2008	na	46	43	43	42	42	na	na	27	31	31	30
	2011	na	46	43	43	42	42	na	na	27	31	31	30
	2014	na	46	43	43	42	42	na	na	27	31	31	30
	2017	na	45	43	43	42	42	na	na	27	31	31	30

The MOBILE6.2 command "AVERAGE SPEED" was used to enter the daily speeds provided by NCDOT. This command requires two data elements: average speed and a roadway scenario. As with all average speed inputs to MOBILE6.2, average speeds may range from 2.5 to 65 miles per hour. The roadway scenario data element indicates the type of driving that the user intends for the average speed input to model. NCDAQ and NCDOT follow the USEPA Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation (Office of Transportation, and Air Quality EPA420-R-04-013, August 2004) to match FHWA roadways to MOBILE6.2 driving cycles with the exception of local roads. For local roads, NCDAQ used arterial/collector roadway scenario, in accordance to the above mentioned USEPA guidance found on page 30:

> *Note that the MOBILE6.2 driving cycle used for local roadways may differ from the range of activity on the roadways defined as local by USDOT Publication No. FHWA-ED-90-006 revised March 1989 (Highway Functional Classification) for both rural and urban local VMT. The local roadway driving cycle used in MOBILE6.2 likely constitutes only a small subset of urban local VMT as defined by FHWA. When in doubt, EPA recommends that any roadway VMT that does not clearly match the MOBILE6.2 driving cycle for local roadways be included with MOBILE6.2 arterial/collector VMT rather than included with MOBILE6.2 local roadway VMT.*

Roadway scenarios per facility type are defined as follows:

Rural interstate	Non-Ramp
Rural principle arterial	Non-Ramp
Rural minor arterial	Arterial
Rural major collector	Arterial
Rural minor collector	Arterial
Rural local	Arterial
Urban interstate	Non-Ramp
Urban freeway	Non-Ramp
Urban principle arterial	Arterial
Urban minor arterial	Arterial
Urban collector	Arterial
Urban local	Arterial

Interstates are modeled as "Non-Ramp" instead of "Freeway" because both speed and VMT for ramps are included in the functional classification for the major facility it is connected to in the model. This is consistent with the August 2004 USEPA guidance mentioned above.

Vehicle Age Distribution

The vehicle age distribution comes from annual registration data for North Carolina from the NCDOT. For this analysis the age distribution was generated based on 2004 data, the latest available count data. The NCDOT provided the data based on the number of vehicle types per year from 1974 through 2004. Vehicles greater than 25 years old were combined and included as the 25th model year. The vehicle count information is provided for nine vehicle types; light duty gas vehicles (LDGV), light duty diesel vehicles (LDDV), light duty gas trucks 1 (LDGT1), light duty gas trucks 2 (LDGT2), light duty diesel trucks 1 (LDDT1), light duty diesel trucks 2 (LDDT2), heavy duty gas vehicles (HDGV), heavy duty diesel vehicles (HDDV) and motorcycles (MC). LDDT1 and LDDT2 are combined and labeled as light duty diesel trucks (LDDT). This vehicle distribution corresponds to the old MOBILE5 format and does not correlate to the USEPA MOBILE6.2 model vehicle types. In order to convert the data provided by the NCDOT into the MOBILE6.2 model format, the NCDAQ used a utility developed by the USEPA that disaggregates the 8 MOBILE5 model vehicle types into the 16 MOBILE6.2 vehicle types. The count data provided by the NCDOT is converted to fractions by dividing each count per vehicle type per year by the total number of vehicles in that classification for all years. For example, the number of 2004 light duty vehicles divided by the total number of light duty

vehicles for all years. The fractions are arranged into MOBILE5 format for conversion to the 16 vehicle types required by the MOBILE6.2 model using the USEPA conversion utility.

Vehicle Mix Assumptions

The vehicle mix refers to the percentage of different vehicle types on each of the 12 FHWA road types. These road types are listed above in the speed assumptions section. It is critical for estimating mobile emissions in an area to use data that accurately reflects the vehicles types traveling on each of these different road types.

Historically, the North Carolina statewide vehicle mix was created using spreadsheets that were developed in the mid-1990s. In August 2004, the USEPA released the guidance document EPA420-R-04-013, Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation. The NCDAQ created a new statewide mix based on this methodology. Outlined below is the methodology used to convert the 13 Highway Performance Monitoring System (HPMS) vehicle types count data reported to FHWA and generate a state specific vehicle mix.

The North Carolina HPMS data that was used to generate the new statewide vehicle mix was based on 1999 through 2001 data counts. This is the latest available statewide count information. Table 4.1.2-3 shows the percent of vehicles per vehicle type for each of the 12 road classes.

Table 4.1.2-3 Percentage of Vehicles Per Vehicle Type by Functional Road Class

	PASS CARS	PICK UPS	BUS	2-A TRK	3-A TRK	4-A TRK	4-A TTST	5-A TTST	6-A TTST	5-A TWIN	6-A TWIN	7-A TWIN	MC
Rural													
Interstate	56.93%	10.80%	1.06%	2.50%	1.56%	1.09%	4.79%	19.23%	0.48%	0.73%	0.24%	0.11%	0.49%
Oth Prin Art*	69.34	15.79	0.71	2.80	1.48	0.25	2.07	6.67	0.26	0.16	0.05	0.04	0.40
Minor Art**	70.58	17.23	0.59	3.19	1.87	0.27	1.79	3.69	0.21	0.05	0.01	0.02	0.49
Major Col*	73.21	17.52	0.51	3.01	1.45	0.24	1.63	1.84	0.18	0.02	0.01	0.02	0.36
Minor Col*	74.00	16.50	0.65	3.00	1.55	0.17	1.75	1.50	0.30	0.05	0.02	0.06	0.45
local	71.93	18.66	0.51	4.09	1.06	0.02	1.54	1.60	0.05	0.00	0.00	0.00	0.55
Urban													
Interstate	68.68	12.84	0.89	2.12	1.68	0.42	2.70	9.29	0.45	0.36	0.09	0.10	0.36
Oth Freeway	74.79	13.97	0.57	2.48	1.17	0.42	2.56	3.42	0.17	0.07	0.01	0.03	0.33
Oth Prin Art**	76.64	14.84	0.46	2.20	1.30	0.13	1.66	2.12	0.21	0.04	0.01	0.04	0.32
Minor Art	79.35	14.43	0.47	2.16	1.08	0.10	1.26	0.66	0.11	0.00	0.00	0.02	0.36
Collectors	81.15	13.42	0.43	2.02	1.12	0.07	0.99	0.40	0.05	0.00	0.00	0.01	0.34
local	75.56	16.59	0.82	2.57	1.73	0.03	0.95	1.05	0.10	0.00	0.00	0.00	0.59

Disaggregating State Specific Information

Section 4.1.5 of Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation, illustrates how to map the HPMS statewide vehicle data to general vehicle categories. This mapping is outlined below:

HPMS Category	**General Category**
Motorcycle	Motorcycle (MC)
Passenger Car	Passenger Car (LDV)
Other 2-Axel, 4-Tire Vehicles	Light Truck (LDT)
Busses	Bus (HDB)
All Other Trucks: Single unit, 2-axel, 6-tire Single unit, 3-axel Single unit, 4 or more axel Single trailer, 4 or fewer axel Single trailer, 5-axel Single trailer, 6 or more axel Multi-trailer, 5 or fewer axel Multi-trailer, 6-axel Multi-trailer, 7 or more axel	Heavy Duty Truck (HDV)

The HPMS data in Table 4.1.2-3 was grouped into these five general categories for each road type. In order to expand the five general categories to the 16 vehicle types used in MOBILE6.2, the national average VMT fractions by each vehicle class were used. The 2000 fractions were used since the state specific data is from 1999 through 2001. The national average data was obtained from Table 4.1.2 in Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation. An example for rural interstates is illustrated below:

From Table 4.1.2-3 above:

Passenger Cars	=	56.93%	5 axel Trailer	=	19.23%
Pickup Trucks	=	10.80%	6 axel Trailer	=	0.48%
Bus	=	1.06%	5 axel Multi Trailer	=	0.73%
2 axel Trucks	=	2.50%	6 axel Multi Trailer	=	0.24%
3 axel Trucks	=	1.56%	7 axel Multi Trailer	=	0.11%
4 axel Trucks	=	1.09%	Motorcycles	=	0.49%
4 axel Trailer	=	4.79%			

Therefore, the five general categories are:

Motorcycles	=	0.49%
Light Duty Vehciles	=	56.93%
Light Duty Trucks	=	10.80%
Heavy Duty Buses	=	1.06%
Heavy Duty Vehicles	=	30.73%

From Table 4.1.2 in Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation, the 2000 national average vehicle mix for light duty trucks, buses and heavy duty trucks are:

Light Duty Trucks

LDT1	=	0.0655
LDT2	=	0.2179
LDT3	=	0.0672
LDT4	=	0.0309
Total	**=**	**0.3815**

Buses

HDBS	=	0.0019
HDBT	=	0.0009
Total	**=**	**0.0028**

Heavy Duty Trucks

HDV2B	=	0.0380
HDV3	=	0.0038
HDV4	=	0.0029
HDV5	=	0.0022
HDV6	=	0.0082
HDV7	=	0.0098
HDV8A	=	0.0108
HDV8B	=	0.0386
Total	**=**	**0.1143**

Using the methodology described in Section 4.1.5 in Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation the new 2000 North Carolina statewide mix was developed. The basic formula for developing the mix is shown below,

$$\text{Vehicle Type} = (\text{2000 M6.2 fraction for vehicle}) \times \frac{\text{(99-01 State total for group)}}{\text{(2000 M6.2 total for subcategory)}}.$$

Table 4.1.2-4 displays the calculation for each vehicle type for the 2000 rural interstate vehicle mix.

Table 4.1.2-4 Calculation of New 2000 Statewide Rural Interstate Vehicle Mix

Vehicle Type		Calculation		New 2000 Mix
LDV	=	LDV	=	0.5693
MC	=	MC	=	0.0049
Light Duty Trucks				
LDT1	=	0.0655 x (0.1080/0.3815)	=	0.0185
LDT2	=	0.2179 x (0.1080/0.3815)	=	0.0617
LDT3	=	0.0672 x (0.1080/0.3815)	=	0.0190
LDT4	=	0.0309 x (0.1080/0.3815)	=	0.0087
Heavy Duty Vehicles				
HDV2B	=	0.0380 x (0.3073/0.1143)	=	0.1022
HDV3	=	0.0038 x (0.3073/0.1143)	=	0.0102
HDV4	=	0.0029 x (0.3073/0.1143)	=	0.0078
HDV5	=	0.0022 x (0.3073/0.1143)	=	0.0059
HDV6	=	0.0082 x (0.3073/0.1143)	=	0.0220
HDV7	=	0.0098 x (0.3073/0.1143)	=	0.0263
HDV8A	=	0.0108 x (0.3073/0.1143)	=	0.0290
HDV8B	=	0.0386 x (0.3073/0.1143)	=	0.1038
Buses				
HDBS	=	0.0019 x (0.0106/0.0028)	=	0.0072
HDBT	=	0.0009 x (0.0106/0.0028)	=	0.0034

2005, 2008, 2011, 2014 and 2017 Statewide Vehicle Mix

Once the 2000 vehicle mix was generated, the other years were created using the methodology described in Section 4.1.4 in Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation. This method grouped light duty vehicles, light duty trucks and motorcycles together and heavy duty buses, heavy duty trucks and heavy duty vehicles together. The combined percentages for these groupings are listed below.

Light Duty Vehicles = 68.22%
Heavy Duty Vehicles = 31.78%

The MOBILE6.2 vehicle mix fractions for the year being developed were obtained from Table 4.1.2 in Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation. The MOBILE6.2 vehicle fractions for 2005 are listed below.

Light Duty Vehicles		
LDV	=	0.4231
LDT1	=	0.0774
LDT2	=	0.2577
LDT3	=	0.0794
LDT4	=	0.0365
MC	=	0.0057
Total	**=**	**0.8798**

Heavy Duty Vehicles		
HDV2B	=	0.0387
HDV3	=	0.0038
HDV4	=	0.0031
HDV5	=	0.0023
HDV6	=	0.0086
HDV7	=	0.0102
HDV8A	=	0.0111
HDV8B	=	0.0395
HDBS	=	0.0020
HDBT	=	0.0009
Total	**=**	**0.1202**

The North Carolina 2005 vehicle mix was normalized to the MOBILE6.2 fractions using the following formula:

$$\text{Vehicle Type} = (\text{2005 M6 fraction for vehicle}) \times \frac{\text{(2000 State total for group)}}{\text{(2005 M6 total for group)}}$$

Table 4.1.2-5 below displays the calculations used to generate the 2005 North Carolina vehicle mix for rural interstate.

Table 4.1.2-5 Calculation of 2005 Statewide Rural Interstate Vehicle Mix

Vehicle Type		Calculation		2005 State Mix
Light Duty Vehicles				
LDV	=	0.4231 x (0.6822/0.8798)	=	0.3281
LDT1	=	0.0774 x (0.6822/0.8798)	=	0.0600
LDT2	=	0.2577 x (0.6822/0.8798)	=	0.1998
LDT3	=	0.0794 x (0.6822/0.8798)	=	0.0616
LDT4	=	0.0365 x (0.6822/0.8798)	=	0.0283
MC	=	0.0057 x (0.6822/0.8798)		0.0044
Heavy Duty Vehicles				
HDV2B	=	0.0387 x (0.3178/0.1202)	=	0.1023
HDV3	=	0.0038 x (0.3178/0.1202)	=	0.0100
HDV4	=	0.0031 x (0.3178/0.1202)	=	0.0082
HDV5	=	0.0023 x (0.3178/0.1202	=	0.0061
HDV6	=	0.0086 x (0.3178/0.1202)	=	0.0227
HDV7	=	0.0102 x (0.3178/0.1202)	=	0.0270
HDV8A	=	0.0111 x (0.3178/0.1202)	=	0.0293
HDV8B	=	0.0395 x (0.3178/0.1202)	=	0.1044
HDBS	=	0.0020 x (0.3178/0.1202)	=	0.0053
HDBT	=	0.0009 x (0.3178/0.1202)	=	0.0024

This method was used to generate all of the future year vehicle mixes that were needed to compute the emission factors. The North Carolina transportation partners consider the statewide vehicle mix to be the best representation of the vehicle population in the Triangle nonattainment area.

Temperature, Relative Humidity and Barometric Pressure Assumptions

The MOBILE6.2 command "HOURLY TEMPERATURES" was used to enter 24 hourly temperatures to estimate mobile source emissions. This command requires the command name followed by the 24 hourly temperatures in the data field in the RUN SECTION of the mobile input files. The temperatures must be listed beginning with the 6 a.m. and continuing through 5 a.m. the next day. The first 12 values must be on the same line as the command; the remaining twelve must be on the next line. For the Triangle area mobile source emission estimates, the

NCDAQ used average July 2005 24-hour temperature profile from the Automated Surface Observing System at the Raleigh-Durham International Airport (KRDU).

The MOBILE6.2 command "RELATIVE HUMIDITY" was used to enter 24 hourly relative humidity values to estimate mobile source emissions. This command requires the 24 hourly values be in the same format as the HOURLY TEMPERATURES command. The relative humidity values are entered in the SCENARIO section of the mobile input files. Just as the temperatures, the relative humidity data represents an average July 2005 profile from KRDU. When the RELATIVE HUMIDITY command is used, the user supplied relative humidity values are converted to absolute humidity. This conversion requires values of temperature and barometric pressure.

