Attachment A

I/M SIP

Maintenance Demonstration

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1.0 PURPOSE

The Federal Clean Air Act (FCAA), as amended, established National Ambient Air Quality Standards (NAAQS) for carbon monoxide, lead, ozone, nitrogen dioxide, particulate matter and sulfur dioxide. The U.S. Environmental Protection Agency (USEPA) is required to review, and revise as necessary, the NAAQS for each of these air pollutants every five years. Areas that violate a NAAQS are designated nonattainment by the USEPA. In North Carolina, areas have been designated nonattainment for carbon monoxide, ozone and particulate matter. Areas designated as moderate nonattainment or higher for carbon monoxide or ozone are required to implement a vehicle inspection and maintenance program (i.e., an emissions inspection program) in accordance with the CAA, Sections 187(a)(4) and 182(b)(4), respectively. The requirements of an inspection and maintenance program were established in the Code of Federal Regulation (CFR) under Title 40 CFR Part 51.

The state of North Carolina implemented a Motor Vehicle Inspection/Maintenance (I/M) program to attain and maintain compliance with the ozone and carbon monoxide NAAQS. The implementation of this program continues to be an integral part of North Carolina's air quality planning strategy.

On August 1, 2012, the North Carolina General Assembly enacted House Bill 585 (Session Law 2012-199) which exempts certain 1996 or newer vehicles from requiring an emissions inspection. The law is interpreted as exempting vehicles of the three newest model years with less than 70,000 miles on the odometer from an emissions inspection.

Prior to the law being enacted, only the newest model year (1st year) vehicles were exempted from the state I/M program. The revised exemptions become effective on the latter of either January 1, 2014 or the first day of a month that is 30 days after the North Carolina Department of Environment and Natural Resources (DENR) certifies that the USEPA has approved the amendment to the State Implementation Plan (SIP) incorporating the statutory changes.

The new exemption will increase emissions of nitrogen oxides, volatile organic compounds, and carbon monoxide in counties where the I/M program is in place. Consequently, a SIP revision is required to be submitted to the USEPA demonstrating that the SIP complies with the requirements of Section 110(l) of the FCAA as amended. Section 110(l) states:

> *"Each revision to an implementation plan submitted by a State under this chapter shall be adopted by such State after reasonable notice and public hearing. The [USEPA] Administrator shall not approve a revision of a plan if the revision would interfere with any applicable requirement concerning attainment and reasonable further progress (as defined in section 171 of this title), or any other applicable requirement of this act."*

This means that North Carolina would have to demonstrate that any emissions increase would not hinder any area where the I/M program is implemented from attaining and/or maintaining all of the NAAQS. Additionally, it requires the state to compensate or achieve equivalent emissions reductions to offset increased emissions due to changes in the vehicle emissions program. Failure to have a revised SIP approved by USEPA before eliminating or modifying an I/M program could result in the state being sued for non-compliance with the Clean Air Act.

The purpose of this SIP revision is to document the changes in emissions resulting from the I/M program change, to demonstrate the state's approach for compensating for these emissions increases, and to demonstrate that these changes will not interfere with the attainment or maintenance of NAAQS. In a separate action, North Carolina is amending state rules (15A NCAC 02 3 .1000) that contain provisions related to the I/M program.

2.0 BACKGROUND

The North Carolina I/M program started in 1982 with Mecklenburg County being required to implement the program to address violations of the carbon monoxide (CO) NAAQS. In 1984, Wake County was added to the program to address CO NAAQS violations. With the passage of the 1990 CAA Amendments, seven other counties (Cabarrus, Durham, Forsyth, Gaston, Guilford, Orange, and Union) were added to the I/M program to address violations of the 1-hour ozone and/or CO NAAQS. Under the 1997 8-hour ozone standard, the Charlotte/Gastonia/Rock Hill area (referred to as Metrolina) was designated moderate nonattainment, which required the following three counties to be included in the program: Iredell, Lincoln, and Rowan. Later on, Senate Bill 953 (Session Law 1999-328) was enacted requiring an additional 36 counties to have the vehicle emission program in order to improve air quality statewide. These counties were added based on population, vehicle miles traveled, and the likely contribution by motor vehicles to high ozone levels in these counties and nearby counties. This expanded the program to a total of 48 counties.

In 2011, Session Law 2011-95 was passed to exempt plug-in electric vehicles from the emissions inspection requirement. In the following year, Session Law 2012-199 was enacted to change the I/M exemption from first model year vehicles to three newest model year vehicles with less than 70,000 miles.

The North Carolina Department of Transportation (NCDOT) - Division of Motor Vehicles (DMV), License and Theft Bureau, has operational responsibility for the emissions inspection program in North Carolina and has created rules for implementing and monitoring the program under the North Carolina Administrative Code (Title 19A NCAC 03D.05). The North Carolina Division of Air Quality (NCDAQ) has adopted air quality rules under 15A NCAC 02D .1000 to reflect the requirements of Senate Bill 953 and USEPA regulations. In addition the NCDAQ develops specifications for the program and certifies the emissions testing equipment used in the program.

The initial emissions inspection program in North Carolina was based on a "tail-pipe" test. The test was administered by inserting a probe in the vehicle's tailpipe and measuring the amount of pollution emitted. The tail-pipe test measured carbon monoxide and volatile organic compound emissions. The test could not identify the emissions-related component that was malfunctioning, nor could it measure emissions of nitrogen oxides, which is a key precursor to ozone formation.

Beginning October 2002, inspection stations in the original nine counties converted from tail-pipe testing to the new On Board Diagnostic II (OBDII) emissions testing for all 1996 and newer light duty gasoline vehicles. The program continued to expand until January 1, 2006, at which time inspection stations in 48 counties were performing the OBDII emissions test on all 1996 and newer light duty gasoline vehicles. Once the program was fully implemented, tail-pipe testing for vehicles older than 1996 was discontinued.

Model year 1996 and newer vehicles have standardized computer systems that continually monitor the electronic sensors of engines and emission control systems. The vehicle's dashboard warning light is required by the USEPA to illuminate whenever vehicle emissions exceed 1.5 times allowance of the Federal Test Procedure (FTP). When a potential problem is detected, the dashboard warning light may also be illuminated to alert the driver. An OBDII system detects a problem well before symptoms such as poor performance, high emissions or poor fuel economy are recognized by the driver. An OBDII emission test provides a more timely and comprehensive picture of a vehicle's emissions status because it evaluates emissions during vehicle operation, whereas a tailpipe test measures emissions for a few moments once a year. Early detection helps to avoid costly repairs and improves engine and emission control system performance.

On November 1, 2008, the state ended the use of paper stickers and began the electronic authorization program. The electronic authorization program also synchronized the vehicle registration renewal date with the vehicle inspection due date, essentially requiring a passing inspection prior to a vehicle's registration renewal. A safety only inspection is required for all vehicles less than 35 years old in counties without the I/M program and vehicles older than 1996 in counties with the I/M program.

A vehicle that qualifies for an emissions waiver may have their registration renewed after passing the safety equipment portion of the vehicle inspection and receiving a waiver for the OBD portion. The DMV had contracted with Verizon Business to manage the Vehicle Inspection Database (VID). In April 2012, the DMV signed a contract with Systech International to serve as the State's new VID contractor and to enhance its functionality. These new enhancements are expected to not only benefit the state by reducing administrative costs, but to minimize the financial impact currently placed on inspection station owners. The enhancement will be deployed through the implementation of a web-based solution to eliminate the need for inspection stations to own specific analyzers, costly service contracts with analyzer providers and dedicated phone lines for dial up connections. This new system would allow for real time data transfer between the inspection stations, the VID, and the DMV's vehicle registration database, thus minimizing wait time for vehicle registration issuance and renewals.

In 2002, North Carolina inspection stations performed over 2.5 million vehicle emission inspections. The number of OBD inspections in 2006 was about 4.6 million. In 2011, approximately 4.8 million vehicles were tested.

3.0 EMISSIONS INVENTORIES AND MAINTENANCE DEMONSTRATION

3.1 Study Areas

Section 175A(a) of the CAA (Maintenance Plan Revision), requires states to submit a request for re-designation from nonattainment to attainment once an area has attained the NAAQS. It also requires states to submit a maintenance plan for the pollutant of concern for at least 10 years after the redesignation. Furthermore, Section 110(l) of the CAA (Implementation Plan Revisions), states that a revision of a maintenance SIP would not be approved if a proposed action would interfere with any applicable requirement concerning attainment and reasonable further progress, or any other applicable requirement of the Act.

North Carolina has several ozone and CO maintenance areas which rely on the I/M program for continued compliance with the NAAQS. Two of these areas are currently violating the 2008 8-hour ozone standard. Based on this current status, the USEPA has advised the DAQ that emissions analysis would be required for maintenance areas that are currently violating a NAAQS and all other areas where the I/M program is included as part of a federally approved SIP. Based on these criteria, the three study areas are: Metrolina ozone nonattainment area (pending USEPA approval for maintenance status), Triad ozone maintenance area, and the remaining I/M counties. Table 3-1 summarizes key aspects of each study area.

Table 3-1 I/M Program Study Areas

Area	Name	# of Counties[1]	Current Designation	Current NAAQS Violations
1	Metrolina	7	1997 8-hr Ozone NAAQS: moderate nonattainment, pending redesignation approval from USEPA 2008 8-hr Ozone NAAQS: marginal nonattainment	2008 8-hr Ozone Standard
2	Triad	3	Attainment or maintenance for all applicable NAAQS	2008 8-hr Ozone Standard
3	All Remaining	38	Attainment and/or maintenance for all applicable NAAQS	None

[1] For a complete list of I/M program counties, see Table 4-1.

Area 1 was assigned to the Metrolina area because it is currently designated nonattainment under both the 1997 and 2008 8-hour Ozone Standard. The Metrolina area with the I/M program includes the counties of Cabarrus, Gaston, Lincoln, Mecklenburg, Rowan, Union and Iredell. Area 2 was assigned to represent the Triad counties which are maintenance for the 1997 8-hour ozone standard. The three Triad counties with an I/M program in operation includes the counties of Davidson, Forsyth and Guilford. The Triad area was selected because it has recently violated the 2008 8-hour ozone standard, despite being designated as attainment of this standard. Area 3 is comprised of the Raleigh-Durham-Chapel Hill (an ozone maintenance area) as well as the remaining 31 I/M counties which are not part of either Area 1 or 2. The Triangle counties consist of Chatham, Durham, Franklin, Granville, Johnston, Orange and Wake. A list of remaining I/M program counties in Study Area 3 is provided later in Table 4-1.

Several counties in Area 1, 2, and 3 are designated CO maintenance areas. This includes Mecklenburg County in Area 1, Forsyth County in Area 2, and Durham and Wake Counties in Area 3. The CO levels in each of these maintenance counties are less than 23% of the CO NAAQS.

3.2 Theory of Approach

There are two basic approaches used to demonstrate continued maintenance. The first is the comparison of an emissions inventory between the current program and the target program. The second approach involves complex analysis using gridded dispersion modeling. The approach used by the NCDAQ is the comparison of emissions inventories (i.e., current I/M program versus the target I/M program with the new exemptions).

USEPA Region 4 has stated that since the current I/M program meets the performance standards described in 40 CFR Part 51, Section 352, the target I/M program is not to cause an emissions increase which would interfere with the attainment of NAAQS. To demonstrate this, on-road mobile source emissions for each county of the 48 I/M counties were modeled twice, first with the current I/M program parameters and then with the target I/M program parameters. Emissions of each pollutant were compared at the county and area levels in units of kilograms per day (kg/day) to determine whether the target program causes increases in emissions.

USEPA's Motor Vehicle Emission Simulator (MOVES) mobile model was used to generate on-road mobile sources emissions. The MOVES model uses road class vehicle miles traveled and other operating conditions as input parameters to generate an output file containing estimated emissions. For the projected years' inventories, the on-road mobile sources emissions are calculated by running the MOVES mobile model for the future year with the projected VMT to generate emissions under the current and target I/M program specifications. The USEPA recommends that users modeling an existing I/M program in MOVES begin by examining the default I/M program description included in MOVES for the particular county in question. The NCDAQ modified the default data in MOVES to reflect county specific compliance factors. The

USEPA Region 4 has also stated that no additional Travel Demand Modeling (TDM) would be necessary to generate the vehicle miles traveled (VMT) and speed data needed for the modeling and that default data could be used if necessary. The NCDAQ has TDM data from recent SIP development and transportation conformity projects for the Metrolina, Triad, and Triangle non-attainment and maintenance areas, so no MOVES default VMT and speed data was used. A complete discussion of the MOVES modeling is provided in Sections 4 through 7.

Compliance Rate

The current I/M SIP (submitted to USEPA on May 21, 2010) commits North Carolina to ensure a Compliance Rate (CR) of no less than 92% among subject vehicles by 2011. This SIP has not yet been approved by the USEPA. The most recent approved version of the I/M SIP requires a CR of at least 95%.

In recent years, North Carolina instituted an electronic authorization program which replaced paper stickers with electronic authorizations. This process synchronized vehicle registration renewal date with the vehicle inspection renewal date, essentially requiring a safety and/or emissions inspection prior to the vehicle's registration renewal. As a result of tying the inspection requirements to vehicle registration, the actual CR has improved and varies between 96 and 99 percent. In 2011, the North Carolina DMV reported a program-wide CR of 98.48% to USEPA based on electronic records. The reported CR for 2010 was 99.34%. The NCDAQ is proposing to increase the I/M SIP CR to 96% to compensate for emission increases associated with the target exemptions. Based on the trends observed in recent years, the NCDAQ believes the target compliance rate is achievable. Table 3-2 summarizes the study scenarios.

Table 3-2 I/M Program Study Compliance Rates

I/M Program	Model Years Exempted	Compliance Rate	Waiver Rate
Current	Latest Model Year	95%	5%
Target	3 Latest Model Years	96%	5%

Modeling Year

The proposed changes to the I/M program are planned to go into effect in 2014, pending approval of a revised I/M SIP by the USEPA. The USEPA Region 4 has stated that emissions modeling regarding revisions to the I/M program are to be contemporaneous with the implementation date of the proposed changes as practical. Therefore, the emissions modeling was performed for the year 2014, plus or minus one year in keeping with the year of implementation specified in the legislation. Table 3-3 summarizes the projected years modeled for each study area.

Table 3-3 MOVES Emissions Modeling Years

Study Area	Name	Year Modeled	Origin of Data
1	Metrolina	2013	Metrolina Redesignation and Maintenance Plan
2	Triad	2015	Triad transportation conformity – Long Range Transportation Plan update from 2012
3	All Remaining	2014	Triangle Redesignation Plan Supplement

Pollutants Modeled

Table 3-4 lists the pollutants which were modeled using MOVES2010b. For CO, the model was run for a typical winter (January) day to represent highest emission levels expected. For all other pollutants, the model was run for a typical ozone season (July) day.

Table 3-4 I/M Pollutants Modeled

Pollutant	Emissions Modeling Month	Unit
Carbon Monoxide (CO)	January	kg/day
Oxides of Nitrogen (NOx)	July	kg/day
Volatile Organic Compounds (VOC)	July	kg/day
Particulate Matter PM2.5	July	kg/day

Three Newest Model Year Vehicles with 70,000 Miles

As mentioned earlier, the legislation requires emissions inspections for three newest model year vehicles with greater than 70,000 miles and are not qualified for the exemption. Due to the complexities involved in modeling such vehicles in MOVES, the NCDAQ has assumed that all three newest model year vehicles would be exempted. This approach results in an overestimation of modeled emissions for the target program, therefore providing a more conservative estimate of its impact. For example, it is estimated that approximately 0.5 million vehicles out of 4.8 million total number of vehicles tested in 2011 were less than three model years old with less than 70,000 mile odometer reading captured during time of inspection. About 13,600 vehicles were less than three model years and had greater than 70,000 miles. The modeling approach used in this SIP revision assumes that all vehicles less than three model years would be exempted from emissions inspection requirements. In reality, these new vehicles less than three years old with over 70,000 miles traveled would be required to have an emissions inspection and so the study's air emissions would be less than the modeled amounts.

