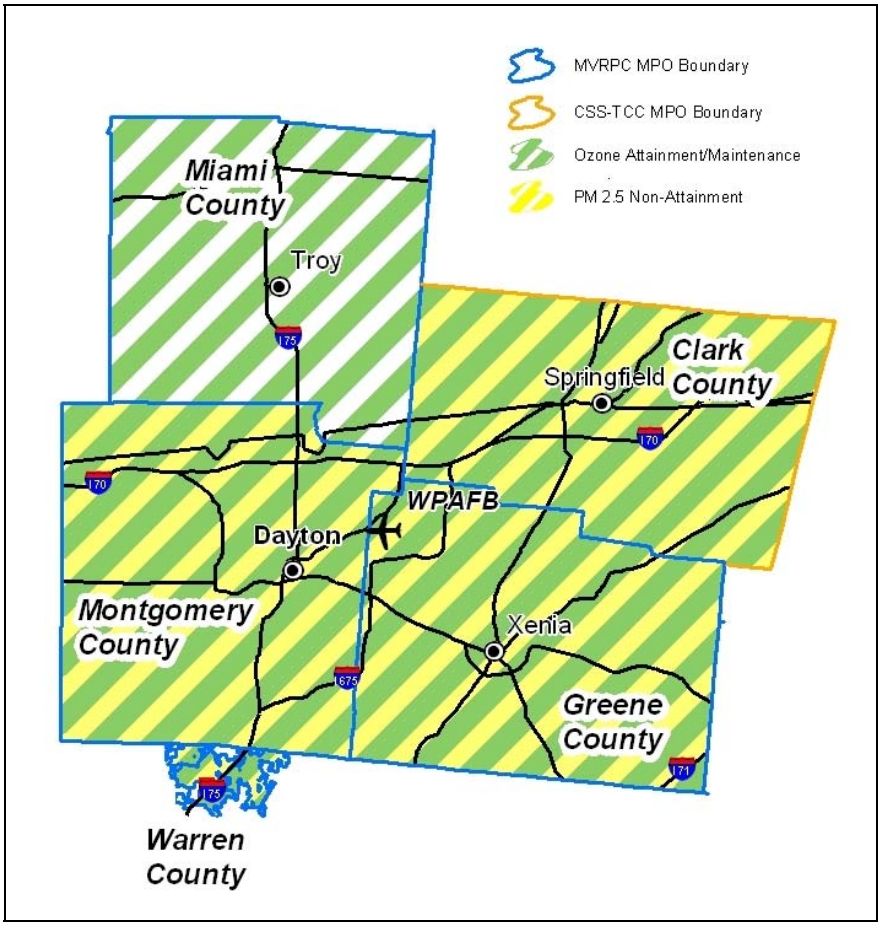
Technical Memorandum
MVRPC/Clark County-Springfield TCC SIP Inventory
Mobile Emissions Estimate (OZONE)

March 2012
(Revised November 2012)



By MVRPC and Ohio Department of Transportation

In Coordination with Clark County-Springfield TCC and the Ohio Environmental Protection Agency

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1. Overview

This memorandum is intended to document the air quality analyses and underlying assumptions performed by the Ohio Department of Transportation (ODOT), Division of Transportation System Development-Modeling and Forecasting Section and the Miami Valley Regional Planning Commission (MVRPC) for the 8-hour ozone on-road mobile source emission inventories for the Dayton-Springfield Region (D/S Region) State Implementation Plan (SIP) revision in coordination with the Ohio Environmental Protection Agency (OEPA).

The D/S Region is comprised of the counties of Clark, Greene, Miami, and Montogomery in west-central Ohio. All four counties are designated non-attainment for the 8-hour Ozone Standard. Clark County Springfield Transportation Coordinating Committee (CCS-TCC) serves as the Metropolitan Planning Organization (MPO) for Clark County while MVRPC serves as the MPO for the remainder counties: Greene, Miami, and Montgomery.

The ODOT Modeling and Forecasting section performed the MOVES runs to generate travel demand model based emission factors as well as the complete air quality analyses for Clark County. Using ODOT generated emission factors, MVRPC completed the air quality analyses for Greene, Miami, and Montgomery Counties.

Latest Planning Assumptions

The ozone inventory runs meet the latest planning assumption requirement. As discussed in Section 2 of this report, the modeling process used to develop each MPO emissions is calibrated using the latest population and land use data available and is validated using corresponding traffic count data. Currently, the travel demand models are validated to year 2000 (CCS-TCC) or year 2005 (MVRPC) depending on available data.

U.S. EPA's most recent emissions software, MOVES, is used for all mobile source emission analyses with MOVES inputs being established at various interagency consultation meetings between August 2011 and February 2012 (See **Appendix A)**

Finally, the regional emissions analysis includes emissions for Volatile Organic Compounds (VOC) and Nitrogen Oxides (NOX).

On Road Mobile Emission Summary

Tables 1 to 5 present a summary of emissions by county as well as the entire D/S Region for the required precursors VOC and NOX for the requested scenarios: 2002 base, 2005 attainment, 2009 interim, and 2018 maintenance. Years 2005 and 2018 are established as budget years. Year 2040 emissions are provided for comparison with the horizon year of the Long Range Transportation Plan. The remainder of the document focuses on the assumptions behind the analyses.

Table 1 – Dayton/Springield Region On-Road Mobile Emissions

	2002 Base	
COUNTY	**VOC (tons/day)**	**NOX (tons/day)**
Clark	9.6498	16.9997
Greene	10.0855	15.6383
Miami	7.1497	11.5819
Montgomery	34.9158	52.2251
TOTAL	**61.8008**	**96.4450**

Table 2 – Dayton/Springield Region On-Road Mobile Emissions

	2005 Attainment	
COUNTY	**VOC (tons/day)**	**NOX (tons/day)**
Clark	8.4192	14.9811
Greene	8.6954	13.7348
Miami	6.2373	10.3292
Montgomery	30.0133	45.6078
TOTAL	**53.3652**	**84.6529**

Table 3 – Dayton/Springield Region On-Road Mobile Emissions

	2009 Maintenance	
COUNTY	**VOC (tons/day)**	**NOX (tons/day)**
Clark	6.7448	12.0907
Greene	7.0589	11.3633
Miami	4.9588	8.2858
Montgomery	24.2552	37.2558
TOTAL	**43.0177**	**68.9956**

Table 4 – Dayton/Springield Region On-Road Mobile Emissions

	2018 Maintenance	
COUNTY	**VOC (tons/day)**	**NOX (tons/day)**
Clark	3.0953	5.0193
Greene	3.2205	4.8311
Miami	2.2310	3.3930
Montgomery	10.8916	14.9918
TOTAL	**19.4384**	**28.2352**

Table 5 – Dayton/Springield Region On-Road Mobile Emissions

	2040 Plan Horizon Year	
COUNTY	**VOC (tons/day)**	**NOX (tons/day)**
Clark	2.0201	2.5457
Greene	1.9947	2.3905
Miami	1.3849	1.6994
Montgomery	6.6242	7.1104
TOTAL	**12.0239**	**13.7460**

2. Urban Travel Demand Models

CCS-TCC and MVRPC maintain regional travel demand forecasting models for use in the urban transportation planning process. The models employ the traditional four step modeling process to project existing and future traffic volumes and travel patterns on the regional transportation network. The four step process consists of trip generation, trip distribution, modal split, and route assignment. Output from the urban models is link-by-link directional 24-hour traffic volumes.

During 2000-2002 MVRPC, in cooperation with the Ohio Kentucky Indiana Regional Council of Governments, updated its travel demand model. The new model includes the combined regions under the jurisdictions of OKI and MVRPC. In 2005, the combined model was updated again to incorporate the results of a household interview survey in the MVRPC Region, change the model interface to Cube Voyager, and improve model functionality. The changes primarily affected trip generation distribution functions in the MVRPC Region. In 2007 in preparation for the 2008 Transportation Plan Update the model was validated using circa 2005 traffic counts counts and in 2011 in preparation for the 2012 Plan Update the socioeconomic data was updated with 2010 census information and extended to the 2040 horizon year. The 2005 Cube Voyager model with the latest planning assumptions (networks and socio-economic data) is used to calculate 2002-2018-2040 emissions in the MVRPC Region. MVRPC inventory emission analyses directory structure can be seen in Figure 1.