The BAROMETRIC PRES command allows the user to change the default value of barometric pressure used in the humidity conversion. The value used was based upon the National Oceanic and Atmospheric Administration Cooperative Institute for Research in Environmental Sciences Climate Diagnostics Center (NOAA-CIRES CDC) reanalysis web page. The Figure below provides the mean barometric pressure for July based upon 1948-2004 data. As one can see, the average July pressure in the Triangle area is between 1016.5 mb and 1017.5 mb or 30.01 and 30.04 inches of mercury. Therefore, a pressure of 30.0 inches of mercury is used in the exercise.

Figure 4.1.2-1. Mean barometric pressure for July based upon 1948-2004 data

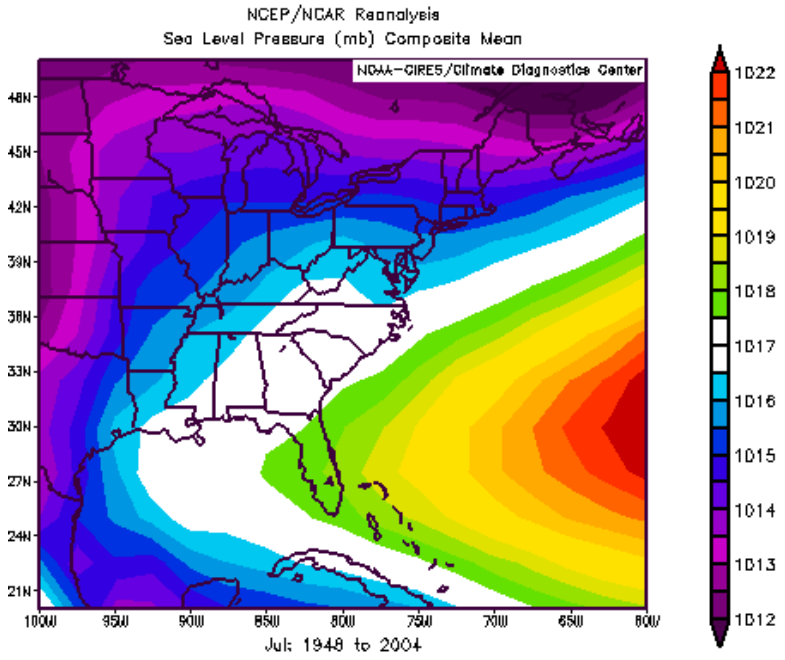


Table 4.1.2-6 provides the tempertatures, relative humidy and barometric pressure data and format used in this analysis.

Table 4.1.2-6 Temperatures, Relative Humidity and Pressure used in MOBILE6.2 Input File

```
HOURLY TEMPERATURES: 73. 73. 74. 77. 78. 81. 82. 85. 86. 89. 89. 88.
                                 86. 86. 84. 81. 80. 77. 76. 75. 74. 73. 73. 73.

RELATIVE HUMIDITY  : 96. 96. 88. 80. 77. 68. 64. 54. 53. 50. 49. 51.
                               57. 60. 67. 70. 75. 82. 86. 90. 93. 94. 95. 96.

BAROMETRIC PRES    : 30.0
```

Vehicle Inspection and Maintenance Program Assumptions

In 2002, North Carolina implemented a new vehicle emissions inspection program referred to as onboard diagnostics (OBDII). This program covers all light duty gasoline powered vehicles that are model year 1996 and newer. The program was initially implemented in 9 counties and was expanded to include a total of 48 counties between July 2002 and January 2006. Durham, Orange, and Wake Counties were phased-in July 1, 2002 followed by Johnston County in July 1, 2003; Chatham and Franklin Counties in January 1, 2004; and Granville County in July 1, 2004. The OBDII compliance rate used in the mobile source emission estimates is 95 percent. In addition, the inspection stations are required to administer an anti-tampering check to ensure that emissions control equipment on any vehicle 1968 and newer has not been altered.

Reid Vapor Pressure Assumptions

RVP reflects a gasoline's volatility. An RVP of 9.0 pounds per square inch is required during May through September for the rural portion of Granville County and the entire area of Chatham, Franklin, Johnston and Orange Counties. Lower RVP leads to lower VOC emissions from gasoline handling and lowers vapor losses from motor vehicles. An RVP of 7.8 is required in Granville County (Dutchville Township), and Durham and Wake Counties, June through September.

4.1.3 VMT Assumptions

In order to calculate emissions from on-road mobile sources, emission factors are developed as discussed throughout this document. The emission factors are then multiplied by an activity level, which for on-road mobile sources is daily VMT. The TRM VMT for the Triangle nonattainment area was provided by NCDOT on February 23, 2007.

The non-TRM VMT for the Triangle nonattainment area was provided by the NCDOT via e-mail on February 9, 2007 for the years 2005, 2008, 2011, 2014, and 2017. This "universe" VMT is generated from the NCDOT's "new rural spreadsheet" calculations. The NCDOT's new version of this rural spreadsheet accounts for the impact of added lane miles on forecasted VMT. This adjustment is done using the following formula:

*Road type VMT for the analysis year = Road type HPMS VMT + [(total base year VMT/total base year lane miles) * added lane miles for the road type in analysis year]*

In counties that are partially covered by the TRM (Johnston, Franklin, and Granville Counties), Triangle Transportation partners have indicated that future versions of the Triangle TRM may include all of those counties. Also, Person County, which is not currently included in the TRM, may be included in future versions of the model. For this reason, the non-TRM (or rural spreadsheet VMT) was factored up by 30% to account for the fact that TRM VMT can be up to 30% higher than the rural spreadsheet VMT. This factor was applied to the Johnston, Franklin, Granville and Person Counties' "universe" VMT for 2005, 2008, 2011, 2014 and 2017.

The transportation partners recommended further upward adjustment of future year VMT for certain areas that are experiencing very high growth. The transportation partners did not believe that the method used to project the VMT in the universe file adequately captured the expected growth for these areas. The additional upward adjustment is applied only to the future years VMT (2008, 2011, 2014, 2017) in Johnston (additional 10%) and Franklin (additional 20%) Counties. The VMT sources and adjustment factors are shown in Table 4.1.3-1 and the total VMT is shown Tables 4.1.3-2 through 4.1.3-9. Please note the VMT presented as "rural area" is the non-TRM VMT with the appropriate factors applied.

Table 4.1.3-1 Vehicle Miles Traveled Sources and Adjustment Factors

County	2005	2008, 2011, 2014 and 2017
Chatham	TRM	TRM
Durham	TRM	TRM
Franklin	TRM + Universe*1.3	TRM + Universe*1.5
Granville	TRM + Universe*1.3	TRM + Universe*1.3
Johnston	TRM + Universe*1.3	TRM + Universe*1.4
Orange	TRM	TRM
Person	TRM + Universe*1.3	TRM + Universe*1.3
Wake	TRM	TRM

Table 4.1.3-2 Vehicle Miles Traveled for Chatham County

Type	Period	Road Type	2005	2008	2011	2014	2017
TRM	AM	Urban Interstate	0	0	0	0	0
		Freeway & Expressway	0	0	0	0	0
		Urban Other Principle Arterial	0	0	0	0	0
		Urban Minor Arterial	0	0	0	0	0
		Urban Collector	0	0	0	0	0
		Urban Local	0	0	0	0	0
		Rural Interstate	0	0	0	0	0
		Rural Other Principle Arterial	99,046	119,910	138,402	164,754	191,107
		ural Minor Arterial	9,455	11,242	12,218	13,526	14,833
		Rural Major Collector	55,726	68,603	79,184	86,102	93,021
		Rural Minor Collector	8,650	10,760	11,495	11,240	10,984
		Rural Local	39,396	51,731	57,960	58,047	58,133
	OP	Urban Interstate	0	0	0	0	0
		Freeway & Expressway	0	0	0	0	0
		Urban Other Principle Arterial	0	0	0	0	0
		Urban Minor Arterial	0	0	0	0	0
		Urban Collector	0	0	0	0	0
		Urban Local	0	0	0	0	0
		Rural Interstate	0	0	0	0	0
		Rural Other Principle Arterial	144,047	172,322	200,819	243,132	285,444
		ural Minor Arterial	14,740	16,962	18,808	21,173	23,538
		Rural Major Collector	62,108	77,289	90,742	103,761	116,781
		Rural Minor Collector	9,946	12,431	13,285	13,732	14,179
		Rural Local	53,885	68,919	77,501	81,368	85,234
	PM	Urban Interstate	0	0	0	0	0
		Freeway & Expressway	0	0	0	0	0
		Urban Other Principle Arterial	0	0	0	0	0
		Urban Minor Arterial	0	0	0	0	0
		Urban Collector	0	0	0	0	0
		Urban Local	0	0	0	0	0
		Rural Interstate	0	0	0	0	0
		Rural Other Principle Arterial	108,496	131,796	152,153	183,035	213,918
		ural Minor Arterial	10,363	12,126	13,414	14,943	16,471
		Rural Major Collector	55,137	67,140	77,054	81,872	86,691
		Rural Minor Collector	7,919	10,091	10,826	10,561	10,297
		Rural Local	42,708	55,363	62,180	63,682	65,185
Chatham County Total VMT			**721,622**	**886,684**	**1,016,041**	**1,150,928**	**1,285,815**

Table 4.1.3-3 Vehicle Miles Traveled for Durham County

Type	Period	Road Type	2005	2008	2011	2014	2017
TRM	AM	Urban Interstate	669,399	759,931	798,524	809,030	819,535
		Freeway & Expressway	459,503	487,289	556,534	674,472	792,409
		Urban Other Principle Arterial	280,029	296,949	315,669	325,694	335,718
		Urban Minor Arterial	398,223	416,306	438,084	439,819	441,554
		Urban Collector	199,928	219,897	234,036	237,480	240,923
		Urban Local	255,045	270,845	288,592	284,931	281,270
		Rural Interstate	22,757	25,900	29,415	34,047	38,679
		Rural Other Principle Arterial	6,741	7,036	8,265	10,899	13,532
		ural Minor Arterial	69,261	72,745	76,240	79,599	82,958
		Rural Major Collector	40,176	47,446	53,371	57,595	61,820
		Rural Minor Collector	13,102	17,320	21,472	25,550	29,629
		Rural Local	114,055	130,196	143,762	153,826	163,891
	OP	Urban Interstate	1,025,684	1,150,151	1,175,136	1,147,253	1,119,370
		Freeway & Expressway	684,191	725,173	762,811	902,995	1,043,179
		Urban Other Principle Arterial	365,339	388,948	424,835	447,883	470,932
		Urban Minor Arterial	478,667	514,369	553,326	595,094	636,862
		Urban Collector	188,778	211,780	261,215	302,517	343,819
		Urban Local	290,736	309,272	339,899	384,451	429,004
		Rural Interstate	35,443	39,949	43,656	48,504	53,352
		Rural Other Principle Arterial	11,847	12,620	13,697	16,036	18,376
		ural Minor Arterial	91,988	95,689	104,108	114,699	125,289
		Rural Major Collector	47,470	56,625	69,055	86,193	103,330
		Rural Minor Collector	13,114	17,171	23,546	36,345	49,144
		Rural Local	156,531	176,865	201,889	230,442	258,996
	PM	Urban Interstate	672,980	765,843	797,793	807,401	817,008
		Freeway & Expressway	449,368	470,238	533,506	652,638	771,771
		Urban Other Principle Arterial	279,964	300,110	320,331	335,244	350,156
		Urban Minor Arterial	398,112	416,204	433,919	440,582	447,244
		Urban Collector	179,040	199,793	222,979	228,828	234,678
		Urban Local	247,794	259,402	280,751	282,987	285,223
		Rural Interstate	25,494	28,688	32,123	37,452	42,782
		Rural Other Principle Arterial	8,144	8,548	9,769	12,488	15,207
		ural Minor Arterial	71,630	74,975	79,478	84,638	89,798
		Rural Major Collector	39,482	46,993	53,823	60,167	66,512
		Rural Minor Collector	12,802	17,288	20,702	25,649	30,596
		Rural Local	124,590	141,722	159,260	171,841	184,421
Durham County Total VMT			**8,427,407**	**9,180,276**	**9,881,571**	**10,585,269**	**11,288,968**

Table 4.1.3-4 Vehicle Miles Traveled for Franklin County

Type	Period	Road Type	2005	2008	2011	2014	2017
TRM	AM	Urban Interstate	0	0	0	0	0
		Freeway & Expressway	0	0	0	0	0
		Urban Other Principle Arterial	0	0	0	0	0
		Urban Minor Arterial	0	0	0	0	0
		Urban Collector	0	0	0	0	0
		Urban Local	0	0	0	0	0
		Rural Interstate	0	0	0	0	0
		Rural Other Principle Arterial	21,258	22,987	24,810	28,030	31,250
		ural Minor Arterial	11,250	12,954	14,501	16,718	18,936
		Rural Major Collector	17,602	20,619	25,237	31,300	37,363
		Rural Minor Collector	835	1,056	1,449	1,947	2,446
		Rural Local	20,728	23,759	30,074	37,614	45,153
	OP	Urban Interstate	0	0	0	0	0
		Freeway & Expressway	0	0	0	0	0
		Urban Other Principle Arterial	0	0	0	0	0
		Urban Minor Arterial	0	0	0	0	0
		Urban Collector	0	0	0	0	0
		Urban Local	0	0	0	0	0
		Rural Interstate	0	0	0	0	0
		Rural Other Principle Arterial	35,439	38,827	41,316	42,738	44,160
		ural Minor Arterial	18,312	20,960	23,663	26,303	28,943
		Rural Major Collector	23,967	28,424	34,641	44,876	55,112
		Rural Minor Collector	963	1,076	1,664	3,258	4,852
		Rural Local	31,388	35,365	43,702	59,997	76,292
	PM	Urban Interstate	0	0	0	0	0
		Freeway & Expressway	0	0	0	0	0
		Urban Other Principle Arterial	0	0	0	0	0
		Urban Minor Arterial	0	0	0	0	0
		Urban Collector	0	0	0	0	0
		Urban Local	0	0	0	0	0
		Rural Interstate	0	0	0	0	0
		Rural Other Principle Arterial	25,246	27,361	29,646	32,723	35,800
		ural Minor Arterial	13,436	15,348	17,519	20,245	22,970
		Rural Major Collector	18,128	21,583	26,399	32,802	39,205
		Rural Minor Collector	874	1,083	1,460	2,006	2,552
		Rural Local	23,891	27,441	33,994	43,976	53,958
Rural Spreadsheet		Urban Interstate	0	0	0	0	0
		Freeway & Expressway	0	0	0	0	0
		Urban Other Principle Arterial	29,060	32,931	36,212	38,312	40,412
		Urban Minor Arterial	33,840	38,348	42,168	44,613	47,059
		Urban Collector	0	0	0	0	0
		Urban Local	13,780	15,616	17,171	18,167	19,163
		Rural Interstate	0	0	0	0	0
		Rural Other Principle Arterial	202,020	228,930	251,737	266,336	280,935
		ural Minor Arterial	232,150	263,074	289,282	306,058	322,835
		Rural Major Collector	235,160	266,485	293,355	311,314	329,273
		Rural Minor Collector	124,270	140,824	154,853	163,833	172,814
		Rural Local	89,340	101,241	111,327	117,783	124,239
Franklin County Total VMT			**1,222,937**	**1,386,291**	**1,546,180**	**1,690,950**	**1,835,720**