3.3 Summary of Emissions

Using the emission estimation approach in the MOVES model gives a summary of emissions in kilograms per typical winter or summer weekday, by county. The county level data results are summed to arrive at total daily emissions by study area. County specific emissions results are provided in Section 6.3.

Tables 3-6 and 3-7 present the results for NOx and VOC, respectively, which are precursors to ozone formation. The modeling results indicate that the increase in emissions associated with additional vehicles being exempted from the target I/M program can be easily offset by a higher compliance rate in all areas. Additionally, it is estimated that statewide, NOx emissions could decrease by about 133 kg/day. Therefore, it is concluded that the target I/M program will not interfere with the attainment of the ozone NAAQS.

Table 3-6 NOx Emissions (kg/day)

Study Area	Name	Current I/M Program (95% compliance Rate, 1 year Exemption)	Target I/M Program (96% compliance Rate, 3 year Exemption)	Difference
1	Metrolina	98,157	98,122	-35
2	Triad	36,157	36,143	-15
3	All Remaining	226,196	226,113	-83
	Statewide Total	**360,510**	**360,377**	**-133**

Table 3-7 VOC Emissions (kg/day)

Study Area	Name	Current I/M Program (95% compliance Rate, 1 year Exemption)	Target I/M Program (96% compliance Rate, 3 year Exemption)	Difference
1	Metrolina	48,545	48,523	-22
2	Triad	19,965	19,954	-11
3	All Remaining	115,443	115,384	-59
	Statewide Total	**183,953**	**183,860**	**-92**

Table 3-8 summarizes direct PM2.5 emissions under the current and target I/M programs. No increase in emissions is expected.

Table 3-8 PM2.5 (Direct) Emissions (kg/day)

Study Area	Name	Current I/M Program (95% compliance Rate, 1 year Exemption)	Target I/M Program (96% compliance Rate, 3 year Exemption)	Difference
1	Metrolina	2,413	2,413	0
2	Triad	791	791	0
3	All Remaining	5,175	5,172	0
	Statewide Total	**8,377**	**8,377**	**0**

Table 3-9 summarizes CO emissions results. The data suggests that with the exception of the Metrolina area, all other areas could achieve a decrease in CO emissions under the target I/M program scenario. A closer look at Metrolina indicates that Mecklenburg County is the only county where a CO emissions increase is modeled (see Table 3-10). The current design value in Mecklenburg County is 1.7 ppm which is 19% of the 8-hour CO NAAQS set at 9 ppm. Since the ambient concentrations are so far below the NAAQS, the NCDAQ is concluding that the projected increase in CO is comparatively minimal, and the effect to ambient concentration of CO will be correspondingly minimal as well. Therefore, there is no expectation or concern that this change in CO emissions due to the I/M program change will affect the attainment status of the Metrolina area CO NAAQS.

Table 3-9 CO Emissions (kg/day)

Study Area	Name	Current I/M Program (95% compliance Rate, 1 year Exemption)	Target I/M Program (96% compliance Rate, 3 year Exemption)	Difference
1	Metrolina	1,047,712	1,047,737	24
2	Triad	492,801	492,720	-82
3	All Remaining	2,560,587	2,560,367	-220
	Statewide Total	**4,101,100**	**4,100,823**	**-277**

Table 3-10 County Specific CO Emissions in the Metrolina Area (kg/day)

County	Current I/M Program (95% compliance Rate, 1 year Exemption)	Target I/M Program (96% compliance Rate, 3 year Exemption)	Difference
CABARRUS	103,874	103,862	-12
GASTON	117,917	117,901	-16
IREDELL	106,337	106,326	-11
LINCOLN	47,477	47,467	-10
MECKLENBURG	477,930	478,026	96
ROWAN	92,986	92,973	-13
UNION	101,191	101,181	-10
Total:	1,047,712	1,047,737	24

The I/M program does not affect emissions of other criteria pollutants (e.g., SO_2, lead). Therefore, the target changes to the I/M program are not expected to interfere with the attainment of other NAAQS.

3.4 Conclusion

The state of North Carolina is revising its I/M program to exempt the three newest model year vehicles with less than 70,000 miles from requiring an emissions inspection. The NCDAQ has demonstrated that emissions increase associated with this exemption can be offset by a higher program compliance rate. As documented in 2010 and 2011 Test Data Reports to the USEPA, the state of North Carolina is already achieving a compliance rate greater than 96%. In summary, the I/M program change is not expected to affect emissions of criteria pollutants, and is not expected to interfere with the attainment of any NAAQS.

4.0 ON-ROAD EMISSIONS ESTIMATION APPROACH

Mobile source emissions are estimated by the methodologies suggested in the USEPA documents: *Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations, Policy Guidance on the Use of MOVES2010 for State Implementation Plan Development, Transportation Conformity, and Other Purposes* (EPA-420-B-09-046, December 2009), and *Technical Guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity* (EPA-420-B-10-023, April 2010).

In 2010, the MOBILE6.2 model was superseded by the MOVES (Motor Vehicle Emissions Simulator) model. MOVES2010b (hereafter referred to as MOVES) replaces the USEPA's previous emissions model for on-road mobile sources, MOBILE6.2. MOVES can be used to estimate exhaust and evaporative emissions as well as brake and tire wear emissions from all types of on-road vehicles. To ease the transition from MOBILE6.2 to MOVES, the USEPA also established a grace period, ending March 2, 2013. After this grace period, MOVES must be used for all SIP and transportation conformity emissions analysis modeling; therefore, MOVES-based modeling is the official approved model at this time and was used for this analysis of the proposed change to the I/M Program

This report covers only the procedures for developing MOVES-based emissions (kg/day) for the following criteria pollutants: NOx, VOC, PM2.5 (Direct), and CO emissions for on-road mobile sources. In this analysis, generating emissions in inventory mode was the preferred option because it is relatively quick and greatly simplifies the post-processing of MOVES output. When the inventory option is selected, MOVES provides emissions estimates as mass, using VMT and vehicle population entered by the user. If the emission rate option is selected, MOVES provides emission rates as mass per unit of activity. The emission rate option produces a look-up table of emission rates that must be post-processed to produce an inventory.

MOVES-based emission inventories were developed for all 48 I/M counties in duplicate with changes only to the I/M input parameters which reflected a difference in compliance rate and the model year value for vehicles exempt from the target I/M Program. The base year selected for each modeled area is contemporaneous with when the rule change is to be implemented in accordance with the NC legislative mandate for this I/M Program update. Each of the three areas' emissions inventory represents the estimated county emissions summed for CO based on a typical winter weekday and for NOx, VOC & PM2.5 (Direct) based on a typical summer weekday.

Furthermore, this technical analysis documents the development of on-road mobile source emissions analysis for North Carolina counties subject to the I/M program grouped by area designated as Nonattainment or Attainment and Maintenance. The technical analysis grouped the modeling of the 48 North Carolina I/M counties into 3 areas. Area 1 was assigned to the Metrolina area because it is designated nonattainment under both the 1997 and 2008 8-hour O_3 standard. The Metrolina area includes the counties of Cabarrus, Gaston, Lincoln, Mecklenburg, Rowan, Union and Iredell. Area 2 was assigned to represent the three Triad area counties consisting of Davidson, Forsyth and Guilford which follows USEPA's comments during the March 25, 2013 conference call with NCDAQ. The USEPA's recommendation was based on the most recent air quality data which shows violations of the 2008 8-hour ozone standard. Area 3 included the Raleigh-Durham-Chapel Hill, North Carolina 8-Hour Ozone Maintenance Area as well as the remaining 31 I/M counties not part of either Area 1 or 2. The Triangle counties consist of Chatham, Durham, Franklin, Granville, Johnston, Orange and Wake. Table 4-1 lists all 48 I/M counties according to the area they were assigned to in this technical analysis.

Table 4-1 I/M Program Counties by Area

Study Area	FIPs Code	County Name
1	37025	Cabarrus
1	37071	Gaston
1	37097	Iredell
1	37109	Lincoln
1	37119	Mecklenburg
1	37159	Rowan
1	37179	Union
2	37057	Davidson
2	37067	Forsyth
2	37081	Guilford
3	37037	Chatham
3	37063	Durham
3	37069	Franklin
3	37077	Granville
3	37101	Johnston
3	37135	Orange
3	37183	Wake

Table 4-1 I/M Program Counties by Area

Study Area	FIPs Code	County Name
3	37001	Alamance
3	37019	Brunswick
3	37021	Buncombe
3	37023	Burke
3	37027	Caldwell
3	37031	Carteret
3	37035	Catawba
3	37045	Cleveland
3	37049	Craven
3	37051	Cumberland
3	37065	Edgecombe
3	37085	Harnett
3	37087	Haywood
3	37089	Henderson
3	37105	Lee
3	37107	Lenoir
3	37125	Moore
3	37127	Nash
3	37129	New Hanover
3	37133	Onslow
3	37147	Pitt
3	37151	Randolph
3	37155	Robeson
3	37157	Rockingham
3	37161	Rutherford
3	37167	Stanly
3	37169	Stokes
3	37171	Surry
3	37191	Wayne
3	37193	Wilkes
3	37195	Wilson

5.0 QUALITY ASSURANCE MEASURES

The quality assurance (QA) for the on-road mobile source category can be broken into two components: 1) input files and 2) MOVES outputs/summaries. Each of these components is 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 areas. Once the speeds are deemed reasonable, the NCDAQ enters the speed information into MOVES input files. In addition to the speed information, the user enters data to characterize local meteorology, fleet and activity information. All input files are checked 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 noted back to the person who generated the input files for correction. Additionally, a report is maintained that identifies the person who produced the input file, the person that QA'd the file, and where the data originated. Once the input files have passed through the QA procedure, MOVES is run to generate an emissions inventory.

6.0 DISCUSSION OF MOBILE SOURCE EMISSIONS MODELING

On-road mobile sources produce daily emission rates for NOx and VOC as well as other criteria pollutants. Emissions of four pollutants: NOx, VOC, PM2.5 (Direct), and CO were estimated for this analysis. The objective of the following section is to describe the mobile source category, the MOVES input files, and the emissions estimation procedures. This section also includes summary tables of the estimated emissions by county for each of the three areas.

6.1 Introduction and Scope

On-road mobile sources are defined as those vehicles that travel on public roadways. 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. An important component of the on-road mobile emission estimation process is interagency consultation. The primary transportation partners involved include the Metropolitan Planning Organizations (MPOs), NCDAQ, NCDOT and USEPA. The MPOs provided NCDAQ TDM speed and VMT data for the areas within their municipal planning organization boundaries. The NCDOT provided speed and VMT data for portions of four counties (Davidson, Franklin, Granville, and Johnston Counties) not covered by the TDM which are referred to as Non-Modeled Analysis Areas (NMAA). The NCDOT also provided vehicle registration data and vehicle mix data.

6.2 MOVES Model Input

All input data for MOVES modeling is first compiled into county-level MySQL databases which including separate tables for each type of input data needed. Output data from MOVES modeling runs are also created as MySQL databases. Due to their size and complexity, the MOVES input and output database files will be provided to USEPA electronically.

6.2.1 On-road Vehicle Speed Data

Emission modeling using MOVES requires vehicle speed input data formatted as fractions of driving time in each of sixteen speed ranges, called “speed bins”, for each combination of clock hour/day type (week day or weekend day), vehicle type, and road type. Speed Bin 1 represents speeds from 0 to 2.5 mph, and Speed Bin 16 represents speeds of 72.5 mph and greater. Speed Bins 2 through 15 each represent 5 mph speed ranges between 2.5 mph and 72.5 mph. The fractions for each combination of vehicle type, road type, and hour/day type sum to one. To generate these average speed distribution input tables, the NCDAQ used spreadsheet-based data converters developed by the USEPA to process the speed data provided by MPOs and NCDOT.

Raw Speed Data

The MPOs were the source of the TDM speed and VMT data for the areas within the MPO boundary jurisdiction. Area 1 included the Metrolina counties of Cabarrus, Gaston, Iredell, Lincoln, Mecklenburg, Rowan, and Union. Area 2 included the Triad counties of Davidson (partial), Forsyth and Guilford. Area 3 included the Triangle counties of Chatham, Durham, Franklin (partial), Granville (partial), Johnston (partial), Orange and Wake and also the remaining 31 NC counties currently under to the I/M Program. The following shortened road type acronyms correspond to the longer functional road classifications which are used in Tables 6-1 through 6-5.

RI	Rural Interstate
ROPA	Rural Other Principle Arterial
RMinArt	Rural Minor Arterial
RMjrColl	Rural Major Collector
RMinColl	Rural Minor Collector
RL	Rural Local
UI	Urban Interstate
UF	Urban Freeway & Expressway
UOPA	Urban Other Principal Arterial
UMinArt	Urban Minor Arterial
UColl	Urban Collector
UL	Urban Local
UH	Urban HOV

For the Metrolina Regional Model (MRM), travel period speed data was categorized by roadway functional class and by the four travel periods described in Table 6-1. Speeds provided for 2013 were broken down to four time periods during the day; AM Peak, Midday, PM Peak and Night. The 2013 speed data was from the Charlotte-Gastonia-Rock Hill, NC-SC 1997 8-Hour Ozone Nonattainment Area Redesignation Demonstration and Maintenance Plan – Supplement.

Table 6-1 Regional Model Speeds for the Metrolina Area (miles/hour) - Area 1

Year	Time	RI	ROPA	RMinArt	RMjrColl	RMinColl	RL	UI	UF	UOPA	UMinArt	Ucoll	UL	UHOV
Cabarrus														
2013	AM	NA	49	51	38	39	28	44	NA	30	29	27	24	NA
	Midday	NA	53	55	43	42	28	66	NA	33	31	30	22	NA
	PM	NA	48	48	36	37	28	40	NA	28	27	25	22	NA
	Night	NA	56	59	51	46	28	68	NA	41	39	38	25	NA
Gaston														
2013	AM	60	57	39	41	39	28	42	52	30	29	29	24	NA
	Midday	63	58	53	48	40	28	63	54	34	35	29	24	NA
	PM	55	57	41	41	39	28	41	52	28	29	25	24	NA
	Night	63	58	57	51	41	28	63	56	39	39	34	24	NA
Iredell														
2013	AM	53	NA	15	28	26	29	48	NA	25	25	27	25	NA
	Midday	68	NA	14	34	28	29	61	NA	25	27	27	25	NA
	PM	56	NA	12	25	28	28	44	NA	21	23	23	24	NA
	Night	68	NA	32	42	42	30	68	NA	36	36	38	26	NA
Lincoln														
2013	AM	NA	56	46	56	44	28	NA	68	36	35	34	26	NA
	Midday	NA	61	49	57	46	28	NA	68	39	38	36	26	NA
	PM	NA	54	43	55	44	28	NA	68	35	33	33	25	NA
	Night	NA	65	55	58	47	28	NA	68	45	44	39	27	NA
Mecklenburg														
2013	AM	NA	33	30	30	35	29	44	49	24	24	21	22	63
	Midday	NA	43	42	39	40	29	57	55	27	27	26	21	65
	PM	NA	34	37	29	34	29	40	46	21	22	20	19	66
	Night	NA	48	45	46	45	29	62	58	37	37	35	24	NA
Rowan														
2013	AM	NA	54	54	51	46	29	59	NA	38	34	33	24	NA
	Midday	NA	58	58	55	49	29	65	NA	39	35	30	24	NA
	PM	NA	55	53	51	46	29	58	NA	36	32	28	23	NA
	Night	NA	60	60	58	50	29	67	NA	44	41	37	25	NA
Union														
2013	AM	NA	50	47	44	44	31	NA	27	33	27	31	26	NA
	Midday	NA	52	50	47	46	30	NA	36	37	30	35	27	NA
	PM	NA	51	45	44	44	31	NA	27	31	25	28	26	NA
	Night	NA	53	56	51	48	30	NA	46	44	38	42	28	NA

The Piedmont Triad Regional Model (PTRM) speeds and NMAA speeds data for Area 2 are listed below in Table 6-2 and represent the Triad area counties. Forsyth and Guilford counties are completely within the PTRM model boundary. Davidson is partially covered by the PTRM.