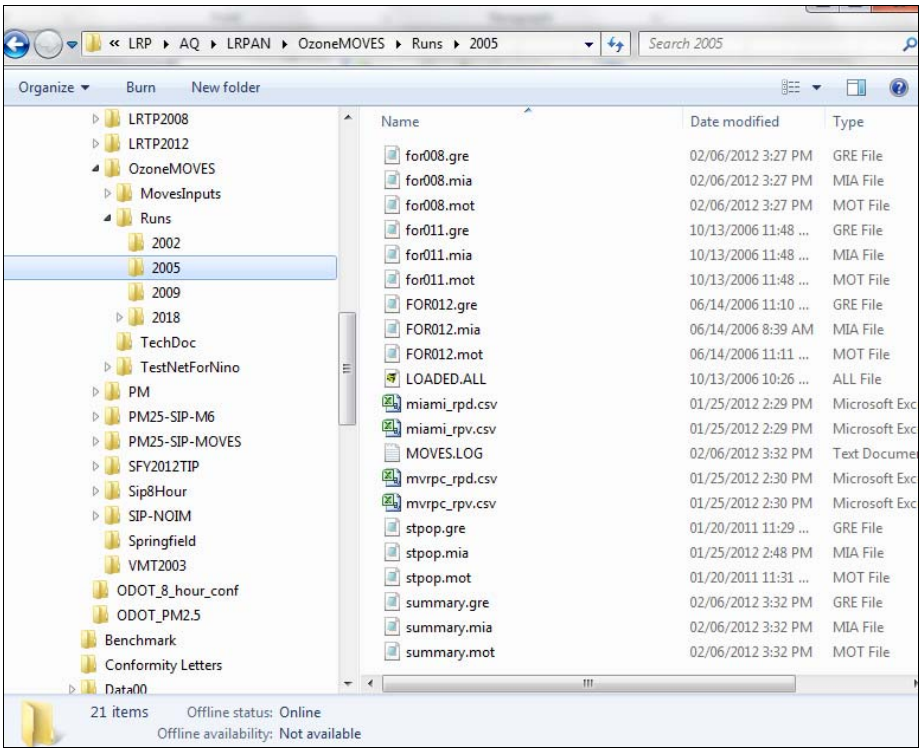

Figure 1 – MVRPC Emission Analyses Runs Directory Structure

Similarly, the Springfield Region also has a new travel demand model that combined with the latest planning assumptions was used to generate emissions in Clark County. The new travel demand model now covers all of Clark County and was validated in December 2005, more information is available at http://www.dot.state.oh.us/urban/data/to_docs/Springfield_model_userguide.doc. Figure 2 shows the directory structure or model run location. Due to the number of files and complexity, travel demand model run details have not been included in this technical memo.

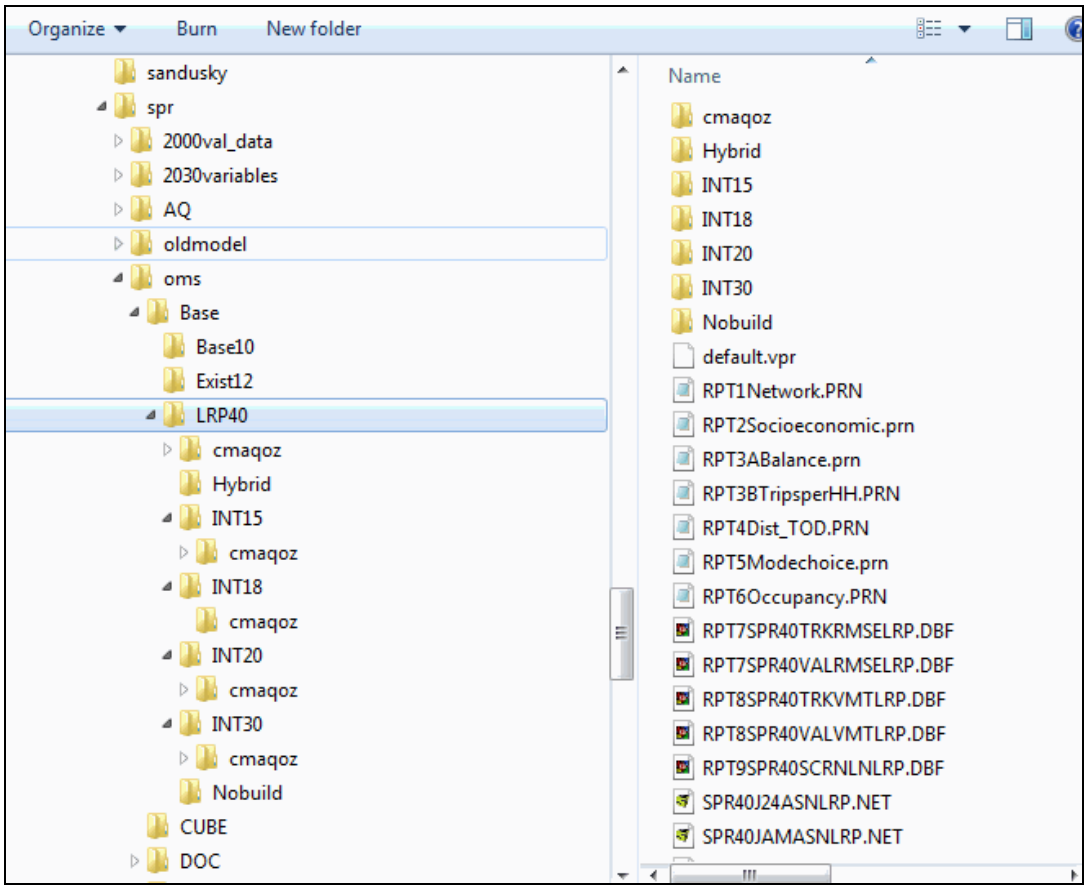

Figure 2 – CCS-TCC Travel Demand Model Run Directory Structure

Networks

Both CCS-TCC and MVRPC's modeled networks accurately reflect projects in their respective TIPs and Long Range Transportation Plans. Project lists can be found online as listed below:

CCS-TCC
http://www.clarktcc.com/LRP/2040%20LRP/DRAFT%202012%20LRP%20Project%20List%20093011.pdf

MVRPC
http://www.mvrpc.org/sites/default/files/2012%20Draft%20Project%20Inventory%20List.pdf

Landuse and Socio-economic Data

Both CCS-TCC and MVRPC's socio-economic model variables reflect the current and expected future regional land uses.

MVRPC's socio-economic variables were developed for the May 2012 2040 LRTP Update and are based on 2000/2010 Census variables and 2040 county-level Ohio Department of Development population projections with the exception of Greene County. In Greene County, the 2040 ODOD population projection was lower than the 2010 Census population count, MVRPC proposed an alternative projection that was accepted for use in the Transportation Plan by the interagency consultation partners (see Appendix A for interagency consultation documentation).

On the employment side, adjustments were made primarily to account for manufacturing job loses between 2000 and 2010, recognizing that the local economy is moving away from a manufacturing base and to account for known planned development efforts.

Independent variables are available for 4 analysis years (2000, 2005, 2010, and 2040) and the travel demand model has the ability of interpolating data for any year between available data sets. A summary of MVRPC's socio-economic data is available in Table 6. As can be seen from the Table, population, households, and employment are expected to make modest gains between 2010 and 2040. Both households and employment are expected to decline in the older urban areas of the region as the trend to develop in the suburban fringes and rural areas continues.

Table 6 – MVRPC Socio-Economic Variables

Variable	Area Type				
	CBD	Urban	Suburban	Rural	**Total**
# of TAZs	65	209	413	130	**817**
Acres	880	30,675	297,967	495,879	**825,401**
2005 Population					**805,816**
2005 Households	1,838	88,631	209,117	26,351	**325,937**
2005 Employment	27,942	95,363	304,111	14,574	**441,990**
2010 Census Population	-	-	-	-	**799,232**
2010 Households	2,151	77,584	220,039	27,856	**327,630**
2010 Employment	28,042	94,306	303,504	15,541	**441,393**
2040 ODOD Population	-	-	-	-	**820,227**
2040 Households	2,280	70,336	229,678	32,550	**334,844**
2040 Employment	29,653	87,835	329,415	16,730	**463,633**
2005 Persons per Household	1.30	2.33	2.41	2.66	**2.40**
2005 Workers per Household	0.61	1.11	1.27	1.41	**1.22**
2005 Autos per Household	0.63	1.42	1.82	2.26	**1.74**

Note: Includes Greene, Miami, and Montgomery Counties.

CCS-TCC's socio-economic variables were developed for the 2040 LRTP based on the 2000 Census variables, 2000 employment from QCEW, and 2030 population projections from the Ohio Department of Development. Projections were updated and extended to 2040 for the 2012 Plan based on 2010 census results and known employment changes including: school enrollment, hotels, educational and recreational employment, and area type. Independent variables (land use/socio-economic data) as provided by CCS-TCC are available for every analysis year. These variables are used by ODOT to generate new trip tables for the analysis years: 2002, 2005, 2009, 2018, and 2040.

Table 7 shows a summary of CCS-TCC's socio-economic data. This summary shows a slight decline in population, while households and employment show a moderate gain.

Table 7 – CCS-TCC Socio-Economic Variables

	Area Type (2000)				
	CBD	Urban	Suburban	Rural	**Total**
# of TAZs	9	67	104	123	**303**
2000 Population	2,893	23,046	64,021	54,912	**144,872**
2000 Households	1,143	8,587	25,840	21,127	**56,697**
2000 Employment	4,204	15,511	27,104	18,037	**64,856**
	Area Type (2010)				
	CBD	Urban	Suburban	Rural	**Total**
# of TAZs	9	67	106	121	**303**
2010 Population	3,195	20,765	61,638	56,013	**141,611**
2010 Households	1,282	8,406	25,915	22,038	**57,641**
2010 Employment	2,641	11,662	27,842	14,140	**56,285**
	Area Type (2040)				
	CBD	Urban	Suburban	Rural	**Total**
# of TAZs	9	67	106	121	**303**
2040 Population	3,212	20,580	61,841	58,940	**144,573**
2040 Households	1,327	9,349	27,961	24,220	**62,857**
2040 Employment	2,816	13,172	29,058	17,203	**62,249**

VMT Trends

Figure 3 shows Vehicle Miles Traveled (VMT) trends for each of the analysis years 2002- 2018- 2040 for the MVRPC (Greene and Montgomery Counties) and CCS-TCC (Clark County) Areas. These values represent un-factored travel demand model output. For ozone runs, model VMT is factored to represent an average summer day using a seasonal factor of **1.08.** Table 8 shows VMT for every analyzed year by County.