Table 4.1.3-5 Vehicle Miles Traveled for Granville County

Type	Period	Road Type	2005	2008	2011	2014	2017
TRM	AM	Urban Interstate	0	0	0	0	0
		Freeway & Expressway	0	0	0	0	0
		Urban Other Principle Arterial	0	0	0	0	0
		Urban Minor Arterial	0	0	0	0	0
		Urban Collector	0	0	0	0	0
		Urban Local	0	0	0	0	0
		Rural Interstate	93,909	106,113	119,903	140,526	161,149
		Rural Other Principle Arterial	0	0	0	0	0
		ural Minor Arterial	0	0	0	0	0
		Rural Major Collector	53,837	66,859	74,097	81,681	89,264
		Rural Minor Collector	17,362	23,122	26,041	29,181	32,321
		Rural Local	26,446	38,002	42,040	45,756	49,472
	OP	Urban Interstate	0	0	0	0	0
		Freeway & Expressway	0	0	0	0	0
		Urban Other Principle Arterial	0	0	0	0	0
		Urban Minor Arterial	0	0	0	0	0
		Urban Collector	0	0	0	0	0
		Urban Local	0	0	0	0	0
		Rural Interstate	144,197	162,754	181,961	208,095	234,229
		Rural Other Principle Arterial	0	0	0	0	0
		ural Minor Arterial	0	0	0	0	0
		Rural Major Collector	76,721	93,540	103,340	121,396	139,452
		Rural Minor Collector	20,790	28,040	32,774	39,607	46,440
		Rural Local	32,160	48,304	54,077	61,714	69,351
	PM	Urban Interstate	0	0	0	0	0
		Freeway & Expressway	0	0	0	0	0
		Urban Other Principle Arterial	0	0	0	0	0
		Urban Minor Arterial	0	0	0	0	0
		Urban Collector	0	0	0	0	0
		Urban Local	0	0	0	0	0
		Rural Interstate	103,831	117,311	132,849	156,529	180,208
		Rural Other Principle Arterial	0	0	0	0	0
		ural Minor Arterial	0	0	0	0	0
		Rural Major Collector	58,517	71,745	78,306	87,422	96,539
		Rural Minor Collector	16,997	23,159	25,961	28,766	31,571
		Rural Local	29,736	38,651	42,808	47,056	51,303
Rural Spreadsheet		Urban Interstate	67,617	70,403	73,189	75,974	78,760
		Freeway & Expressway	0	0	0	0	0
		Urban Other Principle Arterial	49,753	51,803	53,853	55,902	57,952
		Urban Minor Arterial	56,141	58,454	60,767	63,080	65,393
		Urban Collector	35,177	36,626	38,075	39,524	40,974
		Urban Local	15,471	16,108	16,746	17,383	18,021
		Rural Interstate	392,383	408,550	424,716	440,883	457,049
		Rural Other Principle Arterial	22,442	23,366	24,291	25,216	26,140
		ural Minor Arterial	48,483	50,481	52,479	54,476	56,474
		Rural Major Collector	297,029	309,267	321,505	333,742	345,980
		Rural Minor Collector	88,071	91,700	95,329	98,957	102,586
		Rural Local	62,227	64,791	67,355	69,919	72,483
Granville County Total VMT			**1,809,298**	**1,999,149**	**2,142,460**	**2,322,786**	**2,503,112**

Table 4.1.3-6 Vehicle Miles Traveled for Johnston County

Type	Period	Road Type	2005	2008	2011	2014	2017
TRM	AM	Urban Interstate	0	0	0	0	0
		Freeway & Expressway	0	0	0	0	0
		Urban Other Principle Arterial	0	0	0	0	0
		Urban Minor Arterial	0	0	0	0	0
		Urban Collector	0	0	0	0	0
		Urban Local	0	0	0	0	0
		Rural Interstate	81,576	111,930	115,781	146,141	176,502
		Rural Other Principle Arterial	46,733	31,793	32,129	36,826	41,524
		ural Minor Arterial	12,955	14,884	16,765	16,408	16,051
		Rural Major Collector	55,260	63,307	71,140	78,923	86,707
		Rural Minor Collector	17,828	15,629	20,028	26,169	32,311
		Rural Local	84,646	97,164	115,411	131,550	147,689
	OP	Urban Interstate	0	0	0	0	0
		Freeway & Expressway	0	0	0	0	0
		Urban Other Principle Arterial	0	0	0	0	0
		Urban Minor Arterial	0	0	0	0	0
		Urban Collector	0	0	0	0	0
		Urban Local	0	0	0	0	0
		Rural Interstate	136,792	188,864	201,513	251,610	301,707
		Rural Other Principle Arterial	81,554	53,270	46,904	55,170	63,436
		ural Minor Arterial	17,265	20,188	21,947	22,195	22,443
		Rural Major Collector	80,893	93,854	109,336	114,874	120,413
		Rural Minor Collector	18,703	16,355	26,398	42,246	58,094
		Rural Local	125,036	142,568	171,967	209,168	246,369
	PM	Urban Interstate	0	0	0	0	0
		Freeway & Expressway	0	0	0	0	0
		Urban Other Principle Arterial	0	0	0	0	0
		Urban Minor Arterial	0	0	0	0	0
		Urban Collector	0	0	0	0	0
		Urban Local	0	0	0	0	0
		Rural Interstate	91,223	123,747	132,915	170,471	208,027
		Rural Other Principle Arterial	53,298	37,718	36,176	41,831	47,486
		ural Minor Arterial	14,244	16,473	18,274	18,590	18,906
		Rural Major Collector	62,123	71,965	80,192	88,645	97,098
		Rural Minor Collector	19,703	16,435	21,861	29,700	37,539
		Rural Local	98,514	114,364	133,982	155,084	176,185
Rural Spreadsheet		Urban Interstate	228,860	252,867	273,274	286,483	299,692
		Freeway & Expressway	0	0	0	0	0
		Urban Other Principle Arterial	115,000	127,063	137,318	143,955	150,592
		Urban Minor Arterial	24,470	27,037	29,219	30,631	32,043
		Urban Collector	21,490	23,744	25,661	26,901	28,141
		Urban Local	34,680	38,318	41,410	43,412	45,413
		Rural Interstate	1,192,900	1,318,032	1,424,403	1,493,251	1,562,100
		Rural Other Principle Arterial	495,960	547,985	592,210	620,834	649,458
		ural Minor Arterial	149,410	165,083	178,406	187,029	195,652
		Rural Major Collector	549,380	650,904	729,156	760,864	792,571
		Rural Minor Collector	157,800	177,782	194,139	203,247	212,354
		Rural Local	282,120	311,714	336,870	353,153	369,435
Johnston County Total VMT			**4,350,414**	**4,871,038**	**5,334,785**	**5,785,363**	**6,235,940**

Table 4.1.3-7 Vehicle Miles Traveled for Orange County

Type	Period	Road Type	2005	2008	2011	2014	2017
TRM	AM	Urban Interstate	63,810	69,820	77,214	85,277	93,340
		Freeway & Expressway	19,097	17,978	18,581	23,537	28,493
		Urban Other Principle Arterial	112,566	115,859	119,996	125,945	131,894
		Urban Minor Arterial	99,461	110,349	115,170	113,478	111,786
		Urban Collector	16,632	17,908	21,257	26,879	32,501
		Urban Local	45,243	47,693	49,626	47,788	45,951
		Rural Interstate	453,943	498,887	552,625	624,509	696,393
		Rural Other Principle Arterial	0	0	0	0	0
		ural Minor Arterial	51,446	53,937	58,789	64,908	71,027
		Rural Major Collector	105,076	112,840	118,910	120,085	121,260
		Rural Minor Collector	45,411	48,484	52,817	55,740	58,662
		Rural Local	90,944	99,751	107,948	112,342	116,735
	OP	Urban Interstate	94,246	102,105	114,530	130,988	147,446
		Freeway & Expressway	37,965	36,712	29,392	31,342	33,293
		Urban Other Principle Arterial	153,536	160,097	161,963	163,687	165,410
		Urban Minor Arterial	113,855	126,598	145,610	152,177	158,744
		Urban Collector	19,364	20,314	25,654	35,504	45,355
		Urban Local	51,115	54,047	58,304	59,463	60,621
		Rural Interstate	753,755	821,148	907,507	1,018,381	1,129,255
		Rural Other Principle Arterial	0	0	0	0	0
		ural Minor Arterial	81,759	86,009	93,151	103,241	113,330
		Rural Major Collector	146,179	157,147	170,188	188,030	205,872
		Rural Minor Collector	65,308	69,631	75,173	81,246	87,319
		Rural Local	118,806	131,967	150,246	168,008	185,769
	PM	Urban Interstate	65,834	72,438	79,376	88,436	97,497
		Freeway & Expressway	16,908	15,243	16,995	22,425	27,855
		Urban Other Principle Arterial	112,943	117,390	122,147	128,079	134,011
		Urban Minor Arterial	103,474	113,680	118,824	117,109	115,394
		Urban Collector	17,118	18,567	21,546	28,042	34,538
		Urban Local	43,803	45,828	47,450	46,474	45,498
		Rural Interstate	500,884	548,233	606,073	685,101	764,128
		Rural Other Principle Arterial	0	0	0	0	0
		ural Minor Arterial	60,683	63,783	68,564	75,626	82,688
		Rural Major Collector	110,126	117,372	125,085	129,934	134,782
		Rural Minor Collector	48,343	51,539	56,071	59,579	63,086
		Rural Local	98,454	108,089	116,393	123,571	130,750
Orange County Total VMT			**3,918,089**	**4,231,441**	**4,603,173**	**5,036,929**	**5,470,685**

Table 4.1.3-8 Vehicle Miles Traveled for Person County

Type	Road Type	2005	2008	2011	2014	2017
Rural Spreadsheet	Urban Interstate	0	0	0	0	0
	Freeway & Expressway	0	0	0	0	0
	Urban Other Principle Arterial	156,780	163,392	170,698	179,392	188,086
	Urban Minor Arterial	30,700	31,995	33,425	35,128	36,830
	Urban Collector	32,570	33,944	35,461	37,267	39,074
	Urban Local	21,260	22,157	23,147	24,326	25,505
	Rural Interstate	0	0	0	0	0
	Rural Other Principle Arterial	63,260	65,928	68,876	72,384	75,892
	ural Minor Arterial	179,930	187,518	196,918	209,941	222,963
	Rural Major Collector	153,260	159,724	166,866	175,364	183,863
	Rural Minor Collector	141,210	147,165	153,746	161,576	169,407
	Rural Local	84,750	88,324	92,274	96,973	101,673
Person County Total VMT		**863,720**	**900,147**	**941,412**	**992,351**	**1,043,291**

Table 4.1.3-9 Vehicle Miles Traveled for Wake County

Type	Period	Road Type	2005	2008	2011	2014	2017
TRM	AM	Urban Interstate	1,651,286	2,009,667	2,138,245	2,248,943	2,359,640
		Freeway & Expressway	545,310	521,594	551,910	623,222	694,535
		Urban Other Principle Arterial	1,010,916	1,041,399	1,111,170	1,224,283	1,337,397
		Urban Minor Arterial	1,026,586	1,097,830	1,185,783	1,290,286	1,394,788
		Urban Collector	394,686	423,459	465,009	525,323	585,638
		Urban Local	532,223	557,029	629,958	724,167	818,377
		Rural Interstate	89,927	132,240	204,927	406,020	607,114
		Rural Other Principle Arterial	372,161	394,908	411,471	497,184	582,897
		ural Minor Arterial	298,080	335,155	377,666	389,385	401,105
		Rural Major Collector	228,959	240,962	282,855	296,591	310,327
		Rural Minor Collector	267,696	277,078	344,877	418,469	492,061
		Rural Local	510,214	605,107	757,765	894,185	1,030,605
	OP	Urban Interstate	2,462,930	2,945,885	3,057,384	3,084,840	3,112,296
		Freeway & Expressway	773,221	781,830	810,594	865,434	920,273
		Urban Other Principle Arterial	1,428,184	1,448,389	1,508,909	1,648,731	1,788,552
		Urban Minor Arterial	1,220,677	1,273,748	1,450,043	1,657,333	1,864,624
		Urban Collector	433,699	447,589	541,810	682,027	822,244
		Urban Local	604,264	628,460	756,624	971,861	1,187,099
		Rural Interstate	147,720	219,795	344,023	684,328	1,024,632
		Rural Other Principle Arterial	601,993	623,342	603,646	690,950	778,253
		ural Minor Arterial	423,588	469,766	535,928	571,937	607,947
		Rural Major Collector	317,015	341,179	385,716	417,058	448,400
		Rural Minor Collector	335,942	357,692	488,143	621,033	753,923
		Rural Local	618,773	744,243	1,000,233	1,268,093	1,535,953
	PM	Urban Interstate	1,663,601	2,022,979	2,139,974	2,231,183	2,322,393
		Freeway & Expressway	547,465	552,824	585,357	647,700	710,042
		Urban Other Principle Arterial	1,009,669	1,031,630	1,104,639	1,230,296	1,355,953
		Urban Minor Arterial	1,049,982	1,102,306	1,202,149	1,312,610	1,423,071
		Urban Collector	415,429	429,821	472,476	529,381	586,286
		Urban Local	535,875	554,852	635,573	729,341	823,109
		Rural Interstate	100,561	147,221	224,389	429,337	634,286
		Rural Other Principle Arterial	419,842	446,300	441,749	532,967	624,184
		ural Minor Arterial	310,760	344,978	403,543	430,034	456,526
		Rural Major Collector	240,922	249,969	302,640	313,431	324,222
		Rural Minor Collector	295,486	302,268	366,926	452,774	538,622
		Rural Local	555,490	665,134	829,728	975,416	1,121,104
Wake County Total VMT			**23,441,134**	**25,768,625**	**28,653,833**	**32,516,155**	**36,378,477**

4.1.4 Off Model Calculations

Not all 100 counties in North Carolina have a motor vehicle emission inspection and maintenance (I/M) program to address mobile emissions. As a direct result, such a control measure must be evaluated based on commuting activities to account for the vehicles that are not subject to such a program traveling throughout the nonattainment area. A methodology was developed using accident data that is tracked by the NCDOT as a surrogate for commuting patterns. The accident data used in this analysis is for 2005. This methodology was approved by the USEPA and will be used in this analysis.

All Triangle nonattainment area counties were phased into the North Carolina emission inspection program by January 1, 2005 except for Person County. The final counties were incorporated into the program on January 1, 2006 so the 2008, 2011, 2014, and 2017 runs will have the same I/M fraction. Table 4.1.4-1 summarizes the I/M fractions used to calculate the tons per day emissions for each of the counties being analyzed.