NCDOT analyzed the parts of Davidson County outside the model boundary using the NMAA spreadsheet. Note that the NMAA speeds provided were a single average daily speed.

Table 6-2 Piedmont Triad Regional Model and NMAA Speeds for Triad (miles/hour) - Area 2

Modeled speeds for Area 2 - Triad													
County	**Year**	**RI**	**ROPA**	**RMinArt**	**RMjrColl**	**RMinColl**	**RL**	**UI**	**UF**	**UOPA**	**UMinArt**	**UColl**	**UL**
Forsyth	2015	0	62	47	37	35	35	61	56	32	34	31	29
Guilford	2015	61	48	37	37	37	44	63	55	33	31	29	24
Davidson	2015	69	35	45	34	33	31	69	42	33	31	30	29
Non-Modeled speeds for Area 2 - Triad													
County	**Year**	**RI**	**ROPA**	**RMinArt**	**RMjrColl**	**RMinColl**	**RL**	**UI**	**UF**	**UOPA**	**UMinArt**	**UColl**	**UL**
Davidson	2015	66	46	44	43	42	42	62	56	29	32	30	31

The MPOs provided the Triangle Regional Model (TRM) speed data for Area 3. The TRM contains three travel periods, AM peak, Off-Peak (OP) and PM peak, similar to the Metrolina area with the only difference being that the Metrolina area had 4 peak travel periods per day. Table 6-3 lists the speeds.

Table 6-3 Triangle Regional Model Period Specific Speeds for Triangle (miles/hour) – Area 3

County	Year	Period	RI	ROPA	RMinArt	RMjrColl	RMinColl	RL	UI	UF	UOPA	UMinArt	UColl	UL
Chatham	**2014**	AM	NA	57	47	45	41	22	NA	NA	55	31	48	43
		OP	NA	56	47	44	40	22	NA	NA	54	28	46	43
		PM	NA	57	48	45	41	21	NA	NA	56	39	51	43
Durham	**2014**	AM	70	44	53	44	41	27	63	53	39	38	40	22
		OP	68	43	51	42	41	28	59	50	35	36	38	22
		PM	71	46	56	47	42	27	66	57	42	40	42	22
Franklin	**2014**	AM	NA	60	54	51	46	23	NA	NA	52	43	42	21
		OP	NA	59	54	51	45	23	NA	NA	51	41	42	21
		PM	NA	60	55	52	46	23	NA	NA	53	45	43	21
Granville	**2014**	AM	71	50	36	45	42	24	NA	NA	NA	31	46	NA
		OP	69	50	35	45	42	24	NA	NA	NA	30	45	NA
		PM	71	50	40	46	43	24	NA	NA	NA	36	47	NA
Johnston	**2014**	AM	71	59	53	51	45	24	68	NA	40	44	42	24
		OP	70	57	53	50	44	24	66	NA	37	42	40	24
		PM	70	60	54	53	45	24	69	NA	42	46	44	24
Orange	**2014**	AM	69	NA	52	47	41	24	66	40	34	34	38	22
		OP	66	NA	51	47	41	24	59	37	31	32	37	22
		PM	68	NA	53	48	42	24	68	45	38	37	39	22

The NCDOT provided speed data for the NMAA portions of Franklin, Granville, and Johnston counties. The NMAA speed data, unlike the TRM speed data, was provided as daily average speeds categorized by roadway functional class. Table 6-4 lists all NMAA speeds for the Triangle counties not fully covered by the TRM for 2013. Speed data in table 6-3 and 6-4 are from the Supplement to the Redesignation Demonstration and Maintenance Plan for Raleigh-Durham-Chapel Hill, NC 1997 8-hour Ozone Nonattainment Area.

Table 6-4 NMAA Speeds for the Triangle Counties Partially Covered by TRM

County	Year	RI	ROPA	RMinArt	RMjrColl	RMinColl	RL	UI	UF	UOPA	UMinArt	UColl	UL
Franklin	2014	NA	47	44	43	42	42	NA	NA	29	32	NA	31
Granville	2014	66	46	44	43	42	42	63	NA	29	32	31	31
Johnston	2014	66	47	44	43	42	42	63	NA	29	31	31	31

Table 6-5 lists the speeds for the remaining 31 NMAA counties within Area 3. Wake county OP speeds were used as a daily average speeds for the remaining I/M counties not covered by a TDM.

Table 6-5 NMAA Speeds for Remaining I/M Counties - Area 3 (miles/hour)

County	Year	RI	ROPA	RMinArt	RMjrColl	RMinColl	RL	UI	UF	UOPA	UMinArt	UColl	UL
Alamance	2014	68	65	48	48	38	26	65	61	49	43	41	24
Brunswick	2014	68	65	48	48	38	26	65	61	49	43	41	24
Buncombe	2014	68	65	48	48	38	26	65	61	49	43	41	24
Burke	2014	68	65	48	48	38	26	65	61	49	43	41	24
Caldwell	2014	68	65	48	48	38	26	65	61	49	43	41	24
Carteret	2014	68	65	48	48	38	26	65	61	49	43	41	24
Catawba	2014	68	65	48	48	38	26	65	61	49	43	41	24
Cleveland	2014	68	65	48	48	38	26	65	61	49	43	41	24
Craven	2014	68	65	48	48	38	26	65	61	49	43	41	24
Cumberland	2014	68	65	48	48	38	26	65	61	49	43	41	24
Edgecombe	2014	68	65	48	48	38	26	65	61	49	43	41	24
Harnett	2014	68	65	48	48	38	26	65	61	49	43	41	24
Haywood	2014	68	65	48	48	38	26	65	61	49	43	41	24
Henderson	2014	68	65	48	48	38	26	65	61	49	43	41	24
Lee	2014	68	65	48	48	38	26	65	61	49	43	41	24
Lenoir	2014	68	65	48	48	38	26	65	61	49	43	41	24
Moore	2014	68	65	48	48	38	26	65	61	49	43	41	24
Nash	2014	68	65	48	48	38	26	65	61	49	43	41	24
New Hanover	2014	68	65	48	48	38	26	65	61	49	43	41	24

Table 6-5 NMAA Speeds for Remaining I/M Counties - Area 3 (miles/hour)

County	Year	RI	ROPA	RMinArt	RMjrColl	RMinColl	RL	UI	UF	UOPA	UMinArt	UColl	UL
Onslow	2014	68	65	48	48	38	26	65	61	49	43	41	24
Pitt	2014	68	65	48	48	38	26	65	61	49	43	41	24
Randolph	2014	68	65	48	48	38	26	65	61	49	43	41	24
Robeson	2014	68	65	48	48	38	26	65	61	49	43	41	24
Rockingham	2014	68	65	48	48	38	26	65	61	49	43	41	24
Rutherford	2014	68	65	48	48	38	26	65	61	49	43	41	24
Stanly	2014	68	65	48	48	38	26	65	61	49	43	41	24
Stokes	2014	68	65	48	48	38	26	65	61	49	43	41	24
Surry	2014	68	65	48	48	38	26	65	61	49	43	41	24
Wayne	2014	68	65	48	48	38	26	65	61	49	43	41	24
Wilkes	2014	68	65	48	48	38	26	65	61	49	43	41	24
Wilson	2014	68	65	48	48	38	26	65	61	49	43	41	24

Average Speed Distribution Calculations

To generate the MOVES average speed distribution tables from the speed and VMT data discussed earlier, the NCDAQ used spreadsheet-based tools developed by NCDAQ and USEPA to perform the calculation procedures described below.

MOVES uses four different roadway type categories that are affected by the average speed distribution input: rural restricted access, rural unrestricted access, urban restricted access, and urban unrestricted access (these road types are discussed in more detail in Section 6.2.6). In MOVES, local roadways are included with arterials and collectors in the urban and rural unrestricted access roads category. The USEPA recommends that the average speed distribution for local roadway activity be included as part of a weighted distribution of average speed across all unrestricted roads along with the distribution of average speeds for arterials and connectors.

When only a single average speed is available for a specific road type and that average speed is not identical to the average speed in a particular speed bin, MOVES guidance stipulates that users apply the following formula for creating the appropriate speed distribution among two adjacent speed bins.

The general formula is:

VHT Fraction A in Speed Bin with closest average speed lower than observed average speed +

VHT Fraction B in Speed Bin with closest average speed higher that observed average speed = 1

VHT Fraction $A_{(low\ bin)}$ *= 1 – [(observed average speed – average speed of lower speed bin) / (average speed of higher speed bin – average speed of lower speed bin)]*

VHT Fraction $B_{(high\ bin)}$ *= 1 – [(average speed of higher speed bin – observed average speed) / (average speed of higher speed bin – average speed of lower speed bin)]*

Or more simply: VHT Fraction B = 1 – VHT fraction A

The following is an example of applying the above equations. If the single average speed for a roadway is 58 miles per hour, the average speed distribution will be split between the 55 and 60 mph speed bins. The appropriate VHT fractions are found with the following equations:

VHT fraction $A_{(low\ bin)}$ *= 1 – [(58 mph Avg. Speed – 55 mph (Bin Speed)) / (60 mph (Bin Speed) – 55 mph (Bin Speed)] = 0.4*

VHT fraction $B_{(high\ bin)}$ *= 1 – [(60 mph (Bin Speed) – 58 mph Avg. Speed) / (60 mph (Bin Speed) – 55 mph (Bin Speed)] = 0.6*

$$VHT\ Fraction\ A_{(low\ bin)} + VHT\ Fraction\ B_{(high\ bin)} = 1$$
$$0.4 + 0.6 = 1$$

As stated above, MOVES uses only four different roadway types: rural restricted access, rural unrestricted access, urban restricted access and urban unrestricted access. This means that the speeds for multiple roadway types need to be combined into the appropriate speed bins. To create the speed bin fractions for combined roadways, the VMT for each roadway is used to weight the speed bin fraction. For example, below are speeds and VMT for urban restricted access road types:

Road type	Speed (miles/hour)	VMT (hourly miles)
Urban Interstate	63	250,000
Urban Freeway	56	100,000

The first step is to determine the speed bin fractions for each road type separately. For the urban interstate road type, the speed 63 miles/hour is split between the MOVES speed bins of 60 and 65 as described above, which results in the VHT fractions of 0.4 and 0.6 for speed bins 60 and 65, respectively. Similarly, the speed for the urban freeway road type (56 miles/hour) is split between the MOVES speed bins of 55 and 60 and results in the VHT fractions of 0.8 and 0.2, respectively.

The next step requires road type VMT to weigh the VHT fractions so that the final MOVES speed bin fractions can be developed. The VHT Fraction, specific to the road type and speed bin, is multiplied by the corresponding hourly VMT. These hourly totals are divided by the total VMT for that hour for the road type category (in this example, urban restricted access includes urban interstate and urban freeway). The following equation is used to calculate the combined speed bin fractions:

$$VHT_{(Speed\ Bin\ X)} = \left[\sum (VHT\ Fraction_{(RT)} \times hourly\ VMT_{(RT)})\right] \div \left[\sum hourly\ VMT_{(RT)}\right]$$

Where:

RT = the Highway Performance Monitoring System (HPMS) road type

In this example, the HPMS road types are urban interstate (UI) and urban freeway (UF) and the speed bins are 55, 60 and 65. The following layout summarizes the speed bin fractions for this example.

HPMS Road Type	Speed Bin 55	Speed Bin 60	Speed Bin 65
Urban Interstate	0.0	0.4	0.6
Urban Freeway	0.8	0.2	0.0

Using the equation below, the final MOVES speed bin fractions are calculated for the urban restricted access road type.

$$VHT_{(Speed\ Bin\ X)} = \frac{[(VHT\ Fraction_{(UI)} * hourly\ VMT_{(UI)}) + (VHT\ Fraction_{(UF)} * hourly\ VMT_{(UF)})]}{(hourly\ VMT_{(UI)} + hourly\ VMT_{(UF)})}$$

$$VHT_{(Speed\ Bin\ 55)} = \frac{[(0.0 * 250{,}000) + (0.8 * 100{,}000)]}{(250{,}000 + 100{,}000)}$$

$$VHT_{(Speed\ Bin\ 55)} = \mathbf{0.2286}$$

$$VHT_{(Speed\ Bin\ 60)} = \frac{[(0.4 * 250,000) + (0.2 * 100,000)]}{(250,000 + 100,000)}$$

$$VHT_{(Speed\ Bin\ 60)} = \mathbf{0.3428}$$

$$VHT_{(Speed\ Bin\ 65)} = \frac{[(0.6 * 250,000) + (0.0 * 100,000)]}{(250,000 + 100,000)}$$

$$VHT_{(Speed\ Bin\ 65)} = \mathbf{0.4286}$$

The sum of the VHT fractions for all speed bins within a road type category must add up to 1.0. The hourly VHT fractions by speed bin and road type are then processed through a MOVES supplied converter to develop the speed distribution file by hour and road type.

6.2.2 Vehicle Age Distribution

The age distribution of vehicle fleets can vary significantly from area to area. Fleets with a higher percentage of older vehicles will have higher emissions for two reasons. Older vehicles have typically been driven more miles and have experienced more deterioration in emission control systems. In addition, a higher percentage of older vehicles would imply there are more vehicles in the fleet that do not meet newer more stringent emissions standards. Surveys of registration data indicate considerable local variability in vehicle age distributions.

For SIP and conformity purposes, the USEPA recommends and encourages states to develop local age distributions. The MOVES model categorizes the vehicle fleet into different vehicle classes and more model years than MOBILE6.2. A typical vehicle fleet includes a mix of vehicles of different ages. MOVES covers a 31 year range of vehicle ages, with vehicles 30 years and older grouped together. The MOVES model allows the user to specify the fraction of vehicles in each of 30 vehicle ages for each of the 13 source types in the model.

Since MOVES categorizes the vehicle fleet into different vehicle classes and more model years, the USEPA has created data converters that take registration distribution input files created for MOBILE6.2 and converts them to the appropriate age distribution input tables for MOVES. Local age distributions can be estimated from local vehicle registration data. The vehicle age distribution comes from annual registration data for North Carolina from the NCDOT. For this technical analysis, the age distribution was generated based on 2012 data. The NCDOT provided the data based on the number of vehicle types per year from 1974 through 2012. 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). The data converter was then used to take this information and make it ready as an input for MOVES.

6.2.3 Vehicle Mix Data

Vehicle mix or VMT mix is used by MOVES to convert annual VMT to VMT by HPMS class, VMT fractions by hour, and VMT by road type distribution. The vehicle mix is developed by the same method used in MOBILE6.2, as outlined below. The resulting file is then used in a MOVES supplied converter to develop the VMT by HPMS class, VMT fractions by hour, and VMT by road type distribution. The vehicle mix refers to the percentage of different vehicle types on each of the 12 Federal Highway Administration (FHWA) HPMS road types. These road types are listed above in the speed assumptions section. It is critical for estimating on-road mobile emissions in an area to use data that accurately reflects the vehicles types traveling on each of these different road types.