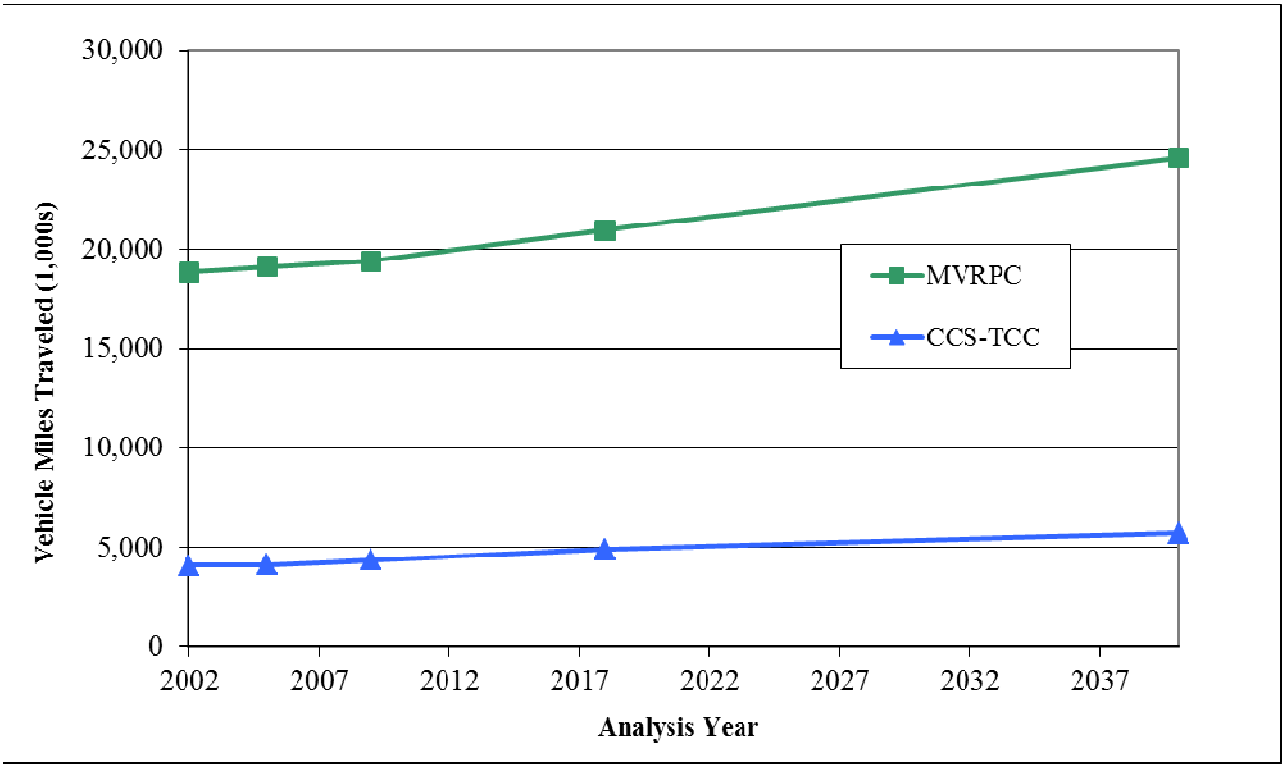

Figure 3 – Dayton/Springfield Region VMT Trends

Table 8 – Dayton/Springfield Region VMT

COUNTY	2002	2005	2009	2018	2040
Clark	4,077,939	4,125,028	4,361,567	4,886,265	5,717,303
Greene	3,699,424	3,772,608	3,885,992	4,505,806	5,592,691
Miami	2,781,320	2,853,082	2,928,990	3,241,290	4,096,994
Montgomery	12,364,039	12,491,875	12,596,718	13,206,968	14,932,076
TOTAL	**22,922,722**	**23,242,593**	**23,773,267**	**25,840,329**	**30,339,064**

3. Emission Factor Generation

Base and Attainment Years

Using MOVES, emission factor files were generated for base year-2002 and attainment year-2005 to represent the programs being implemented in the D/S Region. Programs and corresponding MOVES parameters were developed in consultation with OEPA. The emission factors for Montgomery and Greene Counties include an I/M program.

Future Years

Emission factors were also generated for two future year scenarios: 2009 and 2018. Future year scenarios assume no I/M since the program was terminated in 2005 but assume 7.8 rvp gasoline during since the SIP Ozone Maintenance Plan includes a commitment to implement 7.8 RVP fuel in the Dayton/Springfield area during the months of June through September 15, beginning in 2008. All other assumptions remain the same as those used to generate 2002 emission factors and are further illustrated in this section using year 2002 as an example.

Technical Details

Table 9 summarizes the settings used in the MOVES run specification file and the MOVES County-Data Manager. Further details in specific inputs that are not using default values are provided below.

Table 9 – MOVES Inputs

RunSpec Parameter Settings	
MOVES Version	MOVES2010A
Scale	Custom Domain
MOVES Modeling Technique	Emission Factor Method Rates per Profile (grams/vehicle) Rates per Distance (grams/mile) Rates per Vehicle (grams/vehicle)
Time Span	Time Aggregation: Hour 1 Month representing average summer temperatures All hours of day selected 16 speed bins Weekdays only
Geographic Bounds	Clark, Greene, Miami, and Montgomery Counties
Vehicles/Equipment	All source types, gasoline and diesel
Road Type	All road types including off-network
Pollutants and Processes	Total Gaseous Hydrocarbons, Non-Methane Hydrocarbons, Volitile Organic Compounds, NO_x, NO, NO_2, Total Energy Consumption
Strategies	Default values with assumed CNG buses removed
General Output	Units = grams, joules and miles

Output Emissions	Time = hour, Location = custom area, on-road emission rates by road type and source use type.
Advance Performance	None
County Data Manager Sources	
Source Type Population	Combination of local and default data Local data (2010) ODOT from motor vehicle registration Default data used for source types 41, 51, 54, 61, and 62 Future year growth rate based on MPO model Household growth rate.
Vehicle Type VMT	Combination of local and default data HPMSVTypeYear VMT = daily VMT from travel demand model monthVMTFraction = default dayVMTFraction=default hourVMTFraction=local
I/M Program	I/M program information applied for 2002/2005 where applicable for all counties except Miami (Miami Co. is never had an I/M program)
Fuel Formulation	Default
Fuel Supply	Reformulated gas (7.8 RVP) for summer analyses
Metereology Data	Local data obtained from NOAA National Climatic Data Center. Data will consist of monthly high and low temperatures and daily relative humidity for 2002.
Ramp Fraction	Using the base year travel demand model for VHT fractions. Future fractions will be assumed constant
Road Type Distribution	Use ODOT county summary VMT categorized by federal functional classes
Age Distribution	Combination of local and default data. Local data (2010) ODOT from motor vehicle registration Default data used for source types 41, 51, 54, 61, and 62 The same age distribution will be used for all analysis years
Average Speed Distribution	Default
Alternative Fuel Type	Default

Temperature and Relative Humidity

Temperatures used for the single season approach are representative of July 2002 based on NOAA data from the National Climate Data Center webiste. Data for Wright Patterson AFB was used because it was the most complete compared to other airports in the non-attainment area. To get the correct fomat for MOVES, the data was entered into a spreadsheet provided by EPA which was designed to convert Mobile6 data to MOVES. The average July hourly temperature and relative humidity distribution profile can be seen in Table 10.

Table 10 – Temperature and Relative Humidity Data

Hour	Average Temperature	Average Relative Humidity
1	71.3367	78
2	70.0883	78
3	69.1075	80
4	68.3942	81
5	67.8592	83
6	67.2350	85
7	66.7000	81
8	67.1458	76
9	69.8208	69
10	74.1008	63
11	78.4700	58
12	82.2150	54
13	85.5142	50
14	87.2975	48
15	87.9217	47
16	88.1000	46
17	87.6542	47
18	86.4058	50
19	84.2658	54
20	81.5017	60
21	78.7375	66
22	76.3300	70
23	74.6358	71
24	72.9417	76

Ramp Fraction

Ramp fractions were derived using the base year travel demand model VHT fractions. Ramp fractions can be seen in Table 11. Base year fractions were assumed to apply to future years.

Table 11 – Ramp Fractions

roadTypeID	roadDesc	rampFraction
2	Rural Restricted Access	0.04
4	Urban Restricted Access	0.11

Source Type Population

Source type population is based on a combination of local and MOVES default data. Local data was provided by ODOT based on 2010 motor vehicle registration. Default data is used for source types 41, 51, 54, 61, and 62. Future year growth rate is based on MPO model household growth rate which is 0% in MVRPC. In Clark County cars are an independent variable to the travel demand model. The base year (2000) and the LP year (2040) are used to interpolate the number of cars for the needed analysis years in Clark County. Table 12 shows source type population for the analyzed counties in 2005.