Table 4.1.4-1 I/M Fractions

County	2005	2008, 2011, 2014 and 2017
Chatham	0.95	0.96
Durham	0.91	0.92
Franklin	0.84	0.89
Granville	0.82	0.83
Johnston	0.85	0.90
Orange	0.88	0.90
Wake	0.93	0.95
Person	No I/M	No I/M

The calculation of tons per day is as follows:

Emissions = [I/M EF x I/M fraction x VMT] + [Non I/M EF x (1-I/M fraction) x VMT]

Where:

I/M EF	=	all vehicle emission factor from M6.2 inspection and maintenance run output for each road type (grams/mile)
I/M fraction	=	calculated I/M fraction for the analysis year
VMT	=	daily vehicle miles traveled (miles/day)
Non I/M EF	=	all vehicle emission factor from M6.2 non-inspection and maintenance output for each road type
C	=	conversion factor from grams to tons = 907185 grams per ton

4.1.5 Estimated Emissions From Mobile Sources

Each road type will have a different emission, which is then summed for each county for each year evaluated. A summary of emissions in tons per day, by county, is provided in Tables 4.1.5-1 and 4.1.5-2 for VOC and NOx emissions, respectively.

Table 4.1.5-1 VOC Road Type Emissions by County (tons/day)

Road Type	2005	2008	2011	2014	2017
Chatham County TRM					
Rural principle arterial	0.49	0.47	0.46	0.42	0.39
Rural minor arterial	0.05	0.04	0.04	0.04	0.03
Rural major collector	0.25	0.25	0.25	0.21	0.18
Rural minor collector	0.04	0.04	0.03	0.03	0.03
Rural local	0.20	0.21	0.20	0.15	0.13
Total VOC for Chatham County	**1.03**	**1.01**	**0.98**	**0.85**	**0.76**
Durham County TRM					
Rural interstate	0.07	0.07	0.05	0.05	0.04
Rural principle arterial	0.03	0.02	0.02	0.02	0.02
Rural minor arterial	0.23	0.17	0.15	0.13	0.11
Rural major collector	0.13	0.11	0.10	0.10	0.08
Rural minor collector	0.03	0.03	0.03	0.04	0.04
Rural local	0.39	0.34	0.31	0.26	0.23
Urban interstate	2.15	1.82	1.52	1.19	0.97
Urban freeway	1.52	1.21	1.06	1.00	0.97
Urban principle arterial	0.95	0.75	0.66	0.53	0.45
Urban minor arterial	1.34	1.06	0.89	0.70	0.61
Urban collector	0.59	0.49	0.44	0.36	0.32
Urban local	0.83	0.66	0.57	0.47	0.39
Total VOC for Durham County	**8.26**	**6.73**	**5.80**	**4.85**	**4.23**

Table 4.1.5-1 VOC Road Type Emissions by County (tons/day) (Continued)

Road Type	2005	2008	2011	2014	2017
Franklin County TRM					
Rural principle arterial	0.12	0.10	0.09	0.07	0.07
Rural minor arterial	0.07	0.05	0.05	0.05	0.04
Rural major collector	0.10	0.10	0.10	0.09	0.07
Rural minor collector	0.00	0.00	0.00	0.00	0.00
Rural local	0.12	0.10	0.10	0.11	0.11
Total VOC for TRM	*0.41*	*0.35*	*0.34*	*0.32*	*0.29*
Franklin County Rural					
Rural principle arterial	0.30	0.27	0.24	0.20	0.17
Rural minor arterial	0.36	0.32	0.29	0.24	0.20
Rural major collector	0.37	0.33	0.30	0.24	0.21
Rural minor collector	0.19	0.17	0.16	0.13	0.11
Rural local	0.14	0.12	0.11	0.09	0.08
Urban Other Principle Art	0.05	0.05	0.04	0.03	0.03
Urban Minor Arterial	0.06	0.05	0.05	0.04	0.03
Urban Local	0.02	0.02	0.02	0.02	0.01
Total VOC for Rural	*1.49*	*1.33*	*1.21*	*0.99*	*0.84*
Total VOC for Franklin County	**1.90**	**1.68**	**1.55**	**1.31**	**1.13**
Granville County TRM					
Rural interstate	0.29	0.24	0.22	0.20	0.19
Rural major collector	0.20	0.18	0.15	0.14	0.13
Rural minor collector	0.06	0.06	0.06	0.04	0.04
Rural local	0.09	0.10	0.09	0.07	0.07
Total VOC for Granville TRM	*0.64*	*0.58*	*0.52*	*0.45*	*0.43*
Granville County Rural					
Rural interstate	0.35	0.28	0.23	0.19	0.16
Rural principal arterial	0.02	0.02	0.02	0.01	0.01
Rural minor arterial	0.05	0.04	0.03	0.03	0.02
Rural major collector	0.33	0.26	0.21	0.17	0.14
Rural minor collector	0.10	0.08	0.06	0.05	0.04
Rural local	0.07	0.05	0.04	0.04	0.03
Urban interstate	0.07	0.05	0.04	0.03	0.03
Urban principal arterial	0.06	0.05	0.04	0.03	0.03
Urban minor arterial	0.07	0.05	0.04	0.03	0.03
Urban collector	0.04	0.03	0.03	0.02	0.02
Urban local	0.02	0.01	0.01	0.01	0.01
Total VOC for Granville Rural	*1.18*	*0.92*	*0.75*	*0.61*	*0.52*
Total VOC for Granville County	**1.82**	**1.50**	**1.27**	**1.06**	**0.95**

Table 4.1.5-1 VOC Road Type Emissions by County (tons/day) (Continued)

Road Type	2005	2008	2011	2014	2017
Johnston County TRM					
Rural interstate	0.39	0.42	0.38	0.37	0.36
Rural principal arterial	0.28	0.15	0.12	0.10	0.10
Rural minor arterial	0.07	0.06	0.06	0.04	0.03
Rural major collector	0.30	0.28	0.26	0.22	0.18
Rural minor collector	0.09	0.06	0.07	0.07	0.08
Rural local	0.48	0.44	0.42	0.39	0.37
Total VOC for Johnston TRM	*1.61*	*1.41*	*1.31*	*1.19*	*1.12*
Johnston County Rural					
Rural interstate	1.50	1.31	1.17	0.97	0.82
Rural principal arterial	0.74	0.65	0.58	0.47	0.40
Rural minor arterial	0.23	0.20	0.18	0.14	0.12
Rural major collector	0.85	0.80	0.73	0.59	0.49
Rural minor collector	0.25	0.22	0.20	0.16	0.13
Rural local	0.44	0.38	0.34	0.28	0.23
Urban interstate	0.31	0.27	0.24	0.20	0.17
Urban principal arterial	0.20	0.18	0.15	0.12	0.10
Urban minor arterial	0.04	0.04	0.03	0.03	0.02
Urban collector	0.04	0.03	0.03	0.02	0.02
Urban local	0.06	0.05	0.05	0.04	0.03
Total VOC for Johnston Rural	*4.66*	*4.13*	*3.70*	*3.02*	*2.53*
Total VOC for Johnston County	**6.27**	**5.54**	**5.01**	**4.21**	**3.65**
Orange County TRM					
Rural interstate	1.53	1.27	1.12	0.99	0.92
Rural minor arterial	0.19	0.16	0.14	0.12	0.10
Rural major collector	0.39	0.32	0.27	0.21	0.18
Rural minor collector	0.17	0.14	0.12	0.10	0.09
Rural local	0.34	0.28	0.24	0.20	0.17
Urban interstate	0.21	0.17	0.16	0.14	0.12
Urban freeway	0.08	0.06	0.04	0.04	0.03
Urban principle arterial	0.43	0.33	0.27	0.22	0.19
Urban minor arterial	0.37	0.31	0.26	0.20	0.17
Urban collector	0.06	0.06	0.06	0.05	0.05
Urban local	0.18	0.14	0.12	0.09	0.07
Total VOC for Orange County	**3.95**	**3.24**	**2.80**	**2.36**	**2.09**

Table 4.1.5-1 VOC Road Type Emissions by County (tons/day) (Continued)

Road Type	2005	2008	2011	2014	2017
Person County Rural					
Rural principal arterial	0.10	0.08	0.07	0.06	0.05
Rural minor arterial	0.28	0.24	0.21	0.18	0.16
Rural major collector	0.25	0.21	0.18	0.16	0.14
Rural minor collector	0.23	0.19	0.17	0.14	0.13
Rural local	0.14	0.12	0.10	0.09	0.08
Urban principal arterial	0.28	0.24	0.21	0.18	0.16
Urban minor arterial	0.05	0.05	0.04	0.03	0.03
Urban collector	0.06	0.05	0.04	0.04	0.03
Urban local	0.04	0.03	0.03	0.02	0.02
Total VOC for Person County	**1.43**	**1.21**	**1.05**	**0.90**	**0.80**
Wake County TRM					
Rural interstate	0.27	0.32	0.40	0.60	0.75
Rural principle arterial	1.28	1.01	0.80	0.74	0.71
Rural minor arterial	0.99	0.84	0.77	0.64	0.57
Rural major collector	0.78	0.62	0.58	0.47	0.41
Rural minor collector	0.90	0.71	0.71	0.69	0.68
Rural local	1.67	1.50	1.53	1.44	1.40
Urban interstate	5.23	4.75	3.99	3.23	2.75
Urban freeway	1.73	1.31	1.09	0.94	0.84
Urban principle arterial	3.53	2.70	2.29	1.92	1.73
Urban minor arterial	3.40	2.67	2.35	2.03	1.83
Urban collector	1.31	1.03	0.92	0.84	0.78
Urban local	1.72	1.34	1.24	1.16	1.12
Total VOC for Wake County	**22.81**	**18.80**	**16.67**	**14.70**	**13.57**
Triangle Area Total VOC	**47.5**	**39.7**	**35.1**	**30.2**	**27.2**

Table 4.1.5-2 NOx Road Type Emissions by County (tons/day)

Road Type	2005	2008	2011	2014	2017
Chatham County TRM					
Rural principle arterial	0.94	0.87	0.71	0.61	0.52
Rural minor arterial	0.07	0.07	0.04	0.04	0.03
Rural major collector	0.31	0.29	0.25	0.20	0.16
Rural minor collector	0.05	0.04	0.03	0.03	0.03
Rural local	0.25	0.23	0.19	0.14	0.10
Total NOx for Chatham County	**1.62**	**1.50**	**1.22**	**1.02**	**0.84**

Table 4.1.5-2 NOx Road Type Emissions by County (tons/day) (Continued)

Road Type	2005	2008	2011	2014	2017
Durham County TRM					
Rural interstate	0.45	0.37	0.25	0.15	0.11
Rural principle arterial	0.07	0.04	0.04	0.03	0.03
Rural minor arterial	0.44	0.32	0.24	0.17	0.12
Rural major collector	0.20	0.16	0.13	0.10	0.08
Rural minor collector	0.06	0.06	0.06	0.04	0.04
Rural local	0.60	0.48	0.38	0.29	0.21
Urban interstate	7.09	5.78	3.62	2.22	1.47
Urban freeway	3.14	2.33	1.65	1.29	1.05
Urban principle arterial	1.32	1.01	0.74	0.53	0.39
Urban minor arterial	1.60	1.21	0.89	0.64	0.48
Urban collector	0.69	0.54	0.43	0.32	0.25
Urban local	1.06	0.81	0.61	0.43	0.32
Total NOx for Durham County	**16.72**	**13.11**	**9.04**	**6.21**	**4.55**
Franklin County TRM					
Rural principle arterial	0.23	0.17	0.14	0.10	0.07
Rural minor arterial	0.10	0.09	0.07	0.05	0.04
Rural major collector	0.10	0.10	0.08	0.07	0.07
Rural minor collector	0.00	0.00	0.00	0.00	0.00
Rural local	0.13	0.12	0.10	0.10	0.09
Total NOx for TRM	*0.56*	*0.48*	*0.39*	*0.32*	*0.27*
Franklin County Rural					
Rural principle arterial	0.49	0.41	0.33	0.24	0.19
Rural minor arterial	0.46	0.39	0.32	0.24	0.19
Rural major collector	0.41	0.35	0.29	0.22	0.17
Rural minor collector	0.22	0.19	0.15	0.12	0.09
Rural local	0.15	0.13	0.11	0.08	0.07
Urban Other Principle Art	0.05	0.04	0.03	0.03	0.02
Urban Minor Arterial	0.05	0.04	0.04	0.03	0.02
Urban Local	0.02	0.02	0.02	0.01	0.01
Total NOx for Rural	*1.85*	*1.57*	*1.29*	*0.97*	*0.76*
Total NOx for Franklin County	**2.41**	**2.05**	**1.68**	**1.29**	**1.03**
Granville County TRM					
Rural interstate	1.88	1.50	1.08	0.74	0.53
Rural major collector	0.28	0.25	0.20	0.14	0.11
Rural minor collector	0.09	0.09	0.07	0.04	0.04
Rural local	0.14	0.13	0.10	0.07	0.07
Total NOx for Granville TRM	*2.39*	*1.97*	*1.45*	*0.99*	*0.75*

Table 4.1.5-2 NOx Road Type Emissions by County (tons/day) (Continued)

Road Type	2005	2008	2011	2014	2017
Granville County Rural					
Rural interstate	2.15	1.55	1.03	0.64	0.42
Rural principal arterial	0.05	0.04	0.02	0.02	0.01
Rural minor arterial	0.08	0.06	0.04	0.03	0.02
Rural major collector	0.45	0.34	0.24	0.17	0.12
Rural minor collector	0.13	0.10	0.07	0.05	0.04
Rural local	0.09	0.07	0.05	0.04	0.03
Urban interstate	0.22	0.16	0.11	0.07	0.05
Urban principal arterial	0.07	0.05	0.04	0.03	0.02
Urban minor arterial	0.07	0.05	0.04	0.03	0.02
Urban collector	0.04	0.03	0.02	0.02	0.01
Urban local	0.02	0.02	0.01	0.01	0.01
Total NOx for Granville Rural	*3.37*	*2.47*	*1.67*	*1.11*	*0.75*
Total NOx for Granville County	**5.76**	**4.44**	**3.12**	**2.10**	**1.50**
Johnston County TRM					
Rural interstate	1.82	1.89	1.38	1.12	0.96
Rural principal arterial	0.42	0.20	0.14	0.12	0.10
Rural minor arterial	0.10	0.08	0.07	0.04	0.03
Rural major collector	0.36	0.32	0.26	0.19	0.16
Rural minor collector	0.09	0.06	0.07	0.07	0.07
Rural local	0.54	0.47	0.42	0.35	0.30
Total NOx for Johnston TRM	*3.33*	*3.02*	*2.34*	*1.89*	*1.62*
Johnston County Rural					
Rural interstate	7.15	5.90	4.45	3.05	2.19
Rural principal arterial	1.19	0.97	0.75	0.55	0.42
Rural minor arterial	0.30	0.25	0.20	0.15	0.11
Rural major collector	0.96	0.86	0.72	0.54	0.42
Rural minor collector	0.27	0.24	0.19	0.14	0.11
Rural local	0.49	0.41	0.33	0.25	0.19
Urban interstate	0.83	0.69	0.53	0.37	0.28
Urban principal arterial	0.19	0.16	0.13	0.10	0.08
Urban minor arterial	0.04	0.03	0.02	0.02	0.02
Urban collector	0.03	0.03	0.02	0.02	0.01
Urban local	0.06	0.05	0.04	0.03	0.02
Total NOx for Johnston Rural	11.51	9.59	7.38	5.22	3.85
Total NOx for Johnston County	**14.84**	**12.61**	**9.72**	**7.11**	**5.47**