In August 2004, the USEPA released the guidance document, Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation (EPA420-R-04-013), which outlines how to convert HPMS traffic count data to MOBILE6.2 vehicle mix data. Outlined below is the methodology used to convert the 13 HPMS vehicle types count data reported to FHWA and generate a state specific vehicle mix.

The North Carolina HPMS data used to generate the statewide vehicle mix was based on 2011 count data for the contemporaneous modeling of all three areas for years 2013, 2014 and 2015. Table 6-6 uses the new FHWA Functional Classification designations and the standard FHWA 13 vehicle classification scheme which shows the percent of VMT per vehicle type for each of the 12 road classes.

Table 6-6 North Carolina Vehicle Activity Summary by Functional Classification - 2011

FC	Functional Class	Stations	MC	Cars	2A4T	Bus	2ASU	3ASU	4ASU	4AST	5AST	6AST	5AMT	6AMT	7AMT
1	Rural Interstate	23	0.0038	0.7025	0.1448	0.0057	0.0213	0.0067	0.0003	0.0086	0.1017	0.0011	0.0022	0.0010	0.0002
3	Rural Principal Arterial	164	0.0061	0.6954	0.1959	0.0063	0.0278	0.0068	0.0007	0.0117	0.0459	0.0018	0.0009	0.0003	0.0003
4	Rural Minor Arterial	167	0.0055	0.7172	0.1976	0.0053	0.0256	0.0061	0.0006	0.0088	0.0312	0.0017	0.0001	0.0000	0.0003
5	Rural Major Collector	401	0.0070	0.7057	0.2137	0.0055	0.0276	0.0062	0.0006	0.0086	0.0235	0.0013	0.0000	0.0000	0.0002
6	Rural Minor Collector	25	0.0120	0.6640	0.2178	0.0078	0.0311	0.0105	0.0009	0.0078	0.0455	0.0025	0.0000	0.0000	0.0002
7	Rural Local	52	0.0086	0.7178	0.2046	0.0090	0.0351	0.0103	0.0010	0.0055	0.0069	0.0011	0.0000	0.0000	0.0000
1	Urban Interstate	71	0.0041	0.7579	0.1563	0.0049	0.0182	0.0057	0.0003	0.0039	0.0466	0.0005	0.0011	0.0005	0.0001
2	Urban Principal Arterial - Frwy/Expwy	100	0.0062	0.7360	0.1748	0.0054	0.0217	0.0069	0.0007	0.0100	0.0354	0.0011	0.0012	0.0004	0.0001
3	Urban Principal Arterial	330	0.0053	0.7736	0.1686	0.0048	0.0206	0.0057	0.0010	0.0053	0.0130	0.0014	0.0003	0.0001	0.0003
4	Urban Minor Arterial	231	0.0057	0.7708	0.1772	0.0041	0.0220	0.0048	0.0006	0.0052	0.0085	0.0008	0.0001	0.0000	0.0001
5	Urban Major Collector	37	0.0046	0.7859	0.1688	0.0053	0.0199	0.0043	0.0004	0.0046	0.0055	0.0005	0.0000	0.0000	0.0001
7	Urban Local	23	0.0108	0.7175	0.1976	0.0099	0.0296	0.0130	0.0003	0.0055	0.0152	0.0006	0.0000	0.0002	0.0001

6.2.4 Disaggregating State Specific Vehicle Mix Information for MOVES

The procedures in Section 4.1.4 and 4.1.5 of the Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation were used to create vehicle mix tables used as inputs for VMT converter applications provided by the USEPA. The procedures map the vehicle mixes shown in Section 6.2.3 (12 roadway functional classes, 13 vehicle types) to the mix matrix required for the VMT converter applications (12 roadway functional classes, 16 vehicle types). The process also provides calculation of projected mixes for future years. The resulting vehicle mix tables for years 2013, 2014, and 2015 are presented in Section 7.1.

6.2.5 Vehicles/Equipment: On-Road Vehicle Equipment

The Vehicles/Equipment menu item and panel is used to specify the vehicle types that are included in the MOVES run. The MOVES model allows the user to select from among 13 source use types and 4 different fuel types (gasoline, diesel, compressed natural gas (CNG), and electricity).

For SIP and regional conformity analyses, users must select the appropriate fuel and vehicle type combinations that reflect the full range of vehicles that will operate in each county. In general, all valid diesel, gasoline, and CNG (only transit buses) vehicle and fuel combinations should be selected, unless data is available showing that some vehicles or fuels are not used in the area of analysis.

6.2.6 Road Type

The determination of rural or urban road types should be based on the HPMS classification of the roads in the county being analyzed. The Road Type Panel is used to specify the types of roads that are included in the run. The MOVES model defines five different road types to categorize the roadways used in a particular MOVES run. The five road types are:

- Off-Network (road type 1) – all locations where the predominant activity is vehicle starts, parking and idling (parking lots, truck stops, rest areas, freight or bus terminals)
- Rural Restricted Access (2) – rural highways that can only be accessed by an on-ramp
- Rural Unrestricted Access (3) – all other rural roads (arterials, connectors, and local streets)

- Urban Restricted Access (4) – urban highways or freeways that can only be accessed by an on-ramp

- Urban Unrestricted Access (5) – all other urban roads (arterials, connectors, and local streets).

The NCDAQ followed the USEPA guidance that states that all SIP and regional conformity analyses must include the Off-Network road type in order to account for emissions from vehicle starts, extended idle activity, and evaporative emissions (for VOCs). The Off-Network road type is automatically selected when start or extended idle pollutant processes are chosen and must be selected for all evaporative emissions to be quantified. Off-Network activity in MOVES is primarily determined by the Source Type Population input, which is described in Section 6.2.9 of this document. Some evaporative emissions are estimated on roadways (i.e., road types 2, 3, 4, and 5) to account for evaporative emissions that occur when vehicles are driving. All roads types are automatically selected when Refueling emission processes are selected.

The MOVES model uses Road Type to assign default drive cycles to activity on road types 2, 3, 4, and 5. For example, for unrestricted access road types, MOVES uses drive cycles that assume stop and go driving, including multiple accelerations, decelerations, and short periods of idling. For restricted access road types, MOVES uses drive cycles that include a higher fraction of cruise activity with less time spent accelerating or idling, by default MOVES incorporates some ramp activity as well.

6.2.7 Pollutants and Processes

For this analysis, county-level year specific daily emissions were modeled. In order to account for the complete on-road source emissions, all emission processes generating NOx, VOC, CO and PM2.5 pollutant emissions; including running exhaust, start exhaust, and evaporative processes were incorporated into the model run as required for SIP development.

6.2.8 Temperature and Relative Humidity Data

Local temperature and humidity data are required inputs for SIP development with MOVES. Ambient temperature is a key factor in estimating emission rates for on-road vehicles for all pollutant processes. Relative humidity is also important for estimating NOx emissions from motor vehicles. The MOVES model requires a temperature (in degrees Fahrenheit) and relative humidity (in percent – 0 to 100 Scale) for each clock hour. For example, MOVES requires a 24-hour temperature and relative humidity profile to model a full day of emissions on an hourly basis. For the technical analysis a typical January and July monthly average 24-hour temperature and relative humidity profiles from twelve distinct meteorology zones representative of the 48 I/M counties were applied. The source of the meteorology was specific to the years for I/M modeling for each of the three areas, as summarized earlier in Table 3-3. The data was pulled from airport weather stations referred to as "Met_Station_Name" listed by Meteorology Zone ID below in Table 6-7. The input data tables used in the MOVES modeling are listed in Section 7.2.

Table 6-7 Metrology Stations Assigned to I/M Counties

County	FIPS	MET_Zone_ID	MET_Station_Name
BUNCOMBE	37021	2	Asheville Airport
HAYWOOD	37087	2	Asheville Airport
HENDERSON	37089	2	Asheville Airport
RUTHERFORD	37161	4	Rutherford County Airport
BURKE	37023	5	Hickory Airport
CALDWELL	37027	5	Hickory Airport
CATAWBA	37035	5	Hickory Airport
SURRY	37171	6	Wilkes County Airport
WILKES	37193	6	Wilkes County Airport
ALAMANCE	37001	7	Piedmont Triad International Airport
DAVIDSON	37057	7	Piedmont Triad International Airport
FORSYTH	37067	7	Piedmont Triad International Airport
GUILFORD	37081	7	Piedmont Triad International Airport
RANDOLPH	37151	7	Piedmont Triad International Airport
ROCKINGHAM	37157	7	Piedmont Triad International Airport
STOKES	37169	7	Piedmont Triad International Airport
CABARRUS	37025	8	Charlotte / Douglas International Airport
CLEVELAND	37045	8	Charlotte / Douglas International Airport
GASTON	37071	8	Charlotte / Douglas International Airport
IREDELL	37097	8	Charlotte / Douglas International Airport
LINCOLN	37109	8	Charlotte / Douglas International Airport
MECKLENBURG	37119	8	Charlotte / Douglas International Airport
ROWAN	37159	8	Charlotte / Douglas International Airport
STANLY	37167	8	Charlotte / Douglas International Airport
UNION	37179	8	Charlotte / Douglas International Airport
CHATHAM	37037	9	Raleigh-Durham International Airport
DURHAM	37063	9	Raleigh-Durham International Airport
FRANKLIN	37069	9	Raleigh-Durham International Airport
GRANVILLE	37077	9	Raleigh-Durham International Airport

Table 6-7 Metrology Stations Assigned to I/M Counties

County	FIPS	MET_Zone_ID	MET_Station_Name
JOHNSTON	37101	9	Raleigh-Durham International Airport
ORANGE	37135	9	Raleigh-Durham International Airport
WAKE	37183	9	Raleigh-Durham International Airport
CUMBERLAND	37051	10	Fayetteville Regional Airport
HARNETT	37085	10	Fayetteville Regional Airport
LEE	37105	10	Fayetteville Regional Airport
MOORE	37125	10	Fayetteville Regional Airport
ROBESON	37155	10	Fayetteville Regional Airport
EDGECOMBE	37065	11	Rocky Mount-Wilson Regional Airport
NASH	37127	11	Rocky Mount-Wilson Regional Airport
WILSON	37195	11	Rocky Mount-Wilson Regional Airport
LENOIR	37107	12	Greenville Airport
PITT	37147	12	Greenville Airport
WAYNE	37191	12	Greenville Airport
BRUNSWICK	37019	14	Wilmington International Airport
NEW HANOVER	37129	14	Wilmington International Airport
ONSLOW	37133	14	Wilmington International Airport
CARTERET	37031	15	Craven County Airport
CRAVEN	37049	15	Craven County Airport

6.2.9 Source Type Population

Source type (i.e., vehicle type) population is used by MOVES to calculate start and evaporative emissions. In MOVES, start and resting evaporative emissions are related to the population of vehicles in an area. Since vehicle type population directly determines start and evaporative emission, users must develop local data for this input.

The MOVES model uses a vehicle classification system based on the way vehicles are classified in the Federal Highway Administration's HPMS rather than on the way they are classified in the USEPA emissions regulations; thus making it easier for users to develop local data for MOVES. The MOVES model categorizes vehicles into 13 source types, which are subsets of the 6 HPMS vehicle types in MOVES, as shown in the crosswalk in Table 6-8. The USEPA believes that states should be able to develop population data for many of these source type categories from state motor vehicle registration data (e.g., motorcycles, passenger cars, passenger trucks, light commercial trucks) and from local transit agencies, school districts, bus companies, and refuse haulers (intercity, transit, and school buses, and refuse trucks). The NCDOT supplied the NCDAQ with source population data as described in the following section.

Table 6-8 MOVES Source Types and HPMS Vehicle Types

Source Type ID	Source Types	HPMS Vehicle Type ID	HPMS Vehicle Type
11	Motorcycle	10	Motorcycles
21	Passenger Car	20	Passenger Cars
31	Passenger Truck	30	Other 2 axle-4 tire vehicles
32	Light Commercial Truck	30	Other 2 axle-4 tire vehicles
41	Intercity Bus	40	Buses
42	Transit Bus	40	Buses
43	School Bus	40	Buses
51	Refuse Truck	50	Single Unit Trucks
52	Single Unit Short-haul Truck	50	Single Unit Trucks
53	Single Unit Long-haul Truck	50	Single Unit Trucks
54	Motor Home	50	Single Unit Trucks
61	Combination Short-haul Truck	60	Combination Trucks
62	Combination Long-haul Truck	60	Combination Trucks

Source Type Population – Local Data

The MOVES model uses allocation factors to distribute emissions and activity (such as vehicle type populations) to individual counties. The NCDAQ is committed to using representative local data which will override MOVES default values through the County Data Manager. This decision was based on the fact that default allocation factors used in MOVES are derived from the VMT. Since the allocations are based on VMT, the vehicle populations allocated to counties are proportional to the VMT being allocated to that county. The NCDAQ corresponded with the USEPA Office of Transportation and Air Quality (OTAQ) to arrive at an acceptable method to allocate current year vehicle populations, as well as to project future year vehicle populations, to source type populations. The NCDAQ believes that using MOVES default vehicle population to estimate a fraction is the best method of taking state specific vehicle registration data and allocating county total vehicles to specific vehicle source types.

The MOVES model categorizes vehicles into 13 source types, which are subsets of 6 HPMS vehicle types. Presently NCDAQ is unable to develop county source type population data for many of these source type categories based on how the NCDOT collects vehicle registration data. The latest vehicle registration data broken down by county and towns is available by January of each year. Since the vehicle type database available from NCDOT differs from what is required for MOVES2010b, the NCDAQ relies on MOVES default fractions and applies these fractions to county total vehicle population, not including registered trailers. It is assumed that trailers do not have engines and do not generate emissions.

For future year MOVES runs, the NCDAQ needed to be able to grow the vehicle population reflective of the county of interest. From FHWA Highway Statistics graph of Licensed Drivers, Vehicle Registrations, and Resident Population, the NCDAQ has determined that growth in human population is a better indicator of growth in vehicle ownership as compared to VMT growth.

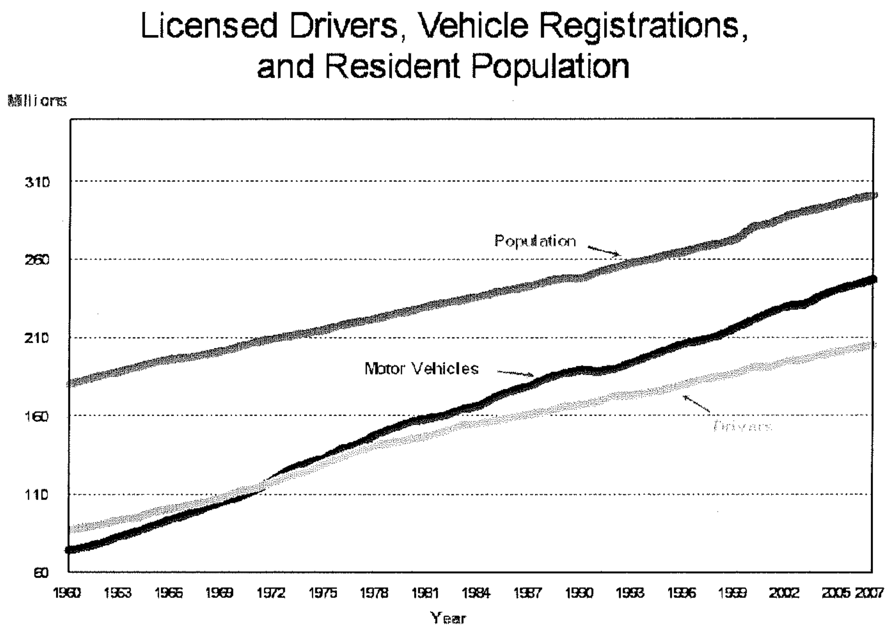

Figure 6-1 Federal Highway Association Statistics Graph

In order to forecast future year vehicle population and disaggregate to the appropriate source type, a reliable source of county population is needed. The North Carolina Office of State Budget and Management (OSBM) coordinates with the Census in the Federal State Cooperative Program for population estimates for all state government data, with special emphasis on a consistent set of population projections. On the OSBM website are certified annual county population estimates which account for births, deaths and natural growth representing a net migration populous at the county level.