Similar to VMT, the vehicle population is adjusted from average number of vehicles to the number of vehicles in a summer day. In the absence of data, a 1.08 factor, as agreed via interagency consultation and the same as for VMT is used. (Appendix A)

Table 12 – Source Type Population for year 2005

sourceTypeID	sourceTypeName	Clark	Greene	Miami	Montgomery
11	MotorCycle	8,341	9,014	7,967	25,096
21	Passenger Car	96,932	105,808	71,041	395,925
31	Passenger Truck	44,885	53,557	37,861	172,425
32	Light Commercial Truck	1,129	1,235	698	4,614
41	Intercity Bus	71	52	47	178
42	Transit Bus	17	14	7	66
43	School Bus	256	356	245	1,187
51	Refuse truck	44	36	28	138
52	Single Unit Short-haul Truck	68	46	26	119
53	Single Unit Long-haul Truck	133	124	238	169
54	Motor Home	214	172	136	665
61	Comb Short-haul Truck	877	478	443	1,789
62	Comb Long-haul Truck	1,009	550	510	2,058

I/M Program

I/M program information was applied to 2002/2005 input files based on an ASM 2525, biennial I/M program, for gasoline-powered passenger cars and trucks and light commercial trucks, assuming a 98 percent compliance rate. The I/M program was turned “off” for analyses years after 2005 and emission factor in Miami County.

Vehicle Age Distribution

Vehicle age distribution information was derived using Ohio Bureau of Motor Vehicle registration data for year 2010. The data was given to OEPA who supplied a VIN decoder that allowed ODOT to create correctly formatted MOVES inputs. MOVES default data is used for

source types 41, 51, 54, 61, and 62. The registration data for all three counties in the non-attainment area were combined to create a regional vehicle age distribution file, see Table 13. The same age distribution will be used for all analysis years

Table 13 – Vehicle Age Distribution

yearid	sourcetypeid	ageid	ageFraction		sourcetypeid	ageid	ageFraction		sourcetypeid	ageid	ageFraction
2005	11	0	0.0018		21	17	0.0364		32	3	0.0708
2005	11	1	0.0214		21	18	0.0330		32	4	0.0678
2005	11	2	0.0551		21	19	0.0256		32	5	0.0341
2005	11	3	0.0702		21	20	0.0211		32	6	0.0268
2005	11	4	0.0831		21	21	0.0174		32	7	0.0330
2005	11	5	0.0782		21	22	0.0133		32	8	0.0332
2005	11	6	0.0617		21	23	0.0098		32	9	0.0367
2005	11	7	0.0775		21	24	0.0087		32	10	0.0497
2005	11	8	0.0569		21	25	0.0067		32	11	0.0525
2005	11	9	0.0506		21	26	0.0051		32	12	0.0406
2005	11	10	0.0429		21	27	0.0026		32	13	0.0411
2005	11	11	0.0328		21	28	0.0016		32	14	0.0348
2005	11	12	0.0241		21	29	0.0015		32	15	0.0745
2005	11	13	0.0205		21	30	0.0444		32	16	0.0526
2005	11	14	0.0215		31	0	0.0062		32	17	0.0408
2005	11	15	0.0164		31	1	0.0255		32	18	0.0354
2005	11	16	0.0136		31	2	0.0463		32	19	0.0267
2005	11	17	0.0124		31	3	0.0558		32	20	0.0215
2005	11	18	0.0089		31	4	0.0650		32	21	0.0245
2005	11	19	0.0082		31	5	0.0782		32	22	0.0156
2005	11	20	0.0079		31	6	0.0722		32	23	0.0135
2005	11	21	0.0086		31	7	0.0708		32	24	0.0102
2005	11	22	0.0091		31	8	0.0674		32	25	0.0107
2005	11	23	0.0125		31	9	0.0545		32	26	0.0066
2005	11	24	0.0186		31	10	0.0579		32	27	0.0039
2005	11	25	0.0172		31	11	0.0569		32	28	0.0014
2005	11	26	0.0147		31	12	0.0507		32	29	0.0007
2005	11	27	0.0169		31	13	0.0452		32	30	0.0094
2005	11	28	0.0249		31	14	0.0407		41	0	0.0000
2005	11	29	0.0168		31	15	0.0424		41	1	0.0282
2005	11	30	0.0950		31	16	0.0350		41	2	0.0466
2005	21	0	0.0063		31	17	0.0298		41	3	0.0791
2005	21	1	0.0237		31	18	0.0215		41	4	0.0819
2005	21	2	0.0347		31	19	0.0166		41	5	0.0819
2005	21	3	0.0428		31	20	0.0123		41	6	0.0636
2005	21	4	0.0439		31	21	0.0114		41	7	0.0734

yearid	sourcetypeid	ageid	ageFraction		sourcetypeid	ageid	ageFraction		sourcetypeid	ageid	ageFraction
2005	21	5	0.0478		31	22	0.0096		41	8	0.0381
2005	21	6	0.0504		31	23	0.0072		41	9	0.0678
2005	21	7	0.0527		31	24	0.0057		41	10	0.0664
2005	21	8	0.0548		31	25	0.0038		41	11	0.0438
2005	21	9	0.0523		31	26	0.0026		41	12	0.0297
2005	21	10	0.0571		31	27	0.0016		41	13	0.0226
2005	21	11	0.0570		31	28	0.0006		41	14	0.0212
2005	21	12	0.0519		31	29	0.0004		41	15	0.0480
2005	21	13	0.0518		31	30	0.0062		41	16	0.0367
2005	21	14	0.0489		32	0	0.0063		41	17	0.0155
2005	21	15	0.0535		32	1	0.0418		41	18	0.0071
2005	21	16	0.0432		32	2	0.0828		41	19	0.0353
2005	41	20	0.0226		43	6	0.0595		51	23	0.0086
2005	41	21	0.0056		43	7	0.0584		51	24	0.0086
2005	41	22	0.0056		43	8	0.0623		51	25	0.0000
2005	41	23	0.0071		43	9	0.0639		51	26	0.0086
2005	41	24	0.0085		43	10	0.0611		51	27	0.0043
2005	41	25	0.0155		43	11	0.0823		51	28	0.0000
2005	41	26	0.0127		43	12	0.0656		51	29	0.0000
2005	41	27	0.0014		43	13	0.0506		51	30	0.0385
2005	41	28	0.0056		43	14	0.0183		52	0	0.0043
2005	41	29	0.0042		43	15	0.0222		52	1	0.0343
2005	41	30	0.0243		43	16	0.0183		52	2	0.0343
2005	42	0	0.0103		43	17	0.0167		52	3	0.1159
2005	42	1	0.0000		43	18	0.0178		52	4	0.0730
2005	42	2	0.0515		43	19	0.0178		52	5	0.0472
2005	42	3	0.0412		43	20	0.0167		52	6	0.0472
2005	42	4	0.0309		43	21	0.0156		52	7	0.0815
2005	42	5	0.0928		43	22	0.0117		52	8	0.1373
2005	42	6	0.0309		43	23	0.0133		52	9	0.0429
2005	42	7	0.0412		43	24	0.0117		52	10	0.0386
2005	42	8	0.0412		43	25	0.0078		52	11	0.0472
2005	42	9	0.1237		43	26	0.0044		52	12	0.0386
2005	42	10	0.0412		43	27	0.0061		52	13	0.0343
2005	42	11	0.0412		43	28	0.0006		52	14	0.0129
2005	42	12	0.0515		43	29	0.0028		52	15	0.0258
2005	42	13	0.0515		43	30	0.0093		52	16	0.0258
2005	42	14	0.0515		51	0	0.0043		52	17	0.0172
2005	42	15	0.0412		51	1	0.0343		52	18	0.0258
2005	42	16	0.0412		51	2	0.0343		52	19	0.0258
2005	42	17	0.0103		51	3	0.1159		52	20	0.0129