Table 4.1.5-2 NOx Road Type Emissions by County (tons/day) (Continued)

Road Type	2005	2008	2011	2014	2017
Orange County TRM					
Rural interstate	9.14	7.11	4.91	3.30	2.34
Rural minor arterial	0.36	0.28	0.20	0.14	0.11
Rural major collector	0.55	0.42	0.31	0.23	0.16
Rural minor collector	0.24	0.19	0.14	0.10	0.07
Rural local	0.47	0.38	0.28	0.21	0.16
Urban interstate	0.76	0.58	0.42	0.28	0.21
Urban freeway	0.13	0.09	0.05	0.04	0.03
Urban principle arterial	0.54	0.40	0.28	0.20	0.15
Urban minor arterial	0.40	0.31	0.24	0.17	0.13
Urban collector	0.06	0.06	0.04	0.04	0.03
Urban local	0.19	0.15	0.11	0.07	0.06
Total NOx for Orange County	**12.84**	**9.97**	**6.98**	**4.78**	**3.45**
Person County Rural					
Rural principal arterial	0.16	0.12	0.10	0.07	0.06
Rural minor arterial	0.36	0.29	0.24	0.19	0.16
Rural major collector	0.28	0.22	0.18	0.15	0.12
Rural minor collector	0.25	0.21	0.17	0.13	0.11
Rural local	0.15	0.12	0.10	0.08	0.07
Urban principal arterial	0.27	0.22	0.18	0.15	0.12
Urban minor arterial	0.05	0.04	0.03	0.03	0.02
Urban collector	0.05	0.04	0.03	0.03	0.02
Urban local	0.03	0.03	0.02	0.02	0.02
Total NOx for Person County	**1.60**	**1.29**	**1.05**	**0.85**	**0.70**
Wake County TRM					
Rural interstate	1.68	1.66	1.46	1.75	1.68
Rural principle arterial	3.49	2.58	1.63	1.24	0.97
Rural minor arterial	1.84	1.47	1.10	0.74	0.55
Rural major collector	1.21	0.91	0.72	0.51	0.38
Rural minor collector	1.38	1.02	0.89	0.73	0.62
Rural local	2.55	2.19	1.91	1.54	1.27
Urban interstate	16.90	14.55	9.39	6.03	4.14
Urban freeway	3.99	2.76	1.89	1.33	0.99
Urban principle arterial	4.93	3.60	2.58	1.92	1.49
Urban minor arterial	4.18	3.15	2.40	1.82	1.45
Urban collector	1.48	1.11	0.88	0.72	0.61
Urban local	2.26	1.69	1.34	1.09	0.90
Total NOx for Wake County	**45.89**	**36.69**	**26.19**	**19.42**	**15.05**
Triangle Area Total NOx	**101.7**	**81.7**	**59.0**	**42.8**	**32.6**

4.1.6 Motor Vehicle Emissions Budget for Conformity

Transportation Conformity

The purpose of transportation conformity is to ensure that Federal transportation actions occurring in a nonattainment areas does not hinder the area from maintaining the 8-hour ozone standard. This means that the level of emissions estimated by the NCDOT or the MPOs for the Transportation Implementation Plan and Long Range Transportation Plan must not exceed the MVEBs as defined in this maintenance plan.

Highway Mobile Source VOC Insignificance

Section 93.109(k) in the Transportation Conformity Rule Amendments for the new 8-hour ozone and fine particulate matter NAAQS addresses areas with insignificant motor vehicle emissions. It reads:

> *Notwithstanding the other paragraphs in this section, an area is not required to satisfy a regional emissions analysis for §93.118 and/or §93.119 for a given pollutant/precursor and NAAQS, if EPA finds through the adequacy or approval process that a SIP demonstrates that regional motor vehicle emissions are an insignificant contributor to the air quality problem for that pollutant/precursor and NAAQS. The SIP would have to demonstrate that it would be unreasonable to expect that such an area would experience enough motor vehicle emissions growth in that pollutant/precursor for a NAAQS violation to occur.*

The rule suggests that such a finding would be based on a number of factors, including the percentage of motor vehicle emissions in the context of the total State Implementation Plan (SIP) inventory, the current state of air quality as determined by monitoring data for that NAAQS, the absence of SIP motor vehicle control measures, and historical trends and future projections of the growth of motor vehicle emissions.

The NCDAQ has examined the sources of VOC emissions and their contribution to ozone formation in North Carolina. Because of the generally warm and moist climate of North Carolina, vegetation abounds in many forms, and forested lands naturally cover much of the state. The biogenic sector is the most abundant source of VOCs in North Carolina and accounts for approximately 90% of the total VOCs statewide. The overwhelming abundance of biogenic VOCs makes the majority of North Carolina a NOx limited environment for the formation of ozone. This holds true for all of the Triangle area counties. Since biogenic emissions were not generated specifically for this maintenance plan, we used emission summaries from the NCDAQ's 2002 and 2009 modeling effort underway for the attainment demonstrations in other

portions of North Carolina. Figures 4.1.6-1 through 4.1.6-4 provides the percent contributions from point, highway mobile, area, off-road mobile and biogenic sources to the total VOC emissions in the Triangle nonattainment area in 2002 and 2009, respectively.

Figure 4.1.6-1 Triangle Area 2002 Daily Summertime VOC Emissions

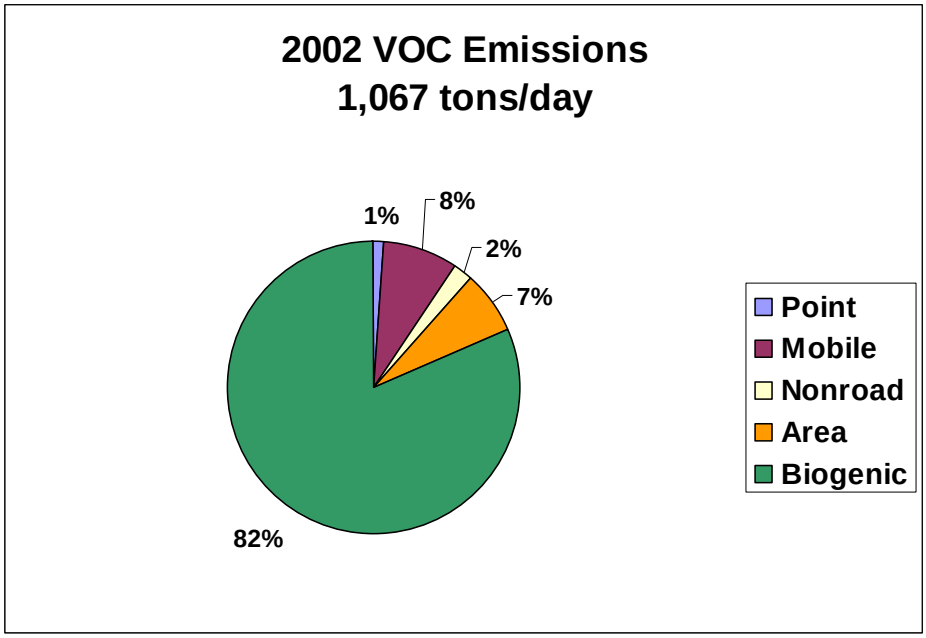
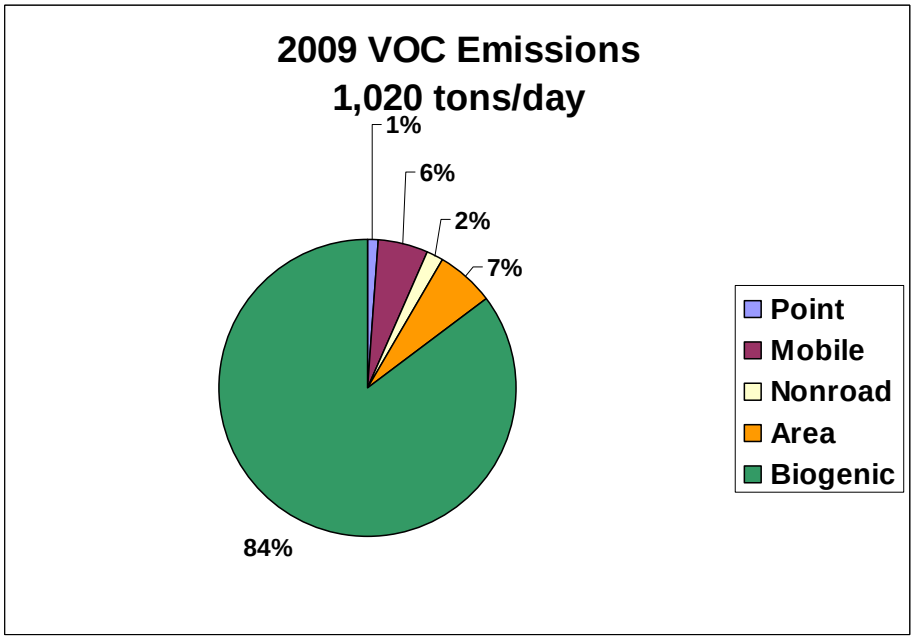


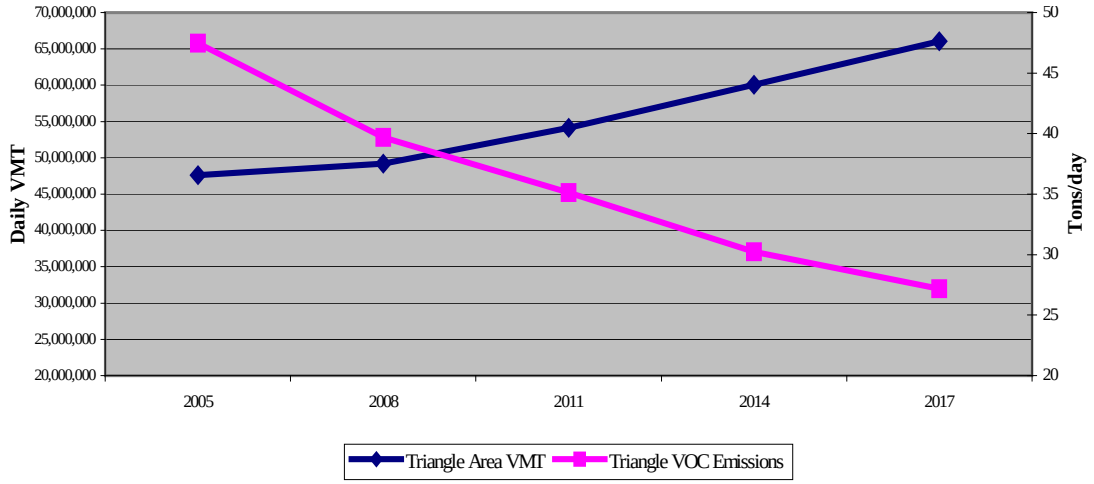
Figure 4.1.6-2 Triangle Area 2009 Daily Summertime VOC Emissions



In the Triangle area, highway mobile sources contrbute only 8 and 6 percent of the 2002 and 2009 total VOC inventories, respectively.

Also noteworthy are the projected decreases in highway mobile VOC emissions through the year 2017 despite projected VMT increases. These reductions are due mainly to the retirement of older vehicles and the growing fleet of Tier 2 vehicles on the roads in future years. Some additional reductions are attributable to North Carolina's I/M program in the Triangle area. The VMT and VOC projections are summarized in Figures 4.1.6-3 below.

Figure 4.1.6-3 Triangle Area VMT and VOC emissions growth



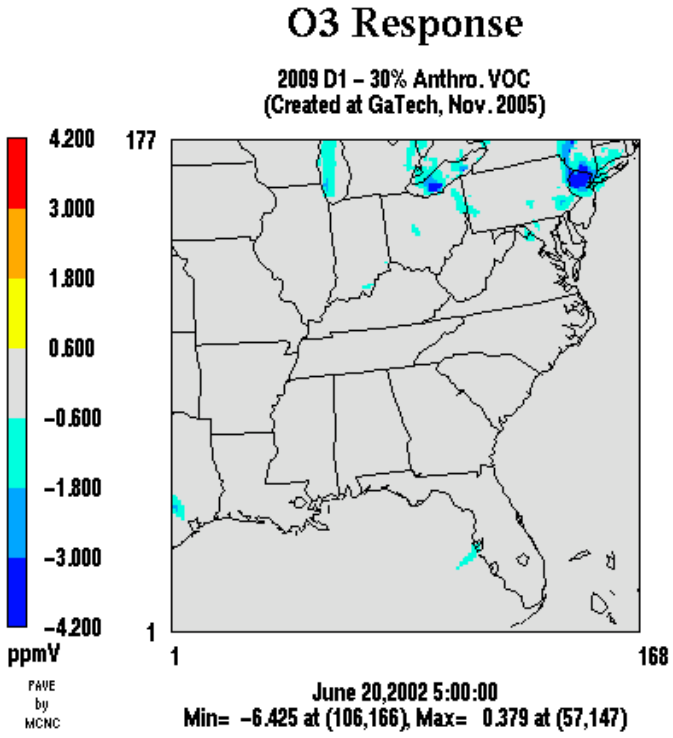
The current state of air quality in the Triangle nonattainment area is steadily improving. The current ozone design value in the Triangle nonattainment area is 0.080 parts per million (ppm) based on data from 2004-2006.

A recent modeling sensitivity test was performed by the Association for Southeastern Integrated Planning (ASIP) that allows an analysis of VOC contributions to ozone concentrations in the Southeastern United States. ASIP is a regional collaborative, set up by the Southeastern States Air Resource Managers, Inc. (SESARM), focused on the coordination of planning activities associated with the analysis of fine particulate matter and 8-hour ozone nonattainment areas and development of options for attaining and maintaining the NAAQS. One of the analyses conducted by ASIP is a series of emissions sensitivity modeling runs to quantify the contributions of various emission sources to ozone and fine particles. The modeling system used in this analysis consisted of 3 components: 1) the Penn State University/National Center for Atomospheric Research Mesoscale Model (MM5 version 3.6.1+), 2) the Sparse Matrix Operator Kernel Emissions Modeling System (SMOKE version 2.1), and 3) the Community Multiscale

Air Quality (CMAQ version 4.4) model. Model configurations, input data, and modeling methods are consistent with those suggested by USEPA in "Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS".

The emissions sensitivities are calculated by taking the difference between two air quality model simulations: one with base case emissions and another with reduced emissions inputs. The emissions sensitivity discussed here reduces *all* athropogenic VOCs in the modeling domain by 30% from 2009 emission levels. Translating this to the Triangle nonatatinment area emissions, this 30% athropogenic VOC reduction is equivalent to nearly eliminating all highway mobile VOC emissions in all Triangle nonattainment area in 2009. This emissions sensitivitiy was run for a 39 day period (June 1-July 9). In all 39 days of the modeling simulation, the 8-hour ozone maximum concentrations were unchanged in the Triangle nonattainment area – a clear indicator that highway mobile VOC is an insignificant contributor to ozone formation in that area. In fact, there was not an 8-hour ozone response as high as 1 ppb anywhere in North Carolina during the sensitivity simulation. Figure 4.1.6-4 provides an example from the 30% athropogenic VOC reduction modeling illustrating the lack of ozone response North Carolina.