Population data is updated annually in May and certified by September for the previous year's data. Projected annual county population estimates are available to adjust future year county vehicle populations as needed. The USEPA has indicated that using human population growth as a surrogate to project vehicle population growth is an acceptable option. For this technical analysis the North Carolina DMV provided 2012 vehicle registration data and the OSBM provided future year annual county populations for 2013, 2014, and 2015 based on the 2011 certified database. An example of how a 2012 vehicle population would be grown to 2015 based on this surrogate of projected county population follows:

$$\text{Vehicle Pop}_{2015} = \text{Vehicle Pop}_{2012} * (\text{Human Pop}_{2015} / \text{Human Pop}_{2012})$$

6.2.10 Vehicle Inspection and Maintenance Program Parameters

In 2002, North Carolina implemented an innovative emission I/M Program based on vehicle onboard diagnostics (OBDII). This program covers all light duty gasoline powered vehicles (designated in MOVES as source type IDs 21, 31, and 32) that are model year 1996 and newer. The program was initially implemented in 9 counties and was later expanded to include a total of 48 counties between July 2002 and January 2006. In addition, the inspection stations are required to administer an anti-tampering check to ensure that emissions control equipment on any vehicle 35 years old or newer has not been altered.

For this technical analysis MOVES modeling was run for all 48 I/M counties for two I/M scenarios; the current and the target I/M Program. The purpose of the two scenarios was to demonstrate that the legislative changes to the current I/M Program would not increase emissions of criteria pollutants if balanced by increasing compliance rate. An emissions difference was measured based on MOVES results from the current program with a compliance factor (CF) of 95 percent and waiver rate (WR) of 5 percent to the target I/M Program with CF = 96 percent and WR = 5 percent, summarized earlier in Table 3-2. For each year modeled, the appropriate endModelYearID value was specified either to account for exemption of only the current model year vehicles or a three model year (MY) exemption from the I/M Program. For example, if the year 2013 was modeled, the endModelYearID value was set to 2012 as required in the current approved I/M SIP. The proposed I/M SIP changes would dictate an endModelYearID set to 2010 for modeling 2013 and exempting the most recent 3 MY vehicles.

6.2.11 Reid Vapor Pressure Specifications

Reid Vapor Pressure (RVP) is a measurement of gasoline volatility. The use of lower RVP gasoline leads to lower VOC emissions from gasoline handling and evaporative VOC emissions from motor vehicles. Gasoline with an RVP of 7.8 pounds per square inch (psi) is required in

I/M Program counties Davidson, Durham, Forsyth, Gaston, Guilford, Mecklenburg and Wake during the months of June through September. Gasoline with an RVP of 9.0 psi is required for months during May through September for the remaining 41 I/M Program counties. Table 6-9 lists the monthly requisite RVPs for the technical analysis.

6-9 Monthly Reid Vapor Pressure

Month	RVP	Area
January	15.0	Statewide
February	13.5	Statewide
March	13.5	Statewide
April	13.5	Statewide
May	9.0	Statewide
June - September	9 (7.8*)	Statewide
October	13.5	Statewide
November	13.5	Statewide
December	15.0	Statewide
*** I/M counties of Davidson, Durham, Forsyth, Gaston, Guilford, Mecklenburg, and Wake.**		

6.2.12 Diesel Sulfur Content

The diesel fuel sulfur content is required in MOVES to generate fine particulate matter emission because the amount of sulfur in diesel fuel directly correlates to sulfate particulate emissions. The USEPA recommends a diesel fuel sulfur content of 43 parts per million (ppm) for the period June 2006 through May 2010 and 11ppm for June 2010 through 2017.

6.2.13 Fuel (Formulation and Supply)

In general, users should first review the MOVES default fuel formulation and fuel supply data, and then make changes only where local volumetric fuel property information is available. The lone exception to this guidance is in the case of RVP where a user should change the value to reflect the regulatory requirements and differences between ethanol and non-ethanol blended gasoline. The current version of MOVES does not allow the user to create new fuel identification numbers. Thus, in accordance with current USEPA guidance, the NCDAQ edited the default fuel supply tables for the individual counties to reflect the county-specific RVP data.

6.2.14 VMT Data

The Travel Demand Model (TDM) data of daily VMT was provided to NCDAQ from the MPOs prior to this analysis for SIP modeling purposes. For the remaining I/M counties either attaining the NAAQS or not fully covered by a TDM, average annual daily HPMS was used. The NCDOT provided daily VMT data for the NMAA portions of Davidson, Franklin, Granville, and Johnston Counties. The NMAA VMT values were calculated by scaling the HPMS county-level VMT by the fraction of the county human population within the NMAA area:

$$VMT_{NMAA} = VMT_{county} * (Population_{NMAA} / Population_{county})$$

Tables 6-10 through 6-13 list the VMT data for the I/M technical analysis areas by county. The values represent the average annual daily vehicle miles traveled (AADVMT) for the specified county/road type/travel period designation. The road types used in the modeling are listed below.

RI	Rural Interstate
ROPA	Rural Other Principle Arterial
RMinArt	Rural Minor Arterial
RMjrColl	Rural Major Collector
RMinColl	Rural Minor Collector
RL	Rural Local
UI	Urban Interstate
UF	Urban Freeway & Expressway
UOPA	Urban Other Principal Arterial
UMinArt	Urban Minor Arterial
UColl	Urban Collector
UL	Urban Local

Table 6-10 2013 Average Annual Daily VMT for Area 1 - Metrolina Counties

Roadtype	AM Peak	Midday	PM Peak	Night	Daily
	Cabarrus				
Rural Interstate	0	0	0	0	0
Rural Principal Arterial	39,690	49,744	43,924	29,564	162,922
Rural Minor Arterial	57,579	66,303	63,817	40,285	227,983
Rural Major Collector	96,286	122,000	107,152	69,310	394,749
Rural Minor Collector	62,542	76,133	77,570	39,591	255,837
Rural Local	112,935	160,718	135,518	86,098	495,269
Urban Interstate	305,951	396,182	327,132	223,159	1,252,425

Table 6-10 2013 Average Annual Daily VMT for Area 1 - Metrolina Counties

Roadtype	AM Peak	Midday	PM Peak	Night	Daily
Urban Freeway/Xprway	0	0	0	0	0
Urban Principal Arterial	192,786	285,433	224,489	166,822	869,530
Urban Minor Arterial	202,876	302,243	229,675	168,931	903,725
Urban Collector	152,677	230,977	182,953	107,757	674,364
Urban Local	206,400	332,279	244,643	163,129	946,452
	Gaston				
Rural Interstate	39,920	46,879	42,542	26,866	156,208
Rural Principal Arterial	57,530	60,049	59,597	38,012	215,188
Rural Minor Arterial	71,617	85,918	78,877	47,154	283,566
Rural Major Collector	85,009	107,250	99,803	63,740	355,803
Rural Minor Collector	43,389	49,328	53,106	26,419	172,241
Rural Local	75,729	106,826	91,902	57,861	332,319
Urban Interstate	473,043	576,738	505,107	351,848	1,906,735
Urban Freeway/Xprway	24,520	29,373	25,343	17,972	97,208
Urban Principal Arterial	285,899	393,624	326,360	226,281	1,232,163
Urban Minor Arterial	222,284	319,668	260,111	182,535	984,598
Urban Collector	61,364	83,850	73,860	43,295	262,370
Urban Local	216,940	342,924	253,970	179,110	992,944
	Iredell				
Rural Interstate	60,907	79,552	63,384	41,332	245,175
Rural Principal Arterial	0	0	0	0	0
Rural Minor Arterial	18,078	28,512	20,174	18,321	85,086
Rural Major Collector	40,694	59,367	46,413	34,379	180,853
Rural Minor Collector	52,559	72,863	60,697	35,499	221,617
Rural Local	115,046	175,266	134,567	88,827	513,706
Urban Interstate	231,120	328,445	247,783	184,652	992,000
Urban Freeway/Xprway	0	0	0	0	0
Urban Principal Arterial	32,272	53,161	37,476	29,999	152,908
Urban Minor Arterial	42,380	65,741	47,876	37,799	193,796
Urban Collector	54,385	88,086	62,687	42,526	247,685
Urban Local	91,890	157,637	109,768	72,838	432,133
	Lincoln				
Rural Interstate	0	0	0	0	0
Rural Principal Arterial	23,188	29,615	24,716	16,393	93,912
Rural Minor Arterial	107,645	144,944	117,874	83,754	454,217
Rural Major Collector	54,304	68,830	61,370	38,898	223,402

Table 6-10 2013 Average Annual Daily VMT for Area 1 - Metrolina Counties

Roadtype	AM Peak	Midday	PM Peak	Night	Daily
Rural Minor Collector	56,727	64,637	63,750	34,462	219,575
Rural Local	144,169	208,472	169,443	110,220	632,304
Urban Interstate	0	0	0	0	0
Urban Freeway/Xprway	54,822	62,997	58,679	34,685	211,183
Urban Principal Arterial	28,570	40,195	31,988	22,408	123,161
Urban Minor Arterial	68,337	98,137	75,567	61,732	303,774
Urban Collector	19,293	27,097	22,974	14,202	83,567
Urban Local	44,890	71,428	52,948	37,697	206,963
	Mecklenburg				
Rural Principal Arterial	41,842	52,184	47,660	31,107	172,793
Rural Minor Arterial	18,110	22,074	21,075	14,584	75,844
Rural Major Collector	17,717	24,810	21,328	11,914	75,769
Rural Minor Collector	35,360	45,669	44,763	23,383	149,174
Rural Local	80,837	113,409	98,815	52,845	345,905
Urban Interstate	1,790,341	2,359,615	1,968,068	1,364,383	7,482,406
Urban Freeway/Xprway	1,159,775	1,468,138	1,341,647	764,373	4,733,934
Urban Principal Arterial	1,160,728	1,761,649	1,352,005	984,438	5,258,820
Urban Minor Arterial	1,074,833	1,629,080	1,260,429	877,703	4,842,045
Urban Collector	841,681	1,267,545	983,510	675,933	3,768,668
Urban Local	1,536,645	2,471,519	1,828,373	1,188,629	7,025,167
Urban HOV	17,602	303	7,967	0	25,873
Roadtype	**Rowan**				
Rural Interstate	0	0	0	0	0
Rural Principal Arterial	38,819	48,803	42,594	25,946	156,161
Rural Minor Arterial	23,678	31,776	26,484	20,031	101,969
Rural Major Collector	129,431	151,206	142,099	92,222	514,958
Rural Minor Collector	89,551	99,045	101,577	51,814	341,986
Rural Local	127,858	170,928	147,212	95,977	541,975
Urban Interstate	359,744	444,089	388,311	256,404	1,448,548
Urban Freeway/Xprway	0	0	0	0	0
Urban Principal Arterial	115,437	165,808	130,437	92,105	503,787
Urban Minor Arterial	127,918	192,234	147,426	108,655	576,233
Urban Collector	128,048	176,700	150,249	93,242	548,239
Urban Local	171,846	269,386	201,954	135,967	779,152
	Union				
Rural Interstate	0	0	0	0	0

Table 6-10 2013 Average Annual Daily VMT for Area 1 - Metrolina Counties

Roadtype	AM Peak	Midday	PM Peak	Night	Daily
Rural Principal Arterial	70,096	96,044	75,072	53,588	294,799
Rural Minor Arterial	24,786	32,658	29,029	18,953	105,426
Rural Major Collector	252,669	351,610	283,699	200,275	1,088,252
Rural Minor Collector	80,709	104,375	93,854	54,951	333,889
Rural Local	300,162	408,814	349,995	206,434	1,265,405
Urban Interstate	0	0	0	0	0
Urban Freeway/Xprway	22,998	30,410	22,674	16,605	92,687
Urban Principal Arterial	149,005	214,505	164,498	120,074	648,082
Urban Minor Arterial	102,821	155,838	118,260	93,893	470,812
Urban Collector	123,687	178,885	141,387	91,287	535,246
Urban Local	225,374	347,969	265,295	179,610	1,018,248

Table 6-11 2015 Average Annual Daily VMT for Area 2 - Triad Counties

	County	Davidson	Davidson	Forsyth	Guilford
Type/Period	**Road Type**	**2015**	**2015**	**2015**	**2015**
TDM/Daily	UI	294,260		1,792,305	3,788,027
	UF	689,389		2,928,881	1,788,735
	UOPA	318,748		254,817	1,939,286
	UMinArt	218,710		1,337,790	2,460,938
	UColl	125,159		1,370,449	1,084,833
	UL	137,154		1,074,240	561,842
	RI	274,178		0	899,525
	ROPA	676		101,431	426,729
	RMinArt	306,219		137,283	223,163
	RMjrColl	77,108		38,349	542,055
	RMinColl	71,251		87,249	219,970
	RL	206,695		91,945	333,723
NMAA/Daily	UI		342,847		
	UF		260,587		
	UOPA		175,980		
	UMinArt		218,130		
	UColl		124,693		
	UL		154,231		
	RI		205,483		
	ROPA		64,656		
	RMinArt		171,223		
	RMjrColl		176,390		
	RMinColl		102,134		
	RL		226,595		
County Total VMT		**2,719,547**	**2,222,949**	**9,214,741**	**14,268,827**

Table 6-12 2014 Average Annual Daily VMT for Area 3 - Triangle Counties

	County	Chatham	Durham	Franklin	Granville	Johnston	Orange	Wake
	Road Type	TRM						
AM	UI	0	640,417	0	0	54,031	246,374	1,823,471
AM	UF	0	443,311	0	0	0	95,273	496,784
AM	UOPA	8,605	272,114	42,997	0	72,130	108,370	1,374,694
AM	UMinArt	3,591	395,762	16,522	3,179	63,693	136,569	1,573,250
AM	UColl	3,208	157,963	5,478	9,185	29,032	23,834	654,914
AM	UL	32	327,679	11,665	0	69,869	109,204	1,333,956
AM	RI	0	35,648	0	100,986	408,840	295,992	9,993
AM	ROPA	137,863	7,998	50,985	1,703	197,424	0	34,968
AM	RMinArt	7,961	49,701	87,382	1,285	65,417	39,226	25,684
AM	RMjrColl	58,579	44,610	62,062	98,602	245,820	84,168	44,269
AM	RMinColl	16,428	10,315	33,253	30,035	56,484	51,392	17,374
AM	RL	68,427	35,979	63,094	60,942	187,586	76,010	68,872
OP	UI	0	1,168,731	0	0	110,133	501,224	2,990,054
OP	UF	0	693,973	0	0	0	148,172	775,902
OP	UOPA	12,583	419,458	69,072	0	109,989	166,844	2,225,635
OP	UMinArt	4,471	574,068	25,188	4,416	91,920	195,786	2,286,606
OP	UColl	4,116	225,702	8,125	12,424	41,279	30,503	900,642
OP	UL	37	472,697	17,041	0	99,161	144,966	1,824,121
OP	RI	0	66,370	0	225,820	1,263,880	657,703	9,428
OP	ROPA	246,081	11,708	87,233	2,638	376,787	0	66,797
OP	RMinArt	12,510	61,668	138,639	1,923	95,745	71,697	33,815
OP	RMjrColl	90,239	61,108	97,581	167,640	359,629	121,801	71,652
OP	RMinColl	23,020	14,833	46,368	40,543	75,760	77,300	23,042
OP	RL	92,864	46,303	87,765	88,265	249,605	106,449	84,440
PM	UI	0	807,441	0	0	69,667	333,540	2,210,569
PM	UF	0	522,281	0	0	0	111,808	614,552
PM	UOPA	9,984	332,468	52,395	0	90,229	130,839	1,678,995
PM	UMinArt	4,918	501,439	21,380	3,875	77,194	178,208	1,957,105
PM	UColl	4,337	204,362	6,971	11,106	37,986	33,573	826,226
PM	UL	61	429,485	14,805	0	92,805	146,488	1,719,024
PM	RI	0	46,249	0	142,305	672,378	406,972	12,850
PM	ROPA	178,824	9,299	64,537	2,227	241,878	0	46,473
PM	RMinArt	9,735	57,097	110,754	1,509	82,077	52,917	33,682
PM	RMjrColl	83,000	56,484	79,241	125,613	313,052	111,363	55,308
PM	RMinColl	21,163	13,265	40,085	37,826	72,254	67,825	23,169
PM	RL	89,940	48,076	80,126	77,025	237,621	97,299	92,128