yearid	sourcetypeid	ageid	ageFraction		sourcetypeid	ageid	ageFraction		sourcetypeid	ageid	ageFraction
2005	42	18	0.0412		51	4	0.0730		52	21	0.0043
2005	42	19	0.0515		51	5	0.0472		52	22	0.0043
2005	42	20	0.0206		51	6	0.0472		52	23	0.0086
2005	42	21	0.0000		51	7	0.0815		52	24	0.0086
2005	42	22	0.0309		51	8	0.1373		52	25	0.0000
2005	42	23	0.0103		51	9	0.0429		52	26	0.0086
2005	42	24	0.0106		51	10	0.0386		52	27	0.0043
2005	42	25	0.0103		51	11	0.0472		52	28	0.0000
2005	42	26	0.0103		51	12	0.0386		52	29	0.0000
2005	42	27	0.0000		51	13	0.0343		52	30	0.0385
2005	42	28	0.0103		51	14	0.0129		53	0	0.0043
2005	42	29	0.0000		51	15	0.0258		53	1	0.0343
2005	42	30	0.0107		51	16	0.0258		53	2	0.0343
2005	43	0	0.0534		51	17	0.0172		53	3	0.1159
2005	43	1	0.0361		51	18	0.0258		53	4	0.0730
2005	43	2	0.0400		51	19	0.0258		53	5	0.0472
2005	43	3	0.0539		51	20	0.0129		53	6	0.0472
2005	43	4	0.0523		51	21	0.0043		53	7	0.0815
2005	43	5	0.0495		51	22	0.0043		53	8	0.1373
2005	53	10	0.0386		54	26	0.0226		62	11	0.0716
2005	53	11	0.0472		54	27	0.0151		62	12	0.0508
2005	53	12	0.0386		54	28	0.0108		62	13	0.0339
2005	53	13	0.0343		54	29	0.0064		62	14	0.0329
2005	53	14	0.0129		54	30	0.1363		62	15	0.0277
2005	53	15	0.0258		61	0	0.0015		62	16	0.0195
2005	53	16	0.0258		61	1	0.0124		62	17	0.0102
2005	53	17	0.0172		61	2	0.0270		62	18	0.0080
2005	53	18	0.0258		61	3	0.0335		62	19	0.0052
2005	53	19	0.0258		61	4	0.0436		62	20	0.0058
2005	53	20	0.0129		61	5	0.0460		62	21	0.0056
2005	53	21	0.0043		61	6	0.0550		62	22	0.0026
2005	53	22	0.0043		61	7	0.0601		62	23	0.0009
2005	53	23	0.0086		61	8	0.0536		62	24	0.0017
2005	53	24	0.0086		61	9	0.0496		62	25	0.0017
2005	53	25	0.0000		61	10	0.0533		62	26	0.0013
2005	53	26	0.0086		61	11	0.0527		62	27	0.0002
2005	53	27	0.0043		61	12	0.0453		62	28	0.0004
2005	53	28	0.0000		61	13	0.0489		62	29	0.0002
2005	53	29	0.0000		61	14	0.0407		62	30	0.0013
2005	53	30	0.0385		61	15	0.0439				
2005	54	0	0.0048		61	16	0.0443				

yearid	sourcetypeid	ageid	ageFraction		sourcetypeid	ageid	ageFraction		sourcetypeid	ageid	ageFraction
2005	54	1	0.0148		61	17	0.0315				
2005	54	2	0.0268		61	18	0.0307				
2005	54	3	0.0365		61	19	0.0282				
2005	54	4	0.0423		61	20	0.0237				
2005	54	5	0.0482		61	21	0.0273				
2005	54	6	0.0504		61	22	0.0278				
2005	54	7	0.0431		61	23	0.0179				
2005	54	8	0.0413		61	24	0.0183				
2005	54	9	0.0418		61	25	0.0130				
2005	54	10	0.0499		61	26	0.0096				
2005	54	11	0.0487		61	27	0.0056				
2005	54	12	0.0454		61	28	0.0046				
2005	54	13	0.0336		61	29	0.0034				
2005	54	14	0.0355		61	30	0.0470				
2005	54	15	0.0381		62	0	0.0045				
2005	54	16	0.0292		62	1	0.0448				
2005	54	17	0.0235		62	2	0.0074				
2005	54	18	0.0171		62	3	0.1062				
2005	54	19	0.0148		62	4	0.1088				
2005	54	20	0.0169		62	5	0.1557				
2005	54	21	0.0209		62	6	0.0692				
2005	54	22	0.0234		62	7	0.0424				
2005	54	23	0.0230		62	8	0.0478				
2005	54	24	0.0200		62	9	0.0504				
2005	54	25	0.0188		62	10	0.0813				

Road Type Distribution

Road type distribution is based on the 2008 ODOT, county summary, HPMS VMT data categorized by federal functional class for the three county non-attainment area. Road type distribution can be seen in Table 14.

Table 14 – Road Type Distribution

sourceTypeID	roadTypeID	roadTypeVMTFraction		sourceTypeID	roadTypeID	roadTypeVMTFraction
11	1	0		43	4	0.29
11	2	0.06		43	5	0.52
11	3	0.13		51	1	0
11	4	0.29		51	2	0.06
11	5	0.52		51	3	0.13
21	1	0		51	4	0.29
21	2	0.06		51	5	0.52
21	3	0.13		52	1	0
21	4	0.29		52	2	0.06
21	5	0.52		52	3	0.13
31	1	0		52	4	0.29
31	2	0.06		52	5	0.52
31	3	0.13		53	1	0
31	4	0.29		53	2	0.06
31	5	0.52		53	3	0.13
32	1	0		53	4	0.29
32	2	0.06		53	5	0.52
32	3	0.13		54	1	0
32	4	0.29		54	2	0.06
32	5	0.52		54	3	0.13
41	1	0		54	4	0.29
41	2	0.06		54	5	0.52
41	3	0.13		61	1	0
41	4	0.29		61	2	0.06
41	5	0.52		61	3	0.13
42	1	0		61	4	0.29
42	2	0.06		61	5	0.52
42	3	0.13		62	1	0
42	4	0.29		62	2	0.06
42	5	0.52		62	3	0.13
43	1	0		62	4	0.29
43	2	0.06		62	5	0.52
43	3	0.13				

Vehicle Type VMT and VMT Fractions

The first component of the VMT inputs is the Yearly HPMS VMT, but the travel demand model was used instead of ODOT's HMPS data since it was felt that the model would better predict future year VMT. ODOT's CMS post-processor was run for each year to generate congestion reports, which includes total daily VMT. The vehicle type percentages of the total VMT were based on ODOT's weigh-in-motion (WIM) data. Since there are not enough WIM stations for lower class facilties in the non-attainment area, a statewide average of all ODOT WIM data collectors was used. Daily VMT was then converted to yearly. Yearly HPMS VMT for 2005 can be seen in Table 15. The same method was to generate all other analysis years

Table 15 – Yearly HPMS VMT for 2005

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2005	30590102	0
20	2005	5455503318	0
30	2005	1683283544	0
40	2005	17205399	0
50	2005	127192033	0
60	2005	301977250	0

Monthly and daily VMT fractions used MOVES default data. The hourly VMT fractions were derived from ODOT WIM data. Hourly VMT fractions vary for each of the five MOVES road types but do not change for each of the 16 MOVES source types. A representative sample of the hour VMT fraction input file can be seen in Table 16, the entire file is too large to include in this document.

Table 16 – Hourly VMT Fractions

sourceTypeID	roadTypeID	dayID	hourID	hourVMTFraction
11	1	2	1	0.0089
11	1	2	2	0.00564
11	1	2	3	0.00424
11	1	2	4	0.00427
11	1	2	5	0.00695
11	1	2	6	0.01798
11	1	2	7	0.03806
11	1	2	8	0.057
11	1	2	9	0.05773
11	1	2	10	0.05538
11	1	2	11	0.05554
11	1	2	12	0.05558
11	1	2	13	0.05584
11	1	2	14	0.06051

sourceTypeID	roadTypeID	dayID	hourID	hourVMTFraction
11	1	2	15	0.06765
11	1	2	16	0.07755
11	1	2	17	0.08428
11	1	2	18	0.0797
11	1	2	19	0.06012
11	1	2	20	0.04522
11	1	2	21	0.03646
11	1	2	22	0.02912
11	1	2	23	0.02142
11	1	2	24	0.01486
11	2	2	1	0.0089
11	2	2	2	0.00564
11	2	2	3	0.00424
11	2	2	4	0.00427
11	2	2	5	0.00695
11	2	2	6	0.01798
11	2	2	7	0.03806
11	2	2	8	0.057
11	2	2	9	0.05773
11	2	2	10	0.05538
11	2	2	11	0.05554
11	2	2	12	0.05558
11	2	2	13	0.05584
11	2	2	14	0.06051
11	2	2	15	0.06765
11	2	2	16	0.07755
11	2	2	17	0.08428
11	2	2	18	0.0797
11	2	2	19	0.06012
11	2	2	20	0.04522
11	2	2	21	0.03646
11	2	2	22	0.02912
11	2	2	23	0.02142
11	2	2	24	0.01486
11	3	2	1	0.00655
11	3	2	2	0.0037
11	3	2	3	0.00304
11	3	2	4	0.00363

sourceTypeID	roadTypeID	dayID	hourID	hourVMTFraction
11	3	2	5	0.00792
11	3	2	6	0.02343
11	3	2	7	0.04899
11	3	2	8	0.06319
11	3	2	9	0.05402
11	3	2	10	0.05121
11	3	2	11	0.0528
11	3	2	12	0.05608
11	3	2	13	0.05814
11	3	2	14	0.05875
11	3	2	15	0.06676
11	3	2	16	0.07812
11	3	2	17	0.08469
11	3	2	18	0.08152
11	3	2	19	0.05852
11	3	2	20	0.04343
11	3	2	21	0.03606
11	3	2	22	0.02829
11	3	2	23	0.01883
11	3	2	24	0.01233
11	4	2	1	0.00752
11	4	2	2	0.0044
11	4	2	3	0.00354
11	4	2	4	0.00374
11	4	2	5	0.00705
11	4	2	6	0.02123
11	4	2	7	0.054
11	4	2	8	0.0768
11	4	2	9	0.06545
11	4	2	10	0.05114
11	4	2	11	0.04692
11	4	2	12	0.04916
11	4	2	13	0.05112
11	4	2	14	0.0534
11	4	2	15	0.06105
11	4	2	16	0.07421
11	4	2	17	0.08321
11	4	2	18	0.08385
11	4	2	19	0.06062

sourceTypeID	roadTypeID	dayID	hourID	hourVMTFraction
11	4	2	20	0.04229
11	4	2	21	0.03442
11	4	2	22	0.0292
11	4	2	23	0.02137
11	4	2	24	0.01431
11	5	2	1	0.00678
11	5	2	2	0.00378
11	5	2	3	0.00295
11	5	2	4	0.0029
11	5	2	5	0.00498
11	5	2	6	0.01422
11	5	2	7	0.03449
11	5	2	8	0.05728
11	5	2	9	0.05435
11	5	2	10	0.04991
11	5	2	11	0.05261
11	5	2	12	0.06098
11	5	2	13	0.06457
11	5	2	14	0.06387
11	5	2	15	0.06812
11	5	2	16	0.07672
11	5	2	17	0.08274
11	5	2	18	0.08284
11	5	2	19	0.06344
11	5	2	20	0.04866
11	5	2	21	0.0407
11	5	2	22	0.03083
11	5	2	23	0.01966
11	5	2	24	0.01262