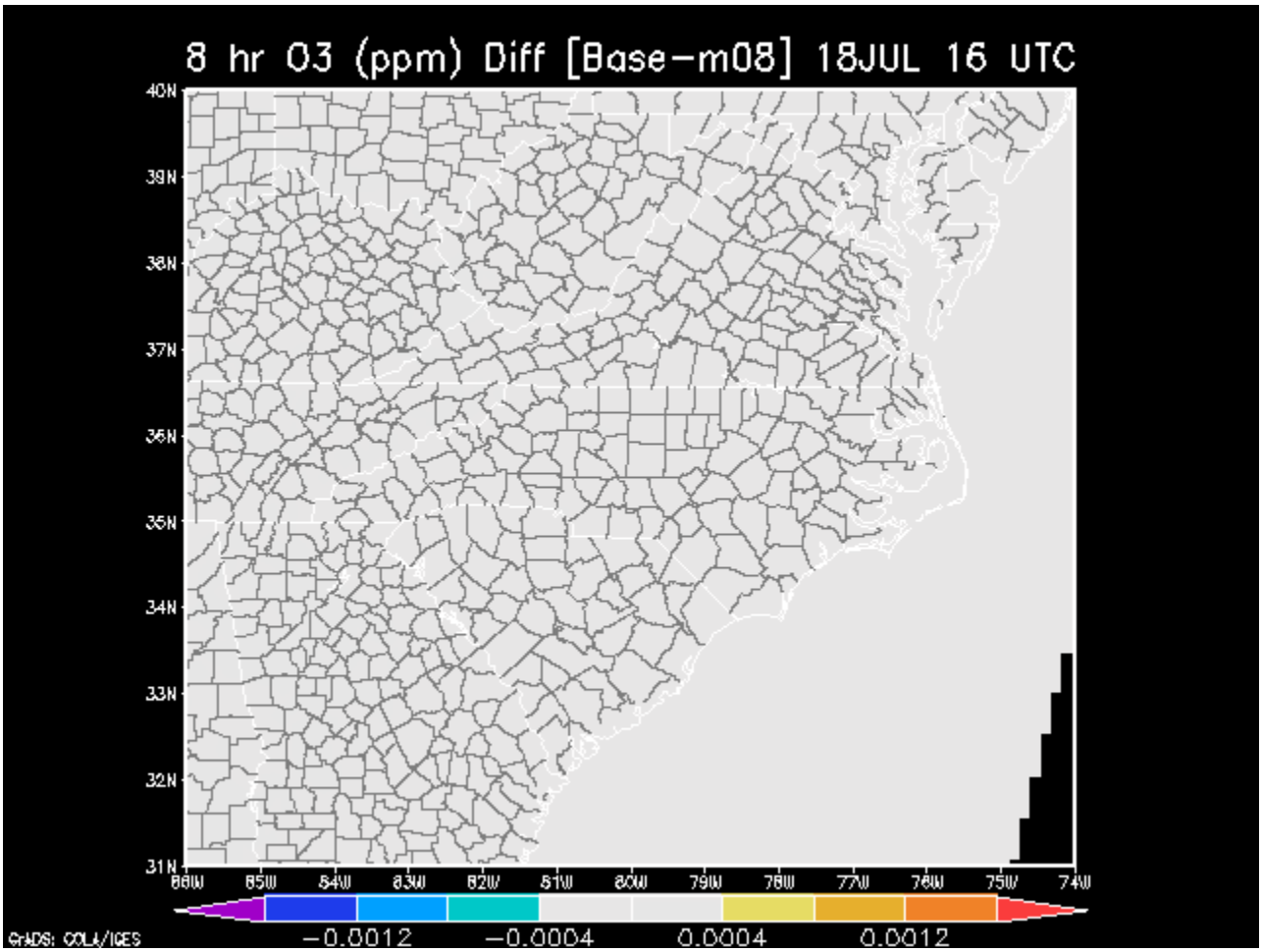
Figure 4.1.6-4 8-hour Ozone response to 30% athropogenic VOC reductions in 2009



Additional mobile source sensitivity simulations have been conducted by the NCDAQ. These modeling runs focused specifically on the impact of mobile source VOC emissions on ozone.

The first sensitivity reduced mobile source VOC by 50% in the counties in the Triangle ozone nonattainment area (Chatham, Durham, Franklin, Granville, Orange, Person and Wake Counties) in the year 2008. This emissions sensitivitiy was run for a 7 day period (July 13-19). In all 7 days of the modeling simulation, the 8-hour ozone maximum concentrations were unchanged in the Triangle area (and all of North Carolina), a clear indicator that highway mobile VOC is an insignificant contributor to ozone formation in that area. Figure 4.1.6-5 provides an example of the lack of an 8-hour ozone response from the 50% mobile VOC reduction sensitivity modeling.

Figure 4.1.6-5 8-hour Ozone Response to 50% mobile VOC decrease in 2008



The second sensitivity conducted by the NCDAQ focused on a 50% increase of mobile source VOC in the same counties and over the same 7-day period mentioned above. The results were identical, no change in 8-hour ozone concentrations indicating highway mobile VOC is an insignificant contributor to ozone formation in the Triangle area.

Based on the information discussed above, the NCDAQ steadfastly believes highway mobile VOCs are insignificant contributors to ozone formation in the Triangle nonattainment area.

Emission estimates indicate highway mobile VOC is a small percentage of the total VOC emissions inventory. Highway mobile VOC emissions are projected to decrease into the future notwithstanding VMT increases. The area is currently below the NAAQS and emission sensitivity modeling performed by ASIP and the NCDAQ indicates no change in future ozone concentrations when VOC emissions are significantly changed. Further, the NCDAQ considers it unreasonable to expect that the Triangle nonattainment area will experience enough motor vehicle VOC emissions growth for a future ozone violation to occur. For these reasons, the NCDAQ will not be setting MVEB for VOC for the Triangle nonattainment area.

Safety Margin

A safety margin is the difference between the attainment level of emissions from all source categories (i.e., point, area, and mobile) and the projected level of emissions from all source categories. The State may choose to allocate some of the safety margin to the MVEBs, for transportation conformity purposes, so long as the total level of emissions from all source categories remains below the attainment level of emissions.

The NCDAQ has decided to allocate a portion of the safety margin to the MVEBs to allow for unanticipated growth in VMT, changes to vehicle mix assumptions, etc. that will influence the emission estimations. The NCDAQ has developed and implemented a four-step approach for determining the amount of safety margin to apply to the MVEBs.

Step 1 Percentage below the standard

All counties get 5% safety margin in 2008

This component of the methodology takes into account the current (2004-2006) monitored ozone design value in the nonattainment area relative to the level of the standard. In the Triangle area, the highest current ozone design value is 0.080 ppm. Therefore, based on the latest monitored ozone data, the area is 5% below the standard. This percentage (%) is used to adjust the mobile source emissions in 2008 and 2017 for purposes of establishing MVEBs.

Step 2 Account for continued rapid growth and provide flexibility for counties that are small contributors to on-road mobile NOx emissions inventory

Chatham, Granville and Person get 10% additional safety margin in 2008

Durham, Franklin, Johnston, Orange and Wake get 5% additional safety margin in 2008

Additional safety margin increases of 5-10% are applied to all counties. This is simply to account for continued rapid growth in the Triangle area.

Chatham, Granville and Person Counties are allocated 5% more than the other counties in this step because they make very small contributions to the overall on-road mobile NOx emissisons inventory in the Triangle area and are on the edge of the rapidly growing metropolitan region. This additional allocation is in response to concerns raised in the January 31, 2006 letter from Ed Johnson, Director of the North Carolina Capital Area Metropolitan Planning Organization, to Laura Boothe, NCDAQ (Appendix B).

Step 3 Account for input uncertainty in final year of the maintenance plan

All counties get 10% additional safety margin in 2017.

An additional increase of 10% is applied to the 2017 MVEBs to account for potential changes in VMT, vehicle mix and vehicle age distribution. This additional percentage is added to the current percentages outlined in the steps above. The NCDAQ believes this additional 10% is appropriate for the 2017 because ozone values will continue to drop as NOx levels in 2017 are projected to be less than half of what they are currently in the nonattainment area.

Step 4 Ensure the sum of the safety margins applied to the MVEB does not exceed 50% of the total safety margin available

The NCDAQ will implement a cap to the safety margin applied to the MVEBs. The sum of the safety margins applied to the MVEBs in the entire nonattainment area cannot exceed 50% of the total safety margin available. In this analysis, the sum of the 2008 Triangle nonattainment area safety margins applied to the MVEBs is 7,741 kg (8.5 tons/day), or 38% of the total safety margin available. The sum of the 2017 Triangle nonattainment area safety margins applied to the MVEB is 6,049 kg (6.7 tons/day), or 8% of the total safety margin available.

Table 4.1.6-1 summarizes the percent increase to the MVEB for purposes of transportation conformity for each county in the Triangle nonattainment area.

Table 4.1.6-1 Percent Increase To MVEB

County	2008	2017
Chatham	15%	25%
Durham	10%	20%
Franklin	10%	20%
Granville	15%	25%
Johnston	10%	20%
Orange	10%	20%
Person	15%	25%
Wake	10%	20%

Motor Vehicle Emission Budgets

As part of the consultation process on setting MVEBs, NCDAQ sent out a request for comment on setting the geographic extent of the MVEBs to all of the transportation partners. A copy of the letter can be found in Appendix B. In the letter, NCDAQ expressed its preference for setting county level budgets and some of the reasons why NCDAQ believed county level budgets were appropriate.

The NCDAQ received comments from several of the transportation partners regarding the geographic extent of the MVEBs. Some of the partners wanted county-by-county budgets; others wanted regional budgets. Copies of the letters received can be found in Appendix B. Upon careful consideration of all arguments, NCDAQ decided to move forward with setting county-by-county MVEB. NCDAQ believes that the concerns raised in the requests for regional budgets can be addressed by adding to the safety margins for the areas of concern.

Additionally, there was discussion through the interagency consultation process on the years to set MVEBs for the Triangle maintenance plan. According to Section 93.118 of the transportation conformity rule, a maintenance plan must establish a MVEBs for the last year of the maintenance plan (in this case, 2017). Through the interagency consultation process, it was decided that another MVEBs would be set for the year 2008 in the Triangle maintenance plan.

Although the emissions up to this point have been expressed in terms of tons per day, the MVEBs will be set in terms of kilograms (kg) per day. The reason for the change is how the emission factors used to calculate mobile emissions are created. The MOBILE model generates the emission factors in grams per mile. In past conformity exercises, there have been some issues with conversion to tons per day, as well as concerns with how the MVEBs were rounded

to the hundredth place. Setting MVEBs in kilograms per day will avoid these issues in future conformity determinations.

The table below shows the counties with their highway mobile NOx emissions expressed in tons per day and the corresponding kilograms per day values for 2008 and 2017.

Table 4-2 Highway Mobile Source NOx Emissions Triangle Nonattainment Area

County	2008			2017	
	Tons/day	Kg/day		Tons/day	Kg/day
Chatham*	1.50	1,361		0.84	758
Durham	13.11	11,915		4.55	4,133
Franklin	2.05	1,862		1.03	949
Granville	4.44	4,043		1.50	1,371
Johnston	12.61	11,439		5.47	4,965
Orange	9.97	9,030		3.45	3,118
Person	1.29	1,182		0.70	633
Wake	36.69	33,286		15.05	13,627
Total	81.66	74,118		32.59	29,554

* Chatham County emissions for nonattainment area only.

The NCDAQ will set MVEBs, for transportation conformity purposes, as county budgets within the Triangle maintenance area for 2008 and 2017. Tables 4.1.6-2 through 4.1.6-10 below list out the NOx MVEBs, for transportation conformity purposes, by county for the years 2008 and 2017. Upon the USEPA's affirmative adequacy finding for these county level sub-area MVEBs, these MVEBs will become the applicable MVEBs for each county.

Table 4.1.6-2 Chatham County MVEB in kilograms per day

	2008	2017
NOx Emissions (kg/day)		
Base Emissions	1,361	758
Safety Margin Allocated to MVEB	204	190
NOx Conformity MVEB	1,565	948

Table 4.1.6-3 Durham County MVEB in kilograms per day

	2008	2017
NOx Emissions (kg/day)		
Base Emissions	11,915	4,133
Safety Margin Allocated to MVEB	1,191	827
NOx Conformity MVEB	13,106	4,960

Table 4.1.6-4 Franklin County MVEB in kilograms per day

	2008	2017
NOx Emissions (kg/day)		
Base Emissions	1,862	949
Safety Margin Allocated to MVEB	186	190
NOx Conformity MVEB	2,048	1139

Table 4.1.6-5 Granville County MVEB in kilograms per day

	2008	2017
NOx Emissions (kg/day)		
Base Emissions	4,043	1,371
Safety Margin Allocated to MVEB	606	343
NOx Conformity MVEB	4,649	1,714

Table 4.1.6-6 Johnston County MVEB in kilograms per day

	2008	2017
NOx Emissions (kg/day)		
Base Emissions	11,439	4,965
Safety Margin Allocated to MVEB	1144	993
NOx Conformity MVEB	12,583	5,958

Table 4.1.6-7 Orange County MVEB in kilograms per day

	2008	2017
NOx Emissions (kg/day)		
Base Emissions	9,030	3,118
Safety Margin Allocated to MVEB	903	624
NOx Conformity MVEB	9,933	3,742

Table 4.1.6-8 Person County MVEB in kilograms per day

	2008	2017
NOx Emissions (kg/day)		
Base Emissions	1,182	633
Safety Margin Allocated to MVEB	177	158
NOx Conformity MVEB	1,359	791

Table 4.1.6-9 Wake County MVEB in kilograms per day

	2008	2017
NOx Emissions (kg/day)		
Base Emissions	33,286	13,627
Safety Margin Allocated to MVEB	3,329	2,725
NOx Conformity MVEB	36,615	16,352

4.1.7 Speed and VMT provided in May 16, 2006 email from NCDOT

	All VMTs are daily and times 1000				
Franklin County					
VMT	**2005**	**2008**	**2011**	**2014**	**2017**
Urban Functional Classification					
Urban Interstate	-	-	-	-	-
Urban Other Freeway	-	-	-	-	-
Urban Other PA	-	-	-	-	-
Urban Minor Arterial	-	-	-	-	-
Urban Collector	-	-	-	-	-
Urban Local	-	-	-	-	-
Urban Subtotals	0.00	0.00	0.00	0.00	0.00
	2005	**2008**	**2011**	**2014**	**2017**
Rural Functional Classes					
Rural Interstate	-	-	-	-	-
Rural Other PA	228.94	248.09	267.24	286.39	305.54
Rural Minor Arterial	373.94	406.68	437.96	469.25	500.53
Rural Major Collector	281.95	305.54	329.13	352.71	376.30
Rural Minor Collector	122.19	132.41	142.63	152.85	163.07
Rural Local	100.18	108.56	116.94	125.32	133.70
Rural Subtotals	1,107.19	1,201.28	1,293.90	1,386.52	1,479.15
TOTAL	1,107.19	1,201.28	1,293.90	1,386.52	1,479.15
SPEED	**2005**	**2008**	**2011**	**2014**	**2017**
Urban Functional Classification					
Urban Interstate	--	--	--	--	--
Urban Other Freeway	--	--	--	--	--
Urban Other PA	--	--	--	--	--
Urban Minor Arterial	--	--	--	--	--
Urban Collector	--	--	--	--	--
Urban Local	--	--	--	--	--
	2005	**2008**	**2011**	**2014**	**2017**
Rural Functional Classes					
Rural Interstate	0	0	0	0	0
Rural Other PA	46	46	45	45	45
Rural Minor Arterial	42	43	42	42	42
Rural Major Collector	42	42	42	42	42
Rural Minor Collector	42	42	42	42	42
Rural Local	42	42	42	42	42