Table 6-12 2014 Average Annual Daily VMT for Area 3 - Triangle Counties

	County	Chatham	Durham	Franklin	Granville	Johnston	Orange	Wake
	NMAA							
Daily	UI	0	0	0	55,939	91,238	0	0
Daily	UF	0	0	0	0	0	0	0
Daily	UOPA	0	0	12,255	27,480	52,654	0	0
Daily	UMinArt	0	0	7,830	39,802	70,792	0	0
Daily	UColl	0	0	0	23,564	14,717	0	0
Daily	UL	0	0	3,410	12,291	16,255	0	0
Daily	RI	0	0	0	229,136	230,850	0	0
Daily	ROPA	0	0	26,278	12,153	93,780	0	0
Daily	RMinArt	0	0	40,337	22,630	35,411	0	0
Daily	RMjrColl	0	0	41,258	156,868	128,856	0	0
Daily	RMinColl	0	0	30,672	62,292	37,489	0	0
Daily	RL	0	0	23,287	67,528	141,160	0	0
County Total VMT		1,192,577	9,266,062	1,606,071	1,960,755	7,224,557	5,159,689	28,020,444

Table 6-13 2014 HPMS Average Annual Daily VMT for Area 3 - Remaining Counties

	Federal Functional Road Classification											
County	RI	ROPA	RMinArt	RMjrColl	RMinColl	RL	UI	UF	UOPA	UMinArt	UColl	UL
Alamance	121,717	2	191,001	275,395	175,196	334,489	1,575,585	0	246,708	629,530	503,401	371,837
Brunswick	923	885,669	202,267	645,214	39,747	502,880	0	292,193	151,194	117,613	260,149	255,434
Buncombe	0	4	72,659	145,048	63,752	338,272	2,772,042	614,181	1,158,611	902,620	435,863	987,943
Burke	91,302	727	204,357	57,521	112,046	236,162	970,833	11,147	245,350	445,873	138,001	213,210
Caldwell	0	121,018	94,628	44,399	64,379	345,685	0	70,413	609,241	267,788	182,368	353,625
Carteret	0	272,487	49,552	293,340	10,352	110,947	0	0	618,616	218,906	60,218	123,085
Catawba	98,118	210,358	287,054	92,282	289,228	320,555	797,066	281,184	774,523	695,209	212,548	539,504
Cleveland	331,651	316,344	172,497	336,308	118,670	296,567	0	333,061	275,818	254,237	57,168	124,050
Craven	82,306	362,562	590	632,629	74,272	579,151	0	267,397	870,652	187,643	91,082	237,287
Cumberland	769,336	274,015	248,244	266,224	184,971	695,635	824,281	781,796	3,151,647	2,572,053	481,224	2,181,467
Edgecombe	48	302,706	119,400	366,954	142,418	103,351	0	193,895	105,799	156,370	34,457	47,437
Harnett	229,985	430,444	192,665	525,718	203,797	312,153	153,054	0	115,616	70,691	75,387	58,379
Haywood	515,954	4	165,418	56,806	17,395	235,265	529,171	404,847	208,259	260,601	42,955	183,424
Henderson	128,659	75,938	180,921	73,717	30,911	311,407	659,027	0	396,944	306,155	201,523	240,956
Lee	0	424,927	37,040	136,360	58,400	96,651	0	150,819	228,426	196,416	65,451	78,914
Lenoir	0	299,488	202,951	310,414	93,841	182,027	0	0	331,302	109,804	147,613	76,459
Moore	0	178,661	225,983	435,007	127,402	211,364	0	119,098	449,446	345,133	82,847	103,678
Nash	850,990	633,659	102,827	442,511	336,159	197,913	79,933	341,638	296,723	355,186	116,195	80,394
New Hanover	0	165	21,505	1,407	19,832	17,219	288,877	105,066	2,162,633	781,451	295,348	1,099,281
Onslow	0	808,425	28,326	492,756	133,008	1,729,142	0	246,843	1,265,748	669,863	252,731	614,078
Pitt	0	384,301	362,535	643,583	178,716	412,615	0	120,226	1,061,330	1,140,434	237,322	290,838
Randolph	124,297	548,375	97,941	426,270	146,824	378,125	367,950	455,131	480,397	279,427	131,435	154,266
Robeson	1,335,190	152,262	193,525	1,075,912	346,767	621,326	590,675	0	300,739	155,732	128,727	121,529
Rockingham	0	646,326	328,479	569,659	247,031	440,134	0	89,257	282,770	378,145	37,181	135,576
Rutherford	0	245,049	175,584	88,133	133,925	406,670	0	0	250,347	239,549	97,650	146,772
Stanly	0	153,609	215,370	231,676	83,350	181,149	0	0	185,262	99,381	48,451	37,265
Stokes	0	118,353	96,686	224,851	138,990	299,150	0	60,021	1,459	32,783	66,521	27,730
Surry	649,944	283,214	222,798	243,384	129,241	411,999	26,773	0	111,589	163,361	54,167	95,850
Wayne	118,021	297,957	136,955	394,710	205,678	457,085	69,184	320,024	489,312	711,493	181,973	190,589
Wilkes	282	301,446	139,081	236,873	139,571	413,693	0	103,770	172,387	219,474	79,774	72,958
Wilson	651,706	515,097	137,378	230,754	96,892	154,957	0	14,921	324,300	213,820	45,142	80,269

6.3 ESTIMATED EMISSION FROM ON-ROAD MOBILE SOURCES

Using the inventory approach in the MOVES model gives a summary of emissions in kilograms per typical winter weekday, by county. Pollutants were modeled for the season when they are most likely to impact air quality so July was selected for NOx, VOC, PM2.5 (Direct) and January was selected for CO, as summarized previously in Table 3-4. Tables 6-14 through 6-17 below summarize the impact of the target I/M Program on criteria pollutants by study area on a county level.

Table 6-14 NOx County Emissions by Area

County	FIPS	95/5 1yr	96/5 3yr	Δ
Area 1		**NOx kg/day**		
CABARRUS	37025	9,838	9,835	-4
GASTON	37071	11,705	11,700	-5
IREDELL	37097	9,840	9,836	-4
LINCOLN	37109	4,523	4,522	-2
MECKLENBURG	37119	44,067	44,052	-15
ROWAN	37159	9,306	9,302	-4
UNION	37179	8,877	8,874	-3
Total:		98,157	98,122	-35
Area 2		**NOx kg/day**		
DAVIDSON	37057	7,286	7,283	-3
FORSYTH	37067	11,751	11,746	-5
GUILFORD	37081	17,120	17,113	-6
Total:		36,157	36,143	-15
Area 3		**NOx kg/day**		
ALAMANCE	37001	7,506	7,503	-3
BRUNSWICK	37019	4,585	4,584	-2
BUNCOMBE	37021	11,407	11,402	-5
BURKE	37023	4,947	4,945	-2
CALDWELL	37027	4,108	4,106	-2
CARTERET	37031	2,207	2,206	-1
CATAWBA	37035	7,299	7,296	-3
CHATHAM	37037	4,054	4,053	-1
CLEVELAND	37045	4,727	4,725	-2
CRAVEN	37049	4,077	4,075	-1
CUMBERLAND	37051	13,990	13,987	-3
DURHAM	37063	11,924	11,920	-5

Table 6-14 NOx County Emissions by Area

County	FIPS	95/5 1yr	96/5 3yr	Δ
EDGECOMBE	37065	2,376	2,375	-1
FRANKLIN	37069	2,669	2,667	-1
GRANVILLE	37077	3,464	3,463	-1
HARNETT	37085	3,681	3,680	-1
HAYWOOD	37087	4,275	4,274	-1
HENDERSON	37089	4,285	4,283	-2
JOHNSTON	37101	10,615	10,611	-4
LEE	37105	2,202	2,201	-1
LENOIR	37107	2,533	2,531	-1
MOORE	37125	3,472	3,470	-1
NASH	37127	5,596	5,594	-2
NEW_HANOVER	37129	5,447	5,445	-2
ONSLOW	37133	6,773	6,771	-1
ORANGE	37135	7,983	7,980	-3
PITT	37147	5,797	5,795	-2
RANDOLPH	37151	6,673	6,670	-3
ROBESON	37155	7,886	7,883	-3
ROCKINGHAM	37157	5,771	5,768	-2
RUTHERFORD	37161	3,271	3,270	-1
STANLY	37167	2,351	2,350	-1
STOKES	37169	2,291	2,290	-1
SURRY	37171	4,084	4,082	-2
WAKE	37183	29,675	29,665	-10
WAYNE	37191	5,141	5,139	-2
WILKES	37193	3,584	3,583	-1
WILSON	37195	3,471	3,469	-1
Total:		226,196	226,113	-83

Table 6-15 VOC County Emissions by Area

County	FIPS	95/5 1yr	96/5 3yr	Δ
Area 1		**VOC kg/day**		
CABARRUS	37025	5,129	5,127	-2
GASTON	37071	5,866	5,864	-3
IREDELL	37097	4,902	4,899	-2
LINCOLN	37109	2,489	2,488	-1
MECKLENBURG	37119	20,452	20,443	-9
ROWAN	37159	4,799	4,797	-2
UNION	37179	4,908	4,905	-2
Total:		48,545	48,523	-22
Area 2		**VOC kg/day**		
DAVIDSON	37057	4,181	4,178	-2
FORSYTH	37067	6,536	6,532	-4
GUILFORD	37081	9,248	9,243	-5
Total:		19,965	19,954	-11
Area 3		**VOC kg/day**		
ALAMANCE	37001	3,979	3,976	-2
BRUNSWICK	37019	2,352	2,351	-1
BUNCOMBE	37021	5,856	5,853	-3
BURKE	37023	2,612	2,611	-1
CALDWELL	37027	2,468	2,467	-1
CARTERET	37031	1,299	1,298	-1
CATAWBA	37035	4,048	4,046	-2
CHATHAM	37037	1,971	1,970	-1
CLEVELAND	37045	2,579	2,578	-1
CRAVEN	37049	2,037	2,036	-1
CUMBERLAND	37051	6,534	6,532	-3
DURHAM	37063	5,637	5,634	-3
EDGECOMBE	37065	1,261	1,260	-1
FRANKLIN	37069	1,478	1,477	-1
GRANVILLE	37077	1,595	1,595	-1
HARNETT	37085	2,157	2,156	-1
HAYWOOD	37087	1,853	1,853	-1
HENDERSON	37089	2,396	2,395	-1
JOHNSTON	37101	4,434	4,431	-2
LEE	37105	1,243	1,242	-1
LENOIR	37107	1,334	1,333	-1
MOORE	37125	2,185	2,184	-1

Table 6-15 VOC County Emissions by Area

County	FIPS	95/5 1yr	96/5 3yr	Δ
NASH	37127	2,587	2,586	-1
NEW_HANOVER	37129	3,147	3,145	-2
ONSLOW	37133	3,199	3,198	-1
ORANGE	37135	3,518	3,516	-2
PITT	37147	2,915	2,913	-2
RANDOLPH	37151	3,778	3,776	-2
ROBESON	37155	3,436	3,435	-2
ROCKINGHAM	37157	3,041	3,039	-1
RUTHERFORD	37161	1,848	1,847	-1
STANLY	37167	1,505	1,504	-1
STOKES	37169	1,427	1,426	-1
SURRY	37171	2,202	2,201	-1
WAKE	37183	15,007	14,999	-8
WAYNE	37191	2,702	2,701	-1
WILKES	37193	2,091	2,090	-1
WILSON	37195	1,734	1,733	-1
Total:		115,443	115,384	-59

Table 6-16 PM2.5 County Emissions by Area

County	FIPS	95/5 1yr	96/5 3yr	Δ
Area 1		**PM2.5 kg/day**		
CABARRUS	37025	249	249	0
GASTON	37071	296	296	0
IREDELL	37097	242	242	0
LINCOLN	37109	111	111	0
MECKLENBURG	37119	1,072	1,072	0
ROWAN	37159	216	216	0
UNION	37179	227	227	0
Total:		2,413	2,413	0
Area 2		**PM2.5 kg/day**		
DAVIDSON	37057	157	157	0
FORSYTH	37067	264	264	0
GUILFORD	37081	371	371	0
Total:		791	791	0
Area 3		**PM2.5 kg/day**		
ALAMANCE	37001	166	166	0
BRUNSWICK	37019	107	107	0
BUNCOMBE	37021	248	248	0
BURKE	37023	113	113	0
CALDWELL	37027	90	90	0
CARTERET	37031	49	49	0
CATAWBA	37035	159	159	0
CHATHAM	37037	90	90	0
CLEVELAND	37045	105	105	0
CRAVEN	37049	96	96	0
CUMBERLAND	37051	325	325	0
DURHAM	37063	266	266	0
EDGECOMBE	37065	52	52	0
FRANKLIN	37069	57	57	0
GRANVILLE	37077	88	88	0
HARNETT	37085	85	85	0
HAYWOOD	37087	104	104	0
HENDERSON	37089	100	100	0
JOHNSTON	37101	259	259	0
LEE	37105	49	49	0
LENOIR	37107	55	55	0
MOORE	37125	73	73	0

Table 6-16 PM2.5 County Emissions by Area

County	FIPS	95/5 1yr	96/5 3yr	Δ
NASH	37127	131	131	0
NEW_HANOVER	37129	113	113	0
ONSLOW	37133	166	166	0
ORANGE	37135	201	201	0
PITT	37147	134	134	0
RANDOLPH	37151	147	147	0
ROBESON	37155	195	195	0
ROCKINGHAM	37157	125	125	0
RUTHERFORD	37161	78	78	0
STANLY	37167	51	51	0
STOKES	37169	53	53	0
SURRY	37171	88	88	0
WAKE	37183	670	670	0
WAYNE	37191	119	119	0
WILKES	37193	86	86	0
WILSON	37195	80	80	0
Total:		5,172	5,172	0