Output Emission Factors

Table 17 shows the first record in a MOVES sample output (rate per distance) emission file for year 2005 with I/M programs. For any given month, day of week, hour of the day, pollutant, and source type; the rate per distance varies by road type and speed bin. Rates per distance emissions are applied to link and intrazonal VMT.

Table 17 – Sample Emission File (Rate per Distance) for year 2005

Heading:	MOVESScenarioID	MOVESRunID	yearID	monthID	dayID	hourID
Record:			2005	7	5	1
Heading:	linkID	pollutantID	processID	sourceTypeID	SCC	fuelTypeID
Record:		87	0	1		0
Heading:	modelYearID	roadTypeID	avgSpeedBinID	temperature	relHumidity	ratePerDistance
Record:	0	2	1			6.90740776

Table 18 shows the first record in a MOVES sample output (rate per vehicle) emission file for year 2005 with I/M programs. The rate per vehicle varies for any combinations of month, day of week, hour of the day, pollutant, and process. Rates per vehicle emissions are applied to the vehicle source type population.

Table 18 – Sample Emission File (Rate per Vehicle) for year 2005

Heading:	MOVESScenarioID	MOVESRunID	yearID	monthID	dayID
Record:			2005	7	5
Heading:	hourID	zoneID	pollutantID	processID	sourceTypeID
Record:	1		87		1
Heading:	SCC	fuelTypeID	modelYearID	temperature	ratePerVehicle
Record:		0	0		0.27257887

Table 19 shows the first record in a MOVES sample output (rate per profile) emission file for year 2005 with I/M programs. The rate per vehicle varies for any combinations of month, day of week, hour of the day, pollutant, and process. Rates per profile emissions are applied to the vehicle souce type population.

Table 19 – Sample Emission File (Rate per Profile) for year 2005

Heading:	MOVESScenarioID	MOVESRunID	yearID	monthID	dayID
Record:			2005	0	5
Heading:	hourID	zoneID	pollutantID	processID	sourceTypeID
Record:	1		87	0	1
Heading:	SCC	fuelTypeID	modelYearID	temperature	ratePerVehicle
Record:		0	0		0.01774139

4. Post Processing

Total emissions were computed with the aid of several custom programs by ODOT. The process uses data on daily and directional traffic distributions as well as more up to date volume/delay functions from the 2000 Highway Capacity Manual (HCM). This process, described below and illustrated in Figure 4, also uses rewritten code able to handle the newer model network formats and MOVES generated emission factors.

The first step in the the process involves running postcms.exe to calculate hourly link volumes based on the percentage of the daily volume (travel demand model output) determined by a link's facility and area type. Link speeds from the travel demand model are not used in the analysis. The speeds are estimated as a post-process to the model based on HCM methods using a link's volume-to-capacity ratio and link group code. The daily to hourly volume conversion percentages and speed tables can be seen in **Appendix B.1.**

The second step (movesnet.exe) uses a combination of the MOVES emission factors and the hourly link volumes that are output of the postcms.exe program. The hourly volumes are multiplied by the MOVES emission factor for the corresponding hour of day, speed bin, and roadtype to calculate emissions for every network link for each hour. The final link on road vehicle emissions for the area is the sum of all individual link-hour emissions.

The third step, (movesveh.exe), calculates vehicle-based emissions (using a combination of the Rate per Distance and Rate per Profile files) for each source type for each hour of the day. The vehicle source type is based on a combination of local and default data. The final vehicle emissions for each county are the sum of all individual hourly emissions for all vehicle types.

Intrazonal trips do not get loaded onto the network, so the fourth step in the process requires a separate method to account for those trips that use local roads to travel within a zone. The movesintra.exe program uses intrazonal trips to estimate VMT using the area in square miles and intrazonal trips of each zone. The zone is assumed circular and the radius of the circle is used as the average trip length for these intrazonal trips. Intrazonal emissions are then calculated by combining MOVES generated emissions with estimated intrazonal VMT. The emission rates are the same as those used to calculated link based emissions.

The final step is to summarize link, vehicle, and intrazonal emissions for each county, pollutant, and analyzed year. Daily summary emissions for each pollutant, county, and scenario year in the Dayton Springfield Region can be found in **Appendix B.2.**

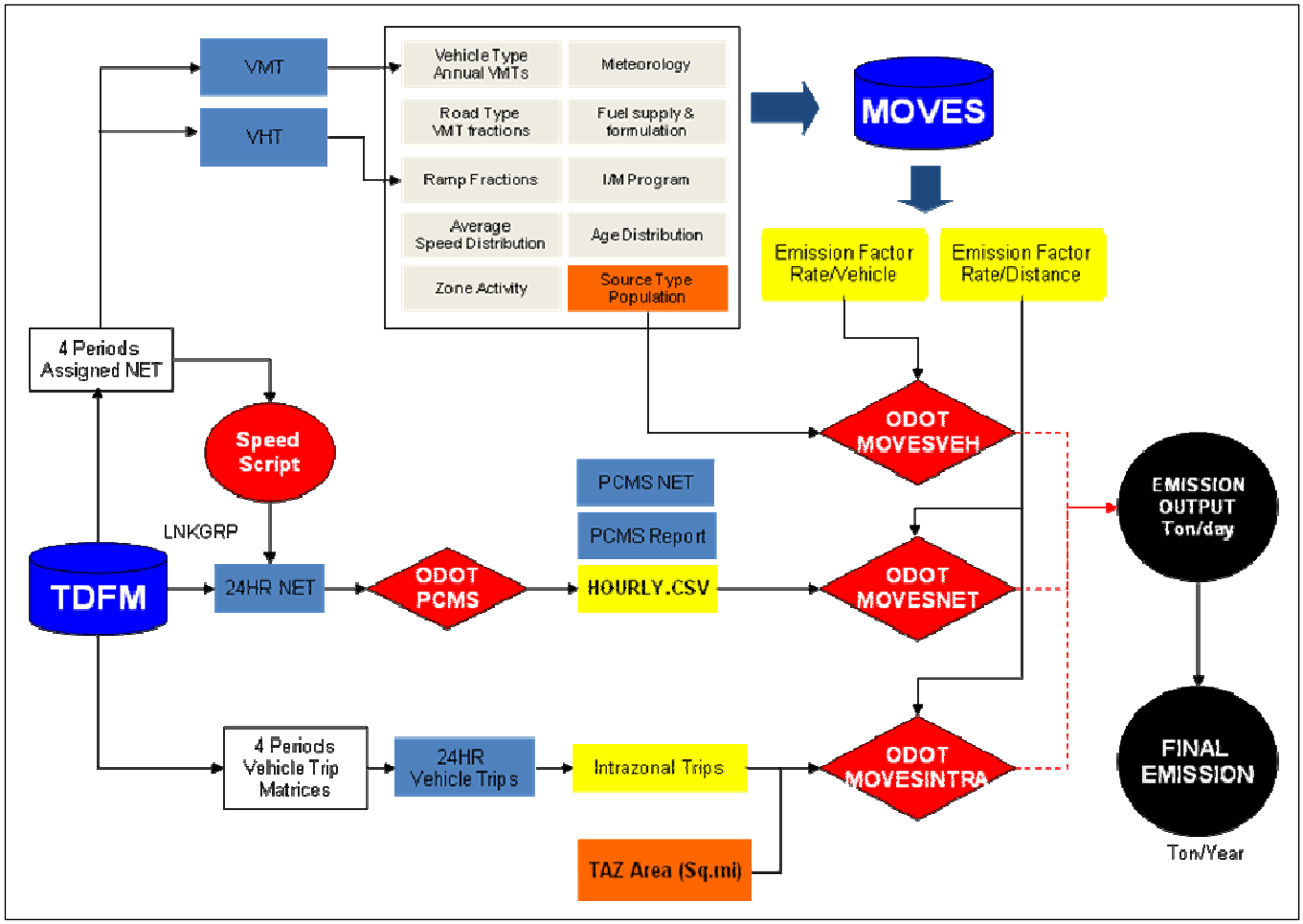

Figure 4 – Emission Calculation Process

5. Multiple MPO Coordination Issues

CCS-TCC, MVRPC, ODOT, and OEPA have a long history of working together in air quality issues, the Memorandum of Understanding, listed below, documents these working relationships. The document is in the process of being signed by all parties involved.