	All VMTs are daily and times 1000				
Granville County					
VMT	**2005**	**2008**	**2011**	**2014**	**2017**
Urban Functional Classification					
Urban Interstate	0.00	0.00	0.00	0.00	0.00
Urban Other Freeway	0.00	0.00	0.00	0.00	0.00
Urban Other PA	0.00	0.00	0.00	0.00	0.00
Urban Minor Arterial	0.00	0.00	0.00	0.00	0.00
Urban Collector	0.00	0.00	0.00	0.00	0.00
Urban Local	0.00	0.00	0.00	0.00	0.00
Urban Subtotals	0.00	0.00	0.00	0.00	0.00
	2005	**2008**	**2011**	**2014**	**2017**
Rural Functional Classes					
Rural Interstate	0.00	0.00	0.00	0.00	0.00
Rural Other PA	228.94	248.09	267.24	286.39	305.54
Rural Minor Arterial	373.94	406.68	437.96	469.25	500.53
Rural Major Collector	281.95	305.54	329.13	352.71	376.30
Rural Minor Collector	122.19	132.41	142.63	152.85	163.07
Rural Local	100.18	108.56	116.94	125.32	133.70
Rural Subtotals	1107.19	1201.28	1293.90	1386.52	1479.15
TOTAL	1107.19	1201.28	1293.90	1386.52	1479.15
SPEED	**2005**	**2008**	**2011**	**2014**	**2017**
Urban Functional Classification					
Urban Interstate	--	--	--	--	--
Urban Other Freeway	--	--	--	--	--
Urban Other PA	--	--	--	--	--
Urban Minor Arterial	--	--	--	--	--
Urban Collector	--	--	--	--	--
Urban Local	--	--	--	--	--
	2005	**2008**	**2011**	**2014**	**2017**
Rural Functional Classes					
Rural Interstate	0	0	0	0	0
Rural Other PA	46	46	45	45	45
Rural Minor Arterial	42	43	42	42	42
Rural Major Collector	42	42	42	42	42
Rural Minor Collector	42	42	42	42	42
Rural Local	42	42	42	42	42

	All VMTs are daily and times 1000				
Johnston County					
VMT	**2005**	**2008**	**2011**	**2014**	**2017**
Urban Functional Classification					
Urban Interstate	230.04	248.32	266.61	284.89	303.18
Urban Other Freeway	0.00	0.00	0.00	0.00	0.00
Urban Other PA	135.01	145.74	156.47	167.21	177.94
Urban Minor Arterial	36.54	39.44	42.35	45.25	48.15
Urban Collector	7.22	7.80	8.37	8.95	9.52
Urban Local	21.08	22.75	24.43	26.10	27.78
Urban Subtotals	429.89	464.06	498.23	532.40	566.57
	2005	**2008**	**2011**	**2014**	**2017**
Rural Functional Classes					
Rural Interstate	1300.23	1403.58	1506.93	1610.28	1713.63
Rural Other PA	608.76	657.15	705.54	753.93	802.32
Rural Minor Arterial	182.03	196.50	210.97	232.48	254.00
Rural Major Collector	648.19	727.64	751.23	830.87	910.51
Rural Minor Collector	185.77	200.54	215.30	230.07	244.84
Rural Local	339.25	366.21	393.18	420.14	447.11
Rural Subtotals	3264.23	3551.62	3783.15	4077.78	4372.41
TOTAL	3694.11	4015.67	4281.38	4610.18	4938.98
SPEED	**2005**	**2008**	**2011**	**2014**	**2017**
Urban Functional Classification					
Urban Interstate	62	62	62	62	62
Urban Other Freeway	0	0	0	0	0
Urban Other PA	28	28	28	28	28
Urban Minor Arterial	32	31	32	32	32
Urban Collector	31	31	31	31	31
Urban Local	30	30	30	30	29
	2005	**2008**	**2011**	**2014**	**2017**
Rural Functional Classes					
Rural Interstate	65	65	65	65	64
Rural Other PA	44	44	43	43	41
Rural Minor Arterial	44	43	43	43	43
Rural Major Collector	43	43	43	43	43
Rural Minor Collector	42	42	42	42	42
Rural Local	42	42	42	42	42

	All VMTs are daily and times 1000				
Person County					
VMT	**2005**	**2008**	**2011**	**2014**	**2017**
Urban Functional Classification					
Urban Interstate	0.00	0.00	0.00	0.00	0.00
Urban Other Freeway	0.00	0.00	0.00	0.00	0.00
Urban Other PA	151.98	160.25	168.51	176.77	185.03
Urban Minor Arterial	28.98	30.56	32.13	33.71	35.28
Urban Collector	31.16	32.86	34.55	36.24	37.94
Urban Local	19.01	20.04	21.07	22.11	23.14
Urban Subtotals	231.14	243.70	256.26	268.83	281.39
	2005	**2008**	**2011**	**2014**	**2017**
Rural Functional Classes					
Rural Interstate	0.00	0.00	0.00	0.00	0.00
Rural Other PA	58.80	62.00	65.20	68.39	71.59
Rural Minor Arterial	174.08	185.01	194.47	203.93	213.40
Rural Major Collector	144.33	152.17	160.02	167.86	175.71
Rural Minor Collector	140.91	148.57	156.23	163.89	171.55
Rural Local	90.06	94.95	99.85	104.75	109.64
Rural Subtotals	608.18	642.70	675.76	708.82	741.88
TOTAL	839.32	886.40	932.02	977.65	1023.27
SPEED	**2005**	**2008**	**2011**	**2014**	**2017**
Urban Functional Classification					
Urban Interstate	0	0	0	0	0
Urban Other Freeway	0	0	0	0	0
Urban Other PA	28	27	27	27	27
Urban Minor Arterial	31	31	31	31	31
Urban Collector	31	31	31	31	31
Urban Local	30	30	30	30	30
	2005	**2008**	**2011**	**2014**	**2017**
Rural Functional Classes					
Rural Interstate	0	0	0	0	0
Rural Other PA	46	46	47	47	47
Rural Minor Arterial	43	43	45	45	45
Rural Major Collector	43	43	43	43	43
Rural Minor Collector	42	42	42	42	42
Rural Local	42	42	42	42	42

4.2 NON-HIGHWAY MOBILE SOURCES

Off-road mobile sources are those sources that can move but do not use the highway system. Examples include lawn mowers, agricultural equipment, construction equipment, aircraft engines and railroad locomotives. All but the aircraft engine and railroad locomotive emissions are estimated using the USEPA off-road mobile model NONROAD2005c, which was released March 21, 2006. The emissions from aircraft engines are estimated using the FAA model EDMS and the emissions from railroad locomotives are estimated in a more traditional way of using activity levels and emission factors. The methodology used to calculate the emissions from these off-road mobile sources are described in detail in the subsections that follow. Off-road mobile source emissions were reported as non-zero values if emissions were 0.01 tons per day or greater. Table 4.2-1 summarize the total VOC and NOx emissions from all off-road mobile source categories.

Table 4.2-1 Off-Road Mobile Source VOC and NOx Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Chatham*	0.79	0.67	0.58	0.55	0.52
Durham	4.72	4.02	3.63	3.44	3.34
Franklin	0.87	0.72	0.63	0.61	0.61
Granville	0.82	0.68	0.62	0.60	0.62
Johnston	2.74	2.41	2.23	2.13	2.05
Orange	3.39	3.25	3.06	2.86	2.58
Person	0.98	0.83	0.72	0.68	0.67
Wake	16.47	13.66	12.52	12.41	12.62
Total	30.78	26.24	23.99	23.28	23.01
NOx Emissions					
Chatham*	0.79	0.69	0.62	0.51	0.41
Durham	7.11	6.26	5.33	4.32	3.42
Franklin	1.60	1.42	1.19	0.97	0.77
Granville	0.85	0.75	0.66	0.55	0.46
Johnston	4.78	4.34	3.88	3.39	2.95
Orange	2.86	2.60	2.34	1.99	1.62
Person	0.80	0.71	0.63	0.52	0.44
Wake	19.63	18.13	16.44	14.27	12.18
Total	38.42	34.90	31.09	26.52	22.25

*Chatham County emissions are for the portion of the county in the nonattainment area.

4.2.1 NONROAD Model Mobile Sources

The nonroad mobile source category includes a diverse collection of equipment such as lawn mowers, chain saws, tractors, all terrain vehicles, fork lifts and construction equipment. The USEPA included more than 80 different types of equipment in the NONROAD2005c model. To facilitate analysis and reporting, the USEPA grouped the equipment types into ten equipment categories. These include:

Agricultural equipment	Lawn and garden equipment
Airport ground support equipment	Logging equipment
Commercial equipment	Railroad maintenance equipment
Construction equipment	Recreational marine equipment
Industrial equipment	Recreational equipment

Additionally, the emissions are broken out by five different engine types. These include: 2-stroke and 4-stroke spark engines, diesel engines, liquid propane gas and compressed natural gas fueled engines.

The NONROAD2005c model version was used to estimate emissions for the 8-hour ozone redesignation demonstration and maintenance plan. This latest version of the model was released to the public on March 21, 2006.

NONROAD2005c is the latest final release of the USEPA NONROAD model that was first released in June 2000, and incorporates many revisions to improve the model's predictive ability. The final version of the model also incorporates all the USEPA final nonroad engine emission standards, including the recreational and large spark-ingintion engines rules that were published in the Federal Register in November 2002. Although this model is considered to be a final model, an updated version is planned that may incorporate revised inputs for the small spark iginition (SI) (<19 kW) and recreational marine SI categories in conjunction with additional promulgated nonroad engine standards.

One of the default input files was edited to reflect North Carolina specific information. In the "SEASON.DAT" file, the region representative of North Carolina was changed from Mid-Atlantic to Southeast. A copy of the revised seasonality input data file is in Section 5.

The options files used in the NONROAD2005c model were tailored to reflect North Carolina specific information also. Copies of the options input files are in Section 5. Default data was used for the remaining input files used in the NONROAD model.

For reporting purposes, the resulting emissions from the NONROAD2005c model were totaled for each equipment category by county. The model generates VOC and NOx emissions directly. The results for most of the equipment categories by county indicate a reduction in emissions with time into the out-years. These reduced emission projections are influenced by several factors, including expected future changes in emission factors and activity levels. These future emission factors and activity levels are accounted for in the model.

Future changes in emission factors are primarily the result of future regulations. With the latest final version of the model, the USEPA has incorporated the final nonroad engine emission standards, including the recreational and large spark-ignition engines rules that were published in the Federal Register in November 2002. Future changes in activity levels are the result of estimated engine populations, which are based on growth rates and scrappage functions of the equipment.

The summary of these results are tabulated in Tables 4.2.1-1 through 4.2.1-10. In Table 4.2.1-11 summaries of the NONROAD model categories emissions for each county within the nonattainment area. To estimate the emissions for just the nonattainment area in Chatham County, the County emissions estimated by the NONROAD model were multiplied by the percent of population (43.2%) located in the nonattainment townships compared to the county as a whole.

Table 4.2.1-1 Agricultural Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Chatham*	0.01	0.01	0.01	0.01	0.00
Durham	0.00	0.00	0.00	0.00	0.00
Franklin	0.02	0.01	0.01	0.01	0.01
Granville	0.03	0.02	0.02	0.02	0.02
Johnston	0.09	0.08	0.07	0.06	0.05
Orange	0.02	0.01	0.01	0.01	0.01
Person	0.02	0.02	0.01	0.01	0.01
Wake	0.02	0.02	0.02	0.01	0.01
Total	0.21	0.17	0.15	0.13	0.11
NOx Emissions					
Chatham*	0.07	0.06	0.06	0.05	0.04
Durham	0.03	0.03	0.02	0.02	0.02
Franklin	0.13	0.12	0.11	0.10	0.08
Granville	0.21	0.19	0.18	0.15	0.13
Johnston	0.67	0.63	0.58	0.50	0.42
Orange	0.12	0.11	0.10	0.09	0.07
Person	0.15	0.14	0.13	0.11	0.09
Wake	0.17	0.16	0.14	0.12	0.10
Total	1.55	1.44	1.32	1.14	0.95

*Partial county emissions

Table 4.2.1-2 Airport Ground Support Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Chatham*	0.00	0.00	0.00	0.00	0.00
Durham	0.00	0.00	0.00	0.00	0.00
Franklin	0.00	0.00	0.00	0.00	0.00
Granville	0.00	0.00	0.00	0.00	0.00
Johnston	0.00	0.00	0.00	0.00	0.00
Orange	0.00	0.00	0.00	0.00	0.00
Person	0.00	0.00	0.00	0.00	0.00
Wake	0.03	0.02	0.02	0.02	0.02
Total	0.03	0.02	0.02	0.02	0.02
NOx Emissions					
Chatham*	0.00	0.00	0.00	0.00	0.00
Durham	0.00	0.00	0.00	0.00	0.00
Franklin	0.00	0.00	0.00	0.00	0.00
Granville	0.00	0.00	0.00	0.00	0.00
Johnston	0.00	0.00	0.00	0.00	0.00
Orange	0.00	0.00	0.00	0.00	0.00
Person	0.00	0.00	0.00	0.00	0.00
Wake	0.26	0.25	0.22	0.18	0.14
Total	0.26	0.25	0.22	0.18	0.14

*Partial county emissions

Table 4.2.1-3 Commercial Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Chatham*	0.03	0.03	0.03	0.03	0.03
Durham	0.28	0.25	0.24	0.25	0.26
Franklin	0.04	0.04	0.03	0.04	0.04
Granville	0.05	0.05	0.04	0.05	0.05
Johnston	0.15	0.14	0.13	0.14	0.15
Orange	0.11	0.10	0.10	0.10	0.11
Person	0.04	0.04	0.04	0.04	0.04
Wake	1.71	1.55	1.46	1.53	1.61
Total	2.41	2.20	2.07	2.18	2.29
NOx Emissions					
Chatham*	0.02	0.02	0.02	0.02	0.01
Durham	0.16	0.15	0.15	0.14	0.13
Franklin	0.02	0.02	0.02	0.02	0.02
Granville	0.03	0.03	0.03	0.03	0.02
Johnston	0.09	0.09	0.08	0.08	0.07
Orange	0.07	0.06	0.06	0.06	0.05
Person	0.02	0.02	0.02	0.02	0.02
Wake	1.00	0.95	0.91	0.86	0.80
Total	1.41	1.34	1.29	1.23	1.12