Table 6-17 CO County Emissions by Area

County	FIPS	95/5 1yr	96/5 3yr	Δ
Area 1		**CO kg/day**		
CABARRUS	37025	103,874	103,862	-12
GASTON	37071	117,917	117,901	-16
IREDELL	37097	106,337	106,326	-11
LINCOLN	37109	47,477	47,467	-10
MECKLENBURG	37119	477,930	478,026	96
ROWAN	37159	92,986	92,973	-13
UNION	37179	101,191	101,181	-10
Total:		1,047,712	1,047,737	24
Area 2		**CO kg/day**		
DAVIDSON	37057	95,082	95,053	-30
FORSYTH	37067	162,969	162,934	-35
GUILFORD	37081	234,750	234,733	-17
Total:		492,801	492,720	-82
Area 3		**CO kg/day**		
ALAMANCE	37001	86,074	86,058	-17
BRUNSWICK	37019	50,019	50,013	-6
BUNCOMBE	37021	139,127	139,105	-22
BURKE	37023	55,007	54,993	-14
CALDWELL	37027	46,316	46,301	-16
CARTERET	37031	28,399	28,395	-4
CATAWBA	37035	86,913	86,895	-18
CHATHAM	37037	39,355	39,350	-6
CLEVELAND	37045	51,276	51,261	-15
CRAVEN	37049	44,391	44,392	1
CUMBERLAND	37051	146,579	146,631	52
DURHAM	37063	133,512	133,505	-7
EDGECOMBE	37065	25,722	25,713	-8
FRANKLIN	37069	29,442	29,433	-8
GRANVILLE	37077	33,871	33,865	-6
HARNETT	37085	46,034	46,029	-5
HAYWOOD	37087	43,476	43,473	-3
HENDERSON	37089	56,095	56,082	-13
JOHNSTON	37101	99,585	99,575	-10
LEE	37105	25,651	25,647	-4
LENOIR	37107	28,543	28,535	-8
MOORE	37125	43,064	43,057	-7

Table 6-17 CO County Emissions by Area

County	FIPS	95/5 1yr	96/5 3yr	Δ
NASH	37127	56,051	56,045	-6
NEW HANOVER	37129	70,083	70,076	-8
ONSLOW	37133	70,492	70,517	25
ORANGE	37135	77,547	77,543	-4
PITT	37147	68,381	68,377	-5
RANDOLPH	37151	77,879	77,858	-22
ROBESON	37155	72,152	72,142	-10
ROCKINGHAM	37157	58,932	58,914	-18
RUTHERFORD	37161	36,234	36,221	-13
STANLY	37167	29,085	29,075	-10
STOKES	37169	26,360	26,351	-9
SURRY	37171	47,471	47,456	-14
WAKE	37183	390,948	390,991	43
WAYNE	37191	59,176	59,166	-10
WILKES	37193	42,946	42,934	-12
WILSON	37195	38,398	38,394	-4
Total:		2,560,587	2,560,367	-220

7.0 MOVES Input Data

7.1 VEHICLE MIX DATA

Tables 7-1 through 7-2 show definitions of the vehicle types and facility (roadway) types referred to in the vehicle mix tables. Tables 7-3 through 7-5 list the vehicle mix data used specific to each inventory year modeled.

Table 7-1 Vehicle Type Descriptions

ID#	Vehicle Type	Description
1	LDV	Light-Duty Vehicles (Passenger Cars)
2	LDT1	Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3,750 lbs. LVW)
3	LDT2	Light-Duty Trucks 2 (0-6,000 lbs. GVWR, 3,751-5,750 lbs. LVW)
4	LDT3	Light-Duty Trucks 3 (6,001-8,500 lbs. GVWR, 0-5,750 lbs. ALVW)
5	LDT4	Light-Duty Trucks 4 (6,001-8,500 lbs. GVWR, 5,751 lbs. and greater ALVW)
6	HDV2	Class 2b Heavy-Duty Vehicles (8,501-10,000 lbs. GVWR)
7	HDV3	Class 3 Heavy-Duty Vehicles (10,001-14,000 lbs. GVWR)
8	HDV4	Class 4 Heavy-Duty Vehicles (14,001-16,000 lbs. GVWR)
9	HDV5	Class 5 Heavy-Duty Vehicles (16,001-19,500 lbs. GVWR)
10	HDV6	Class 6 Heavy-Duty Vehicles (19,501-26,000 lbs. GVWR)
11	HDV7	Class 7 Heavy-Duty Vehicles (26,001-33,000 lbs. GVWR)
12	HDV8A	Class 8a Heavy-Duty Vehicles (33,001-60,000 lbs. GVWR)
13	HDV8B	Class 8b Heavy-Duty Vehicles (>60,000 lbs. GVWR)
14	HDBS	School Buses
15	HDBT	Transit and Urban Buses
16	MC	Motorcycles

Table 7-2 Facility (Roadway) Type Descriptions

Facility Type	Description	Facility Type	Description
11	Rural Interstate	23	Urban Interstate
13	Rural Other Principal Arterial	25	Urban Other Freeways and Expressways
15	Rural Minor Arterial	27	Urban Other Principal Arterial
17	Rural Major Collector	29	Urban Minor Arterial
19	Rural Minor Collector	31	Urban Collector
21	Rural Local	33	Urban Local

Table 7-3 North Carolina Vehicle Mix for 2013

	Fraction of VMT on Facility Type by Vehicle Type (each column should sum to 1)											
Vehicle Type	**11**	**13**	**15**	**17**	**19**	**21**	**23**	**25**	**27**	**29**	**31**	**33**
1	0.3130	0.3300	0.3383	0.3407	0.3288	0.3424	0.3378	0.3373	0.3487	0.3506	0.3526	0.3405
2	0.0915	0.0964	0.0989	0.0996	0.0960	0.1000	0.0987	0.0985	0.1018	0.1025	0.1031	0.0995
3	0.3045	0.3210	0.3292	0.3315	0.3197	0.3331	0.3285	0.3281	0.3390	0.3412	0.3432	0.3312
4	0.0939	0.0990	0.1015	0.1022	0.0986	0.1027	0.1013	0.1011	0.1045	0.1052	0.1058	0.1021
5	0.0431	0.0455	0.0466	0.0469	0.0453	0.0472	0.0465	0.0465	0.0480	0.0483	0.0486	0.0469
6	0.0478	0.0330	0.0256	0.0236	0.0341	0.0221	0.0262	0.0266	0.0168	0.0149	0.0131	0.0238
7	0.0047	0.0032	0.0025	0.0023	0.0033	0.0022	0.0026	0.0026	0.0016	0.0015	0.0013	0.0023
8	0.0039	0.0027	0.0021	0.0019	0.0028	0.0018	0.0022	0.0022	0.0014	0.0012	0.0011	0.0020
9	0.0029	0.0020	0.0016	0.0015	0.0021	0.0014	0.0016	0.0016	0.0010	0.0009	0.0008	0.0015
10	0.0107	0.0074	0.0057	0.0053	0.0076	0.0049	0.0059	0.0059	0.0038	0.0033	0.0029	0.0053
11	0.0126	0.0087	0.0068	0.0062	0.0090	0.0058	0.0069	0.0070	0.0044	0.0039	0.0035	0.0063
12	0.0137	0.0095	0.0074	0.0068	0.0098	0.0064	0.0075	0.0077	0.0048	0.0043	0.0038	0.0068
13	0.0489	0.0337	0.0262	0.0241	0.0349	0.0227	0.0268	0.0273	0.0172	0.0152	0.0134	0.0244
14	0.0025	0.0017	0.0013	0.0012	0.0017	0.0011	0.0013	0.0014	0.0009	0.0008	0.0007	0.0012
15	0.0012	0.0008	0.0007	0.0006	0.0009	0.0006	0.0007	0.0007	0.0004	0.0004	0.0003	0.0006
16	0.0051	0.0054	0.0056	0.0056	0.0054	0.0056	0.0055	0.0055	0.0057	0.0058	0.0058	0.0056
Sum	1	1	1	1	1	1	1	1	1	1	1	1

Table 7-4 North Carolina Vehicle Mix for 2014

	Fraction of VMT on Facility Type by Vehicle Type (each column should sum to 1)											
Vehicle Type	**11**	**13**	**15**	**17**	**19**	**21**	**23**	**25**	**27**	**29**	**31**	**33**
1	0.3049	0.3215	0.3295	0.3318	0.3201	0.3333	0.3290	0.3285	0.3394	0.3416	0.3434	0.3316
2	0.0929	0.0980	0.1005	0.1012	0.0976	0.1017	0.1003	0.1001	0.1035	0.1041	0.1048	0.1011
3	0.3093	0.3260	0.3344	0.3367	0.3247	0.3383	0.3337	0.3332	0.3443	0.3465	0.3486	0.3364
4	0.0953	0.1004	0.1030	0.1037	0.1000	0.1042	0.1028	0.1026	0.1061	0.1067	0.1074	0.1036
5	0.0438	0.0462	0.0474	0.0477	0.0460	0.0479	0.0473	0.0472	0.0488	0.0491	0.0494	0.0476
6	0.0478	0.0330	0.0256	0.0236	0.0341	0.0222	0.0262	0.0266	0.0168	0.0149	0.0131	0.0238
7	0.0046	0.0032	0.0025	0.0023	0.0033	0.0022	0.0025	0.0026	0.0016	0.0014	0.0013	0.0023
8	0.0039	0.0027	0.0021	0.0019	0.0028	0.0018	0.0021	0.0022	0.0014	0.0012	0.0011	0.0019
9	0.0029	0.0020	0.0016	0.0014	0.0021	0.0014	0.0016	0.0016	0.0010	0.0009	0.0008	0.0015
10	0.0108	0.0074	0.0058	0.0053	0.0077	0.0050	0.0059	0.0060	0.0038	0.0034	0.0029	0.0054
11	0.0126	0.0087	0.0067	0.0062	0.0090	0.0058	0.0069	0.0070	0.0044	0.0039	0.0034	0.0063
12	0.0137	0.0094	0.0073	0.0068	0.0098	0.0063	0.0075	0.0076	0.0048	0.0043	0.0037	0.0068
13	0.0489	0.0337	0.0262	0.0241	0.0349	0.0227	0.0268	0.0273	0.0172	0.0152	0.0134	0.0244
14	0.0024	0.0017	0.0013	0.0012	0.0017	0.0011	0.0013	0.0014	0.0009	0.0008	0.0007	0.0012
15	0.0012	0.0008	0.0007	0.0006	0.0009	0.0006	0.0007	0.0007	0.0004	0.0004	0.0003	0.0006
16	0.0050	0.0053	0.0054	0.0055	0.0053	0.0055	0.0054	0.0054	0.0056	0.0056	0.0057	0.0055
Sum	1	1	1	1	1	1	1	1	1	1	1	1

Table 7-5 North Carolina Vehicle Mix for 2015

	Fraction of VMT on Facility Type by Vehicle Type (each column should sum to 1)											
Vehicle Type	11	13	15	17	19	21	23	25	27	29	31	33
1	0.2978	0.3138	0.3216	0.3241	0.3124	0.3256	0.3212	0.3207	0.3313	0.3335	0.3356	0.3237
2	0.0941	0.0992	0.1018	0.1025	0.0988	0.1029	0.1015	0.1014	0.1048	0.1054	0.1061	0.1024
3	0.3134	0.3304	0.3388	0.3411	0.3290	0.3428	0.3381	0.3376	0.3489	0.3511	0.3532	0.3409
4	0.0965	0.1018	0.1044	0.1051	0.1014	0.1056	0.1042	0.1040	0.1075	0.1082	0.1088	0.1050
5	0.0444	0.0468	0.0480	0.0483	0.0466	0.0486	0.0479	0.0478	0.0494	0.0497	0.0500	0.0483
6	0.0477	0.0329	0.0256	0.0236	0.0341	0.0221	0.0262	0.0266	0.0168	0.0149	0.0130	0.0238
7	0.0048	0.0033	0.0026	0.0023	0.0034	0.0022	0.0026	0.0027	0.0017	0.0015	0.0013	0.0024
8	0.0039	0.0027	0.0021	0.0019	0.0028	0.0018	0.0021	0.0022	0.0014	0.0012	0.0011	0.0019
9	0.0029	0.0020	0.0016	0.0014	0.0021	0.0014	0.0016	0.0016	0.0010	0.0009	0.0008	0.0015
10	0.0107	0.0074	0.0058	0.0053	0.0077	0.0050	0.0059	0.0060	0.0038	0.0033	0.0029	0.0054
11	0.0127	0.0088	0.0068	0.0063	0.0091	0.0059	0.0070	0.0071	0.0045	0.0040	0.0035	0.0063
12	0.0137	0.0094	0.0073	0.0067	0.0098	0.0063	0.0075	0.0076	0.0048	0.0043	0.0037	0.0068
13	0.0488	0.0337	0.0262	0.0241	0.0349	0.0226	0.0268	0.0272	0.0172	0.0152	0.0133	0.0243
14	0.0024	0.0017	0.0013	0.0012	0.0017	0.0011	0.0013	0.0014	0.0009	0.0008	0.0007	0.0012
15	0.0012	0.0008	0.0007	0.0006	0.0009	0.0006	0.0007	0.0007	0.0004	0.0004	0.0003	0.0006
16	0.0050	0.0053	0.0054	0.0055	0.0053	0.0055	0.0054	0.0054	0.0056	0.0056	0.0057	0.0055
Sum	1	1	1	1	1	1	1	1	1	1	1	1

7.2 METEOROLOGICAL DATA

Table 7-6 below lists the meteorological data used for all 48 counties. This data was based on annual monthly average 24-hour temperature and relative humidity profiles from twelve distinct meteorology zones representative of the 48 I/M counties. Table 6-7, presented earlier, details the source of the raw temperature and relative humidity for each zone. Each record represents the temperature and relative humidity reading for a specific clock hour, averaged over all days of the month of January or July. For example, the first record shows the average temperature and relative humidity observed between midnight and 1:00AM during January.