- Memorandum of Understanding among the MVRPC, the CCS-TCC, the OKI Regional Council of Governments, the OEPA, the ODOT, the US EPA-Region 5, the FHWA-Ohio Division, and the FTA-Region 5.

Appendix A

Interagency Consultation Documentation

Dayton-Springfield Ozone SIP MOVES Update
Minutes 8/24/2011

Attending: ODOT employees Dave Moore, Monica Drake, Mark Byram, Nino Brunello, and Andrew Shepler, Jennifer Hunter - OEPA, Pat Morris – US EPA, Ana Ramirez – MVRPC, Scott Schmidt – CCSTCC, Lamar Daniel – CCSTCC.

This air quality interagency consultation conference call was held to coordinate development of revision to the Dayton/Springfield 8-Hour Ozone SIP Maintenance Plan. The SIP revision will update the mobile source HC and NOx budgets to reflect US EPA's new MOVES software emission results. The SIP revision will be reviewed and approved via the federal register process.

Pat Morris confirmed that a full SIP revision is needed. She also confirmed that only the mobile source emissions will be updated, not point, area, etc.
Analysis years will be consistent with the existing Ozone SIP:

- 2002 - base year
- 2005 - attainment and budget year
- 2009 - interim non-budget analysis year
- 2018 - out year budget

Pat Morris confirmed that these four years are acceptable. When asked about using fewer years, Pat stated that it is helpful to have the runs for all four years.

Temperature and humidity inputs for the Ozone SIP Update will be consistent with the existing Ozone SIP, reflecting an average day in July. The existing SIP reflected temperature data from the ten hottest days of summer, 2002. Temperature minimum and maximum were provided by OEPA, correspondence is on file at ODOT and included in technical MPO memos. For MOBILE6 runs, hourly temperatures were established based on a daily profile ODOT developed from NOAA data. The MOBILE to MOVES translator applies a daily temperature profile in a similar manner and will be used for this SIP update.

Ana Ramirez asked Nino Brunello to prepare a protocol document recording the analysis input parameters to use as a guide for the technical documentation that MVRPC will produce. Nino agreed to transmit the document the week of August 29.

Latest Planning Assumptions:
Latest land use and population assumptions will be used. Therefore, 2018 forecasts will reflect the latest socio-economic conditions based on the 2010 Census and current Transportation Plan.

Emissions parameters will be consistent with the MOBILE based SIP runs, as follows:
2002 & 2005 will reflect E-check
2009 & 2018 will reflected RVP 7.8

A safety margin was not included in 2005. Pat Morris said that a safety margin could be added in future years if necessary. It was determined that the safety margins would be added if necessary after the runs are completed. 2005 will also be looked at prior to submission of the SIP.

Nino requested that for Ozone emissions, MOVES emission factors by source type (ie vehicle class) be used instead of the aggregated emission factors that have been used for PM2.5 analyses. This is a more detailed approach which should produce more accurate results, more defensible results. This request was approved. MVRPC agreed contingent on the results of comparisons between aggregate versus disaggregate emission factor methods. To insure deadlines are met, Nino will run the aggregate methodology first in case he runs into problems with the more detailed disaggregate methodology.

The schedule was discussed.

1) Emission factors will be provided to MVRPC by ODOT by mid-September.
2) Information would need to be submitted to OEPA & US EPA by mid-November.
3) The deadline for approved budgets is mid-February. OEPA will need three months to process.
4) US EPA will complete as much as possible concurrently with OEPA. Pat Morris stated that she will need 90 days and will need approval by OPEA to complete the budgets for approval.
5) The conformity finding needs to be complete by August 1, 2012.

The meeting concluded following the schedule discussion.

MOVES Ozone Inputs Technical Details

The summaries and the settings used in the MOVES run specification file and the MOVES County-Data Manager are shown below. Further details in specific inputs that are not using default values are provided below.

Parameters used for ozone analyses are similar to those used for PM analyses with the exception of: pollutants, additional profile emissions, analysis month, and the use of consecutive hourly temperature differences for calculation of the vapor venting process.

Instead of using average emission rates for the entire vehicle fleet, total emissions by individual source types will be calculated.

RunSpec Parameter Settings	
MOVES Version	MOVES2010A
Scale	Custom Domain
MOVES Modeling Technique	Emission Factor Method Rates per Profile (grams/vehicle) Rates per Distance (grams/mile) Rates per Vehicle (grams/vehicle)
Time Span	Time Aggregation: Hour 1 Month representing average summer temperatures All hours of day selected 16 speed bins Weekdays only
Geographic Bounds	Clark, Greene, Miami, and Montgomery Counties
Vehicles/Equipment	All source types, gasoline and diesel
Road Type	All road types including off-network
Pollutants and Processes	Total Gaseous Hydrocarbons, Non-Methane Hydrocarbons, Volitile Organic Compounds, NO_x, NO, NO_2, Total Energy Consumption
Strategies	None
General Output	Units = grams, joules and miles
Output Emissions	Time = hour, Location = custom area, on-road emission rates by road type and source use type.
Advance Performance	None

County Data Manager Sources	
Source Type Population	Combination of local and default data Local data (2010) ODOT from motor vehicle registration Default data used for source types 41, 51, 54, 61, and 62 Future year growth rate based on MPO model Household growth rate.
Vehicle Type VMT	Combination of local and default data HPMSVTypeYear VMT = daily VMT from travel demand model monthVMTFraction = default dayVMTFraction=default hourVMTFraction=local
I/M Program	I/M program information applied for 2002/2005 where applicable for all counties except Miami (Miami Co. is never had an I/M program)
Fuel Formulation	Default
Fuel Supply	Reformulated gas (RVP) for summer analyses
Metereology Data	Local data obtained from NOAA National Climatic Data Center. Data will consist of monthly high and low temperatures and daily relative humidity for 2002.
Ramp Fraction	Using the base year travel demand model for VHT fractions. Future fractions will be assumed constant
Road Type Distribution	Use ODOT county summary VMT categorized by federal functional classes
Age Distribution	Combination of local and default data. Local data (2010) ODOT from motor vehicle registration Default data used for source types 41, 51, 54, 61, and 62 The same age distribution will be used for all analysis years
Average Speed Distribution	Default
Alternative Fuel Type	Default

From: Brunello, Nino [mailto:Nino.Brunello@dot.state.oh.us]
Sent: Thursday, April 19, 2012 2:30 PM
To: PJividen@AkronOhio.gov; CBaker@akronohio.gov; Jeff Dutton; Bill Davis; Nick Gill (NGILL@morpc.org); Ramirez, Ana; Saleem Salameh; Lima (tmazur@lacrpc.com); smapel@lcounty.com; 'randy.durst@movrc.org' (randy.durst@movrc.org); sschmid@clarkcountyohio.gov; mikepap@bhjmpc.org; David Gedeon; rsharma@belomar.org; krodi@eastgatecog.org
Cc: Fred Durham; Dines, Jennifer; Patricia Morris (Morris.Patricia@epamail.epa.gov) (Morris.Patricia@epamail.epa.gov); Moore, Dave; Byram, Mark
Subject: FW: Ozone Summer Day Factors

All:

After discussions with ODOT, OEPA, WVDEP, and USEPA, we are of the opinion that there needs to be an additional seasonal factor for summer when calculating ozone pollutants.

There is currently an adjustment for increasing average daily VMT (+ 8%) which was used in previously when using Moblie6 to generate emission factors. With MOVES, there is a vehicle component used in addition to VMT, so there needs to be an adjustment from average number of vehicles to the number of vehicles in summer day. We propose to use the same 8% increase.

We need to have an inter-agency agreement on this, and would prefer to do it via email (to make it easier on all of us). Please respond with your approval and/or questions.