*Partial county emissions

Table 4.2.1-4 Construction Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Chatham*	0.07	0.06	0.05	0.04	0.04
Durham	0.77	0.62	0.55	0.49	0.44
Franklin	0.15	0.13	0.11	0.10	0.09
Granville	0.05	0.04	0.04	0.03	0.03
Johnston	0.24	0.19	0.17	0.15	0.14
Orange	0.33	0.27	0.24	0.21	0.19
Person	0.04	0.04	0.03	0.03	0.03
Wake	2.11	1.72	1.51	1.35	1.22
Total	3.76	3.07	2.70	2.40	2.18
NOx Emissions					
Chatham*	0.41	0.37	0.33	0.27	0.21
Durham	4.60	4.19	3.71	3.02	2.31
Franklin	0.93	0.85	0.75	0.61	0.47
Granville	0.30	0.27	0.24	0.20	0.15
Johnston	1.44	1.31	1.16	0.94	0.72
Orange	1.99	1.82	1.61	1.31	1.00
Person	0.27	0.25	0.22	0.18	0.14
Wake	12.71	11.58	10.26	8.34	6.38
Total	22.65	20.64	18.28	14.87	11.38

*Partial county emissions

Table 4.2.1-5 Industrial Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Chatham*	0.03	0.02	0.01	0.01	0.01
Durham	0.40	0.29	0.17	0.10	0.06
Franklin	0.09	0.07	0.04	0.02	0.01
Granville	0.04	0.03	0.02	0.01	0.01
Johnston	0.10	0.07	0.05	0.03	0.02
Orange	0.02	0.02	0.01	0.01	0.00
Person	0.05	0.03	0.02	0.01	0.01
Wake	0.35	0.25	0.16	0.09	0.06
Total	1.08	0.78	0.48	0.28	0.18
NOx Emissions					
Chatham*	0.14	0.11	0.07	0.05	0.03
Durham	1.64	1.26	0.85	0.56	0.40
Franklin	0.37	0.29	0.19	0.13	0.09
Granville	0.17	0.13	0.09	0.06	0.05
Johnston	0.43	0.34	0.24	0.16	0.12
Orange	0.11	0.09	0.07	0.06	0.05
Person	0.19	0.15	0.10	0.07	0.05
Wake	1.51	1.20	0.86	0.61	0.47
Total	4.56	3.57	2.47	1.70	1.26

*Partial county emissions

Table 4.2.1-6 Lawn and Garden Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Chatham*	0.22	0.19	0.17	0.18	0.18
Durham	2.40	1.98	1.84	1.86	1.94
Franklin	0.54	0.44	0.41	0.41	0.43
Granville	0.52	0.43	0.40	0.40	0.42
Johnston	1.33	1.09	1.01	1.03	1.07
Orange	1.12	0.93	0.86	0.87	0.91
Person	0.40	0.33	0.30	0.31	0.32
Wake	10.71	8.62	7.94	8.09	8.44
Total	17.24	14.01	12.93	13.15	13.71
NOx Emissions					
Chatham*	0.03	0.03	0.03	0.03	0.03
Durham	0.31	0.29	0.28	0.27	0.27
Franklin	0.07	0.07	0.07	0.07	0.07
Granville	0.07	0.06	0.06	0.06	0.06
Johnston	0.18	0.16	0.16	0.15	0.15
Orange	0.14	0.13	0.13	0.12	0.12
Person	0.05	0.05	0.05	0.05	0.05
Wake	1.60	1.49	1.41	1.40	1.39
Total	2.45	2.28	2.19	2.15	2.14

*Partial county emissions

Table 4.2.1-7 Logging Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Chatham*	0.02	0.01	0.01	0.01	0.01
Durham	0.01	0.00	0.00	0.00	0.00
Franklin	0.02	0.02	0.02	0.02	0.02
Granville	0.02	0.02	0.02	0.02	0.02
Johnston	0.03	0.02	0.02	0.02	0.03
Orange	0.01	0.01	0.01	0.01	0.01
Person	0.02	0.01	0.01	0.01	0.01
Wake	0.04	0.03	0.03	0.03	0.03
Total	0.17	0.12	0.12	0.12	0.13
NOx Emissions					
Chatham*	0.03	0.02	0.02	0.01	0.01
Durham	0.01	0.01	0.01	0.00	0.00
Franklin	0.04	0.03	0.02	0.01	0.01
Granville	0.03	0.03	0.02	0.01	0.01
Johnston	0.05	0.04	0.03	0.02	0.01
Orange	0.02	0.01	0.01	0.01	0.00
Person	0.03	0.02	0.02	0.01	0.01
Wake	0.05	0.04	0.03	0.02	0.01
Total	0.26	0.20	0.16	0.09	0.06

*Partial county emissions

Table 4.2.1-8 Railroad Maintenance Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Chatham*	0.00	0.00	0.00	0.00	0.00
Durham	0.00	0.00	0.00	0.00	0.00
Franklin	0.00	0.00	0.00	0.00	0.00
Granville	0.00	0.00	0.00	0.00	0.00
Johnston	0.00	0.00	0.00	0.00	0.00
Orange	0.00	0.00	0.00	0.00	0.00
Person	0.00	0.00	0.00	0.00	0.00
Wake	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	0.00	0.00
NOx Emissions					
Chatham*	0.00	0.00	0.00	0.00	0.00
Durham	0.00	0.00	0.00	0.00	0.00
Franklin	0.00	0.00	0.00	0.00	0.00
Granville	0.00	0.00	0.00	0.00	0.00
Johnston	0.00	0.00	0.00	0.00	0.00
Orange	0.00	0.00	0.00	0.00	0.00
Person	0.00	0.00	0.00	0.00	0.00
Wake	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	0.00	0.00

*Partial county emissions

Table 4.2.1-9 Recreational Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Chatham*	0.00	0.00	0.00	0.00	0.00
Durham	0.59	0.64	0.62	0.56	0.47
Franklin	0.01	0.01	0.01	0.01	0.01
Granville	0.01	0.01	0.01	0.01	0.01
Johnston	0.58	0.63	0.61	0.55	0.45
Orange	1.70	1.85	1.78	1.60	1.31
Person	0.00	0.00	0.00	0.00	0.00
Wake	0.38	0.40	0.40	0.37	0.32
Total	3.27	3.54	3.43	3.10	2.57
NOx Emissions					
Chatham*	0.00	0.00	0.00	0.00	0.00
Durham	0.02	0.02	0.02	0.02	0.02
Franklin	0.00	0.00	0.00	0.00	0.00
Granville	0.00	0.00	0.00	0.00	0.00
Johnston	0.01	0.02	0.02	0.02	0.02
Orange	0.04	0.04	0.04	0.04	0.04
Person	0.00	0.00	0.00	0.00	0.00
Wake	0.03	0.03	0.03	0.03	0.03
Total	0.10	0.11	0.11	0.11	0.11

*Partial county emissions

Table 4.2.1-10 Recreational Marine Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Chatham*	0.41	0.35	0.30	0.27	0.25
Durham	0.26	0.23	0.20	0.17	0.16
Franklin	0.00	0.00	0.00	0.00	0.00
Granville	0.10	0.08	0.07	0.06	0.06
Johnston	0.14	0.12	0.10	0.09	0.08
Orange	0.06	0.05	0.04	0.04	0.03
Person	0.41	0.36	0.31	0.27	0.25
Wake	0.84	0.73	0.63	0.56	0.52
Total	2.22	1.92	1.65	1.46	1.35
NOx Emissions					
Chatham*	0.03	0.03	0.04	0.04	0.04
Durham	0.02	0.02	0.02	0.03	0.03
Franklin	0.00	0.00	0.00	0.00	0.00
Granville	0.01	0.01	0.01	0.01	0.01
Johnston	0.01	0.01	0.01	0.01	0.01
Orange	0.00	0.00	0.01	0.01	0.01
Person	0.03	0.03	0.04	0.04	0.04
Wake	0.06	0.07	0.08	0.08	0.09
Total	0.16	0.17	0.21	0.22	0.23

*Partial county emissions

Table 4.2.1-11 Total NONROAD2005c Model Engine Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Chatham*	0.79	0.67	0.58	0.55	0.52
Durham	4.71	4.01	3.62	3.43	3.33
Franklin	0.87	0.72	0.63	0.61	0.61
Granville	0.82	0.68	0.62	0.60	0.62
Johnston	2.66	2.34	2.16	2.07	1.99
Orange	3.37	3.24	3.05	2.85	2.57
Person	0.98	0.83	0.72	0.68	0.67
Wake	16.19	13.34	12.17	12.05	12.23
Total	30.39	25.83	23.55	22.84	22.54
NOx Emissions					
Chatham*	0.73	0.64	0.57	0.47	0.37
Durham	6.79	5.97	5.06	4.06	3.18
Franklin	1.56	1.38	1.16	0.94	0.74
Granville	0.82	0.72	0.63	0.52	0.43
Johnston	2.88	2.60	2.28	1.88	1.52
Orange	2.49	2.26	2.03	1.70	1.34
Person	0.74	0.66	0.58	0.48	0.40
Wake	17.39	15.77	13.94	11.64	9.41
Total	33.40	30.00	26.25	21.69	17.39

*Partial county emissions

4.2.2 Aircraft Engines

Aircraft engines, like other engines, emit pollutants whenever the engines are in operation. However, the only emissions that are of concern for this inventory are the portion of the operation that occurs below the mixing layer. This is because the emissions tend to disperse whenever the aircraft is above the mixing layer and therefore has little or no effect on ground level ozone.

The aircraft operations of interest are termed the landing and takeoff (LTO) cycle. The cycle begins when the aircraft approaches the airport, descending below the mixing layer, lands and taxis to the gate. It continues as the aircraft idles at the gate and then taxis back out to the runway for the subsequent takeoff and climbout as it heads back to cruising altitudes, above the mixing layer.

Aircrafts can be categorized by use into four classifications: commercial, air taxis, general aviation and military. Commercial aircraft include those used for scheduled service transporting passengers, freight or both. Air taxis, or commuter aircraft, also fly scheduled service carrying passengers and/or freight but usually are smaller aircraft and operate on a more limited basis than commercial carriers. General aviation include all other non-military aircraft used for recreational flying, personal transportation, and various other activities. Military aircraft cover a wide range of sizes, uses and operating missions. The military aircraft are treated as a separate classification since the LTO operations reported at the airports group all military aircraft together.

Base year 2005 emissions for aircraft engines were projected from the 2002 emissions inventory prepared for the southeast regional haze planning organization Visibility Improvement State and Tribal Association of the Southeast (VISTAS). The projection from 2002 to 2005 was made using growth factors generated from the Economic Growth Analysis System Version 5.0 Beta (E-GAS 5.0).

For 2002 aircraft emissions, VISTAS used 1999 emission estimates developed for the USEPA's 1999 National Emission Inventory (NEI) Version 2 as base year estimates for the VISTAS region. VISTAS then projected the revised 1999 inventory to 2002 using surrogate growth indicators. For the aircraft category, 1999 and 2002 approach operations by airport and aircraft type were compiled by VISTAS from the Federal Aviation Administration's Air Traffic Activity Data System (ATADS).The airport-level LTOs were assigned to counties and summed for the county. For counties with aircraft emissions without a county match in ATADS, state-average growth factors were calculated and applied.

Table 4.2.2-1 summarizes the VOC and NOx emissions for aircraft engines.

Table 4.2.2-1 Aircraft Engine Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Chatham	0.00	0.00	0.00	0.00	0.00
Durham	0.00	0.00	0.00	0.00	0.00
Franklin	0.00	0.00	0.00	0.00	0.00
Granville	0.00	0.00	0.00	0.00	0.00
Johnston	0.00	0.00	0.00	0.00	0.00
Orange	0.00	0.00	0.00	0.00	0.00
Person	0.00	0.00	0.00	0.00	0.00
Wake	0.25	0.29	0.32	0.34	0.37
Total	0.25	0.29	0.32	0.34	0.37
NOx Emissions					
Chatham	0.00	0.00	0.00	0.00	0.00
Durham	0.00	0.00	0.00	0.00	0.00
Franklin	0.00	0.00	0.00	0.00	0.00
Granville	0.00	0.00	0.00	0.00	0.00
Johnston	0.00	0.00	0.00	0.00	0.00
Orange	0.00	0.00	0.00	0.00	0.00
Person	0.00	0.00	0.00	0.00	0.00
Wake	1.52	1.71	1.90	2.06	2.23
Total	1.52	1.71	1.90	2.06	2.23

4.2.3 Railroad Locomotives

Railroads are categorized by size (Class I, Class 2) and passenger service (Amtrak and NCDOT Rail Division). Class I railroads are long haul operations, consisting of Norfolk Southern Corporation and CSX Corporation. Class II and Class III railroads are short lines, serving localized markets. Passenger service is provided by Amtrak and the NCDOT Rail Division. These entities lease trackage from Class I railroads. Base year 2005 emissions for railroad locomotive engines were projected from the 2002 VISTAS emissions inventory. The projection from 2002 to 2005 was made using growth factors generated from the E-GAS 5.0.

For 2002 railroad locomotive engine emissions, VISTAS used 1999 emission estimates developed for the USEPA's 1999 NEI Version 2 as base year estimates for the VISTAS region. Projected emissions for 2002 were developed in two steps as described below. For 1999 to 2001,

State-level rail fuel consumption was obtained from the Department of Energy, Energy Information Administration's (EIA's) *Fuel Oil and Kerosene Sales.* For 2001 to 2002, VISTAS applied national growth factors developed from fuel consumption projections in EIA's *Annual Energy Outlook.* A growth factor of 1.4 was used for locomotives and applied to 1999 emissions to first develop 2001 emissions. Table 4.2.3.1 lists the growth factors used to generate 2002 emissions.

Table 4.2.3-1 2002 National Rail Transportation Energy Use by Fuel Type (Trillion BTU)

	2001	**2002**	**Growth Factor (GF)**
Intercity Rail (Electric)	10.17	10.40	1.0226
Intercity Rail (Diesel)	16.60	16.88	1.0169
Transit Rail (Electric)	46.36	47.40	1.0224
Intercity/Transit Rail Average (SCC 2285002008)			**1.0206**
Commuter Rail (Electric)	16.13	16.49	1.0223
Commuter Rail (Diesel)	26.31	26.76	1.0171
Commuter Rail Average (SCC 2285002009)			**1.0197**
Freight Rail (Distillate) (SCCs 2285002000, 2285002005, 2285002006, 2285002007, 2285002010)	512.81	492.32	0.9600

Source: Department of Energy, Energy Information Administration, Annual Energy Outlook 2003: Table 34. Transportation Sector Energy Use by Fuel Type Within a Mode

The summary of emissions from all railroad locomotives in each county are in Table 4.2.3-2.

Table 4.2.3-2 Railroad Locomotive Engine Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Chatham*	0.00	0.00	0.00	0.00	0.00
Durham	0.01	0.01	0.01	0.01	0.01
Franklin	0.00	0.00	0.00	0.00	0.00
Granville	0.00	0.00	0.00	0.00	0.00
Johnston	0.08	0.07	0.07	0.06	0.06
Orange	0.02	0.01	0.01	0.01	0.01
Person	0.00	0.00	0.00	0.00	0.00
Wake	0.03	0.03	0.03	0.02	0.02
Total	0.14	0.12	0.12	0.10	0.10
NOx Emissions					
Chatham*	0.06	0.05	0.05	0.04	0.04
Durham	0.32	0.29	0.27	0.26	0.24
Franklin	0.04	0.04	0.03	0.03	0.03
Granville	0.03	0.03	0.03	0.03	0.03
Johnston	1.90	1.74	1.60	1.51	1.43
Orange	0.37	0.34	0.31	0.29	0.28
Person	0.06	0.05	0.05	0.04	0.04
Wake	0.72	0.65	0.60	0.57	0.54
Total	3.50	3.19	2.94	2.77	2.63

*Partial county emissions