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
MET Zone 2 Temperature and Relative Humidity				
1	1	2	36.6	76
1	2	2	35.9	77
1	3	2	35.7	79
1	4	2	34.9	81
1	5	2	34.3	82
1	6	2	34.7	81
1	7	2	33.9	81
1	8	2	33.5	81
1	9	2	35.7	77
1	10	2	39.7	71
1	11	2	43.1	64
1	12	2	46.5	57
1	13	2	48.4	53
1	14	2	49.7	53
1	15	2	50.6	53
1	16	2	49.7	54
1	17	2	47.7	58
1	18	2	45.9	63
1	19	2	43.9	67
1	20	2	42.9	69
1	21	2	41.4	69
1	22	2	40	68
1	23	2	38.8	70

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
1	24	2	38.2	72
7	1	2	70	89
7	2	2	69.5	90
7	3	2	68.8	90
7	4	2	68.6	91
7	5	2	68.2	91
7	6	2	68	91
7	7	2	69.8	88
7	8	2	72.5	82
7	9	2	76	74
7	10	2	79.4	66
7	11	2	81.8	60
7	12	2	82.8	58
7	13	2	83.2	57
7	14	2	82.5	59
7	15	2	82.4	60
7	16	2	81.8	61
7	17	2	81.3	60
7	18	2	80	63
7	19	2	78.2	68
7	20	2	75.9	74
7	21	2	74.3	79
7	22	2	72.6	84
7	23	2	71.6	86
7	24	2	70.7	88
MET Zone 4 Temperature and Relative Humidity				
1	1	4	39.5	75
1	2	4	39	76
1	3	4	38.3	76
1	4	4	37.7	77
1	5	4	36.9	79
1	6	4	36.3	79
1	7	4	35.7	81
1	8	4	35.8	81

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
1	9	4	37.4	80
1	10	4	40.9	73
1	11	4	43.7	67
1	12	4	46.6	60
1	13	4	48.7	57
1	14	4	50.1	56
1	15	4	51.1	54
1	16	4	51.3	53
1	17	4	50.4	56
1	18	4	48.4	60
1	19	4	46.5	63
1	20	4	45.2	65
1	21	4	44.2	68
1	22	4	43	69
1	23	4	42	70
1	24	4	41.1	71
7	1	4	71	92
7	2	4	70.1	93
7	3	4	69.4	95
7	4	4	68.8	94
7	5	4	68.6	94
7	6	4	68.6	94
7	7	4	70.6	91
7	8	4	75.1	81
7	9	4	78.3	76
7	10	4	81	70
7	11	4	83.4	65
7	12	4	84.8	61
7	13	4	84.9	60
7	14	4	85.5	59
7	15	4	83.5	64
7	16	4	81.6	68
7	17	4	82	66
7	18	4	80.6	69

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
7	19	4	78.1	77
7	20	4	76.4	80
7	21	4	74.5	84
7	22	4	73.2	88
7	23	4	72.3	89
7	24	4	71.8	90
MET Zone 5 Temperature and Relative Humidity				
1	1	5	40.1	70
1	2	5	39.2	71
1	3	5	38.4	72
1	4	5	37.6	74
1	5	5	36.6	76
1	6	5	36.4	75
1	7	5	35.9	75
1	8	5	35.6	76
1	9	5	38.7	71
1	10	5	41.7	65
1	11	5	45.1	60
1	12	5	47.9	54
1	13	5	49.9	50
1	14	5	50.8	50
1	15	5	51.3	49
1	16	5	50.9	51
1	17	5	49.7	54
1	18	5	47.6	58
1	19	5	45.7	61
1	20	5	44.9	62
1	21	5	44.1	63
1	22	5	43.2	64
1	23	5	42.1	66
1	24	5	41.3	67
7	1	5	73.3	85
7	2	5	72.5	87
7	3	5	71.9	88

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
7	4	5	71.5	89
7	5	5	70.9	90
7	6	5	71.1	90
7	7	5	72.7	87
7	8	5	75.8	80
7	9	5	79	73
7	10	5	82.5	65
7	11	5	84.9	60
7	12	5	86.6	56
7	13	5	87.5	53
7	14	5	87.1	54
7	15	5	85.6	57
7	16	5	83.6	62
7	17	5	82.6	64
7	18	5	82	65
7	19	5	80.5	69
7	20	5	78.4	74
7	21	5	77	77
7	22	5	75.5	80
7	23	5	74.7	82
7	24	5	73.7	84
MET Zone 6 Temperature and Relative Humidity				
1	1	6	38	73
1	2	6	37.3	76
1	3	6	36.8	77
1	4	6	35.6	80
1	5	6	35.1	80
1	6	6	34.7	79
1	7	6	34.3	79
1	8	6	33.7	81
1	9	6	36.7	77
1	10	6	40.3	68
1	11	6	44.1	61
1	12	6	46.9	57

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
1	13	6	49.1	51
1	14	6	50.3	50
1	15	6	50.8	50
1	16	6	50.3	51
1	17	6	48.8	54
1	18	6	46.4	57
1	19	6	45	59
1	20	6	43.3	66
1	21	6	42.6	67
1	22	6	41.1	68
1	23	6	40	70
1	24	6	39.1	72
7	1	6	69.2	95
7	2	6	68.8	96
7	3	6	67.9	97
7	4	6	67.3	98
7	5	6	66.8	96
7	6	6	67.3	96
7	7	6	69.6	92
7	8	6	73.3	85
7	9	6	76.6	79
7	10	6	80.3	71
7	11	6	82.3	66
7	12	6	83.2	63
7	13	6	81.7	66
7	14	6	82.2	65
7	15	6	81.8	65
7	16	6	80.8	69
7	17	6	80.2	70
7	18	6	79.2	72
7	19	6	77.7	78
7	20	6	74.8	84
7	21	6	73	89
7	22	6	71.7	92

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
7	23	6	71.2	93
7	24	6	70.3	94
MET Zone 7 Temperature and Relative Humidity				
1	1	7	39.7	67
1	2	7	39	68
1	3	7	38.8	68
1	4	7	38	69
1	5	7	37.4	69
1	6	7	36.4	70
1	7	7	36.1	72
1	8	7	35.7	73
1	9	7	39.3	67
1	10	7	42.6	60
1	11	7	45.3	55
1	12	7	47.5	51
1	13	7	49.6	49
1	14	7	50.9	47
1	15	7	51.5	46
1	16	7	51.1	47
1	17	7	49.2	50
1	18	7	46.8	54
1	19	7	45.4	58
1	20	7	43.8	62
1	21	7	43.1	62
1	22	7	42.4	63
1	23	7	41.4	64
1	24	7	40.9	63
7	1	7	74.8	82
7	2	7	73.9	84
7	3	7	73.2	86
7	4	7	72.7	87
7	5	7	72.3	88
7	6	7	72.4	89
7	7	7	74.5	85

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
7	8	7	77.7	77
7	9	7	81.2	69
7	10	7	84	62
7	11	7	86.2	57
7	12	7	87.7	54
7	13	7	88	53
7	14	7	88.8	51
7	15	7	88.2	51
7	16	7	87.7	52
7	17	7	87.5	53
7	18	7	85.2	57
7	19	7	82.8	63
7	20	7	80.1	69
7	21	7	78.2	74
7	22	7	77	77
7	23	7	76.3	79
7	24	7	75.2	82
MET Zone 8 Temperature and Relative Humidity				
1	1	8	42.2	71
1	2	8	41.4	72
1	3	8	40.3	75
1	4	8	39.6	74
1	5	8	38.6	76
1	6	8	38.4	76
1	7	8	37.4	79
1	8	8	38.2	78
1	9	8	41.3	73
1	10	8	44.7	64
1	11	8	47.4	59
1	12	8	50.2	56
1	13	8	51.8	53
1	14	8	53.5	50
1	15	8	53.8	50
1	16	8	53.8	50

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
1	17	8	52.6	53
1	18	8	49.4	59
1	19	8	48.2	61
1	20	8	46.8	64
1	21	8	45.8	65
1	22	8	44.9	66
1	23	8	44.1	66
1	24	8	43.1	67
7	1	8	75.1	82
7	2	8	74.4	84
7	3	8	73.6	86
7	4	8	73.2	87
7	5	8	72.5	88
7	6	8	72.7	89
7	7	8	75.3	84
7	8	8	78.5	76
7	9	8	81.6	69
7	10	8	84.5	63
7	11	8	87.4	56
7	12	8	88.9	52
7	13	8	90.4	49
7	14	8	91.2	47
7	15	8	90.9	48
7	16	8	89.5	50
7	17	8	87.2	56
7	18	8	84.7	60
7	19	8	82.9	64
7	20	8	80.3	70
7	21	8	79	74
7	22	8	78.2	75
7	23	8	76.7	79
7	24	8	75.9	80
MET Zone 9 Temperature and Relative Humidity				
1	1	9	42.4	68

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
1	2	9	41.6	69
1	3	9	40.9	68
1	4	9	40.3	70
1	5	9	39.4	72
1	6	9	39.1	73
1	7	9	38.4	75
1	8	9	38.5	75
1	9	9	41.7	71
1	10	9	45.4	61
1	11	9	48.3	55
1	12	9	50.5	51
1	13	9	52.6	47
1	14	9	53.5	46
1	15	9	54.3	46
1	16	9	53.9	47
1	17	9	52.4	49
1	18	9	49.6	55
1	19	9	47.8	59
1	20	9	46.8	61
1	21	9	46.3	62
1	22	9	45.2	64
1	23	9	44.5	64
1	24	9	43.5	65
7	1	9	76.3	81
7	2	9	75.4	83
7	3	9	74.9	85
7	4	9	74.4	86
7	5	9	73.7	87
7	6	9	74.2	87
7	7	9	76.5	83
7	8	9	79.4	76
7	9	9	82.6	69
7	10	9	85.6	63
7	11	9	88.3	57

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
7	12	9	89.9	54
7	13	9	91.1	51
7	14	9	92.4	48
7	15	9	91	49
7	16	9	89.4	52
7	17	9	88.2	54
7	18	9	86.2	58
7	19	9	83.5	64
7	20	9	80.4	70
7	21	9	79.1	74
7	22	9	78	77
7	23	9	77.2	79
7	24	9	76.6	81
MET Zone 10 Temperature and Relative Humidity				
1	1	10	44.2	71
1	2	10	43.3	73
1	3	10	42.5	74
1	4	10	41.3	76
1	5	10	41	76
1	6	10	40.4	77
1	7	10	39.8	80
1	8	10	39.9	79
1	9	10	43.4	72
1	10	10	46.7	63
1	11	10	50.1	56
1	12	10	53.2	50
1	13	10	55	47
1	14	10	55.9	47
1	15	10	56.4	46
1	16	10	56.4	48
1	17	10	55	51
1	18	10	51.8	56
1	19	10	49.7	62
1	20	10	48.4	64

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
1	21	10	47.3	67
1	22	10	47	68
1	23	10	45.9	70
1	24	10	45	70
7	1	10	76.5	88
7	2	10	75.8	90
7	3	10	75.8	89
7	4	10	75.2	91
7	5	10	74.6	91
7	6	10	74.7	92
7	7	10	76.8	88
7	8	10	79.9	79
7	9	10	82.9	72
7	10	10	85.8	65
7	11	10	87.9	60
7	12	10	89.2	58
7	13	10	90.5	55
7	14	10	90.2	56
7	15	10	89.1	58
7	16	10	87.8	61
7	17	10	87.1	62
7	18	10	84.7	67
7	19	10	82.5	72
7	20	10	80	78
7	21	10	78.9	80
7	22	10	78.3	81
7	23	10	77.4	84
7	24	10	76.6	86
MET Zone 11 Temperature and Relative Humidity				
1	1	11	42.2	72
1	2	11	43.7	73
1	3	11	40.2	75
1	4	11	39.5	75
1	5	11	38.8	77

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
1	6	11	38.4	77
1	7	11	38	78
1	8	11	38.5	77
1	9	11	42.4	70
1	10	11	45.2	63
1	11	11	48.8	56
1	12	11	51.5	52
1	13	11	53.9	49
1	14	11	54.2	48
1	15	11	55.9	45
1	16	11	56.2	46
1	17	11	52.4	52
1	18	11	48	61
1	19	11	47.9	66
1	20	11	44.9	70
1	21	11	44.3	71
1	22	11	47	67
1	23	11	44	70
1	24	11	45.9	68
7	1	11	75.4	89
7	2	11	74.9	89
7	3	11	74.8	89
7	4	11	74.2	91
7	5	11	74.1	91
7	6	11	74.7	91
7	7	11	77.1	86
7	8	11	80.1	79
7	9	11	82.9	73
7	10	11	85.3	67
7	11	11	87.7	62
7	12	11	89.7	58
7	13	11	90.2	57
7	14	11	90.7	56
7	15	11	89.8	56

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
7	16	11	87.4	61
7	17	11	86	64
7	18	11	83.8	69
7	19	11	81.7	74
7	20	11	78.5	82
7	21	11	77.2	84
7	22	11	76.4	86
7	23	11	76	87
7	24	11	75.7	88
MET Zone 12 Temperature and Relative Humidity				
1	1	12	40.9	76
1	2	12	40.6	75
1	3	12	39.8	76
1	4	12	39.2	77
1	5	12	38.2	78
1	6	12	37.7	80
1	7	12	37.6	79
1	8	12	37.6	80
1	9	12	41.2	74
1	10	12	43.9	65
1	11	12	46.4	59
1	12	12	48.8	56
1	13	12	50.5	51
1	14	12	51.9	49
1	15	12	52.5	47
1	16	12	52.6	47
1	17	12	50.9	52
1	18	12	47.8	58
1	19	12	45.5	66
1	20	12	44.6	68
1	21	12	43.9	70
1	22	12	43.4	70
1	23	12	42.8	71
1	24	12	41.9	73

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
7	1	12	73.6	90
7	2	12	73	91
7	3	12	72.5	92
7	4	12	71.7	93
7	5	12	72	93
7	6	12	72.3	92
7	7	12	74.7	87
7	8	12	77.1	81
7	9	12	80.2	74
7	10	12	83.1	69
7	11	12	84.9	64
7	12	12	86.6	60
7	13	12	87.3	58
7	14	12	87.2	59
7	15	12	86.5	61
7	16	12	84.3	65
7	17	12	82.7	68
7	18	12	80.8	71
7	19	12	79.2	75
7	20	12	76.9	80
7	21	12	75.6	85
7	22	12	75	87
7	23	12	74.2	88
7	24	12	73.6	90
MET Zone 14 Temperature and Relative Humidity				
1	1	14	46.6	78
1	2	14	45.8	79
1	3	14	45.1	79
1	4	14	44.8	79
1	5	14	44.3	78
1	6	14	44.2	77
1	7	14	43.4	78
1	8	14	44.2	77
1	9	14	48.1	70

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
1	10	14	51.3	62
1	11	14	54.2	57
1	12	14	56.4	52
1	13	14	57.8	50
1	14	14	58.9	47
1	15	14	59	47
1	16	14	58.4	48
1	17	14	56.4	53
1	18	14	53.5	61
1	19	14	51.2	68
1	20	14	49.7	73
1	21	14	48.6	77
1	22	14	48.2	77
1	23	14	47.8	78
1	24	14	47.8	77
7	1	14	77.9	87
7	2	14	77.6	88
7	3	14	77.2	89
7	4	14	77	89
7	5	14	76.8	89
7	6	14	77.1	88
7	7	14	79.5	82
7	8	14	82.4	74
7	9	14	85.1	68
7	10	14	87.6	62
7	11	14	89.4	58
7	12	14	90.6	56
7	13	14	91.7	53
7	14	14	91.2	54
7	15	14	91.3	55
7	16	14	89	60
7	17	14	87.5	63
7	18	14	84.1	69
7	19	14	82	74

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
7	20	14	80.5	78
7	21	14	79.7	81
7	22	14	79.5	81
7	23	14	78.9	84
7	24	14	78.5	86
MET Zone 15 Temperature and Relative Humidity				
1	1	15	44.9	76
1	2	15	44.6	76
1	3	15	44.3	76
1	4	15	43.9	75
1	5	15	43.4	74
1	6	15	42.7	75
1	7	15	42.2	76
1	8	15	42.7	78
1	9	15	46.5	70
1	10	15	49.9	62
1	11	15	52.2	57
1	12	15	54.2	53
1	13	15	55.8	50
1	14	15	56.8	48
1	15	15	57.3	48
1	16	15	57	48
1	17	15	54.5	53
1	18	15	51	62
1	19	15	48.9	67
1	20	15	48	70
1	21	15	47.3	72
1	22	15	46.5	73
1	23	15	46.5	73
1	24	15	46.2	73
7	1	15	75.9	89
7	2	15	75.5	91
7	3	15	75.4	91
7	4	15	75.4	90

Table 7-6 MET Zone Temperature and Relative Humidity

monthID	hourID	MET_Zone_ID	temperature	relHumidity
7	5	15	75	92
7	6	15	75.6	91
7	7	15	78.2	86
7	8	15	81.3	79
7	9	15	83.8	73
7	10	15	86.1	70
7	11	15	88	66
7	12	15	88.8	64
7	13	15	89.5	62
7	14	15	89.6	62
7	15	15	89.3	62
7	16	15	88.3	64
7	17	15	85.9	69
7	18	15	83.2	76
7	19	15	80.6	81
7	20	15	78.9	85
7	21	15	77.8	87
7	22	15	77.3	88
7	23	15	76.7	90
7	24	15	76.3	89