Thanks,

~~~~~~
Nino Brunello, P.E.
Modeling & Forecasting Section
Division of Planning
Ohio Department of Transportation
(614) 752-5742

From: Dines, Jennifer
Sent: Thursday, April 12, 2012 9:04 AM
To: Brunello, Nino; Durham, William F
Cc: Moore, Dave
Subject: RE: Ozone Summer Day Factors

Nino and Fred, talked to Pat and she agrees that BOTH VMT and number of vehicles should have the 1.08 factor applied.

Pat suggested we should have consultation on this. I told her ODOT is taking the lead on this project and I'd let Dave know……..she says email is fine.

Thanks,

Jennifer Dines
Manager, State Implementation Plan and Rulemaking Section
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Division of Air Pollution Control
Ohio Environmental Protection Agency
Wk (614) 644-3696
Fax (614) 644-3681

From: Brunello, Nino
Sent: Monday, April 09, 2012 12:59 PM
To: Dines, Jennifer; Durham, William F
Subject: RE: Ozone Summer Day Factors

Jennifer/Fred,

There is another item that needs to be discussed. Since we now calculate emission rates for both VMT and number of vehicles, does there need to be a summer adjustment factors for vehicles as well? This was not done with MOBILE, so we have nothing to follow. If I had to guess, I would think that there would be an increase, but I couldn't guess as to how many or what factor to use. Maybe just use 1.08 in absence of anything better? Thoughts?

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Nino Brunello, P.E.
Modeling & Forecasting Section
Division of Planning
Ohio Department of Transportation
(614) 752-5742

From: Dines, Jennifer
Sent: Monday, April 09, 2012 8:47 AM
To: Brunello, Nino; Durham, William F
Subject: RE: Ozone Summer Day Factors

I'm available

Jennifer Dines
Manager, State Implementation Plan and Rulemaking Section
Division of Air Pollution Control
Ohio Environmental Protection Agency
Wk (614) 644-3696
Fax (614) 644-3681

From: Brunello, Nino
Sent: Monday, April 09, 2012 8:30 AM
To: Durham, William F; Dines, Jennifer
Subject: RE: Ozone Summer Day Factors

I can call anytime. Will you both be around at 9:00? If not, when would be the next earliest time? (on the half hours)

-Nino
~~~~~~

From: Durham, William F [mailto:William.F.Durham@wv.gov]
Sent: Friday, April 06, 2012 8:50 AM
To: Brunello, Nino
Cc: Dines, Jennifer
Subject: Ozone Summer Day Factors

Nino:
I spoke with Jenn this morning and outlined the issue of Summer day VMT v. Average daily VMT.
We agreed that Pat Morris may be able to shed some light on the question.
Jenn & my calendars are open next Mon. and Tues. afternoon. Please give me a call & I'll patch Jenn in.
Fred

Appendix B

Appendix B.1
Post Processing Default Distributions

HOUR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
PCTADT																								
URB FWY	0.9	0.6	0.5	0.6	0.9	2.2	5.2	7.3	6.4	5.2	4.9	5.1	5.3	5.5	6.1	7.2	8.0	7.9	5.8	4.2	3.4	2.9	2.2	1.5
URB ART	0.7	0.4	0.3	0.3	0.6	1.5	3.5	5.7	5.5	5.1	5.3	6.2	6.5	6.4	6.8	7.6	8.2	8.1	6.2	4.8	4.0	3.0	1.9	1.3
RUR FWY	1.4	1.1	0.9	1.0	1.3	2.2	3.7	5.2	5.4	5.4	5.6	5.6	5.7	6.0	6.5	7.1	7.5	7.0	5.6	4.5	3.8	3.2	2.5	2.0
RUR ART	0.8	0.5	0.4	0.5	1.0	2.4	4.8	6.2	5.5	5.3	5.5	5.8	6.0	6.0	6.7	7.6	8.1	7.7	5.6	4.2	3.5	2.8	1.9	1.3
PCTADT TRK																								
URB FWY	2.1	1.9	1.8	2.0	2.4	3.0	3.9	4.6	5.3	6.0	6.3	6.4	6.4	6.4	6.3	5.8	5.2	4.6	4.1	3.7	3.4	3.1	2.8	2.4
URB ART	1.1	0.9	1.0	1.2	1.6	2.3	3.9	5.9	6.9	6.7	7.1	7.6	7.4	7.2	7.4	7.2	6.0	5.0	3.7	2.8	2.3	1.9	1.5	1.3
RUR FWY	2.6	2.2	2.1	2.3	2.6	3.1	3.5	4.0	4.5	5.1	5.6	5.8	5.8	5.8	5.8	5.6	5.3	4.9	4.6	4.3	4.0	3.8	3.5	3.1
RUR ART	1.5	1.3	1.4	1.6	2.2	3.0	4.2	5.3	6.1	6.7	7.0	7.1	7.0	6.9	6.8	6.3	5.5	4.6	3.8	3.1	2.6	2.3	2.1	1.7
PCTDIR																								
URB FWY	38	40	40	46	56	64	70	70	68	62	58	52	52	52	50	46	38	38	46	52	46	42	42	40
URB ART	44	46	44	48	54	62	66	68	64	56	54	52	50	50	50	46	40	38	46	52	48	46	46	46
RUR FWY	44	46	48	54	60	68	68	64	58	54	52	50	50	52	52	48	42	40	44	48	48	44	46	44
RUR ART	40	42	44	48	58	66	72	68	60	56	54	50	50	50	50	46	40	38	46	50	46	44	44	44

LOS E VC	0	0.625	1.25	1.875	2.5	3.125	3.75	4.375	5	5.625	6.25	6.875	7.5	8.125	8.75	9.375	10	10.625	11.25	11.875	12.5	13.125	13.75	14.375
SPEEDVC																								
curve1	75	75	75	75	75	75	74.9	74.8	74.6	74.2	73.5	72.3	70.5	67.8	64.2	59.5	54	47.7	41.2	34.9	28.9	23.7	19.2	15.5
curve2	70	70	70	70	70	70	70	69.9	69.8	69.6	69.2	68.4	67.1	65.1	62.2	58.2	53	47	40.5	33.9	27.7	22.2	17.6	13.8
curve3	65	65	65	65	65	65	65	65	65	64.9	64.8	64.4	63.8	62.6	60.5	57	52	45.4	37.8	29.9	22.7	16.7	12.1	8.6
curve4	60	60	60	60	60	60	60	60	60	59.9	59.8	59.6	59.1	58.2	56.7	54.3	50.8	46.1	40.3	33.8	27.3	21.3	16.2	12.2
curve5	55	55	55	55	55	55	55	55	55	55	55	54.9	54.7	54.3	53.6	52.3	50	46.5	41.5	35.3	28.5	21.9	16.1	11.5
curve6	60	60	60	60	60	60	60	60	59.9	59.8	59.7	59.4	59.1	58.5	57.7	56.5	55	53.1	50.7	47.9	44.7	41.1	37.3	33.4
curve7	55	55	55	55	55	55	55	55	54.9	54.9	54.7	54.5	54.2	53.8	53.1	52.2	50.9	49.3	47.3	44.9	42.1	39	35.7	32.2
curve8	50	50	50	50	50	50	50	50	49.9	49.9	49.8	49.6	49.4	49	48.5	47.7	46.7	45.4	43.8	41.8	39.5	36.8	33.9	30.9
curve9	45	45	45	45	45	45	45	45	45	44.9	44.8	44.7	44.4	44.1	43.6	43	42.1	40.9	39.4	37.6	35.5	33.1	30.5	27.8
curve10	50	50	50	50	49.9	49.8	49.7	49.4	49	48.4	47.5	46.5	45.1	43.5	41.7	39.6	37.3	34.9	32.4	29.8	27.3	24.9	22.6	20.4
curve11	50	50	50	50	50	49.9	49.7	49.4	48.9	48	46.7	44.9	42.5	39.6	36.2	32.6	28.7	25	21.4	18.2	15.3	12.9	10.8	9
curve12	50	50	50	50	50	49.9	49.8	49.6	49.1	48.2	46.8	44.5	41.4	37.5	32.9	28	23.1	18.7	14.9	11.8	9.2	7.2	5.7	4.5
curve13	40	40	40	40	40	40	39.9	39.8	39.5	39.2	38.6	37.8	36.7	35.3	33.5	31.4	29	26.4	23.7	21.1	18.5	16.1	13.9	12
curve14	40	40	40	40	40	39.9	39.8	39.6	39.1	38.5	37.5	36.1	34.3	32.1	29.4	26.5	23.5	20.5	17.7	15.1	12.8	10.7	9	7.6
curve15	40	40	40	40	40	39.9	39.7	39.4	38.8	37.9	36.5	34.7	32.3	29.5	26.4	23.2	20	17	14.3	11.9	9.9	8.2	6.8	5.6
curve16	35	35	35	35	35	34.9	34.8	34.5	34	33.2	32.1	30.5	28.5	26.1	23.5	20.6	17.9	15.2	12.8	10.7	8.9	7.4	6.1	5.1
curve17	35	35	35	35	35	34.9	34.7	34.4	33.9	33.1	32	30.3	28.3	25.8	23.1	20.3	17.5	14.9	12.5	10.4	8.6	7.2	5.9	4.9
curve18	35	35	35	35	35	34.9	34.6	34.2	33.5	32.4	30.9	28.8	26.3	23.4	20.4	17.4	14.6	12.1	9.9	8.1	6.6	5.4	4.4	3.6
curve19	30	30	30	30	30	29.9	29.8	29.5	29	28.2	27.1	25.6	23.7	21.5	19.1	16.6	14.2	12	10	8.3	6.8	5.6	4.6	3.8
curve20	30	30	30	30	30	29.9	29.7	29.4	28.9	28.1	26.9	25.3	23.4	21.1	18.6	16.1	13.6	11.4	9.5	7.8	6.4	5.3	4.3	3.6
curve21	30	30	30	30	30	29.9	29.7	29.3	28.7	27.7	26.2	24.4	22.1	19.6	17	14.4	12	9.9	8.1	6.6	5.4	4.4	3.6	2.9

VC RATIO TO LOS CONVERSION (VALUE SHOWN IS LOWER LIMIT FOR THAT LOS)(URBAN ROADS USE SPEED BREAKS BELOW FOR LOS DETERMINATION) (ALL USE THE BASE VC'S TO DETERMINE EXCEEDANCE)

	BASE	RUR2	FWY
A	0.00	0.00	0.00
B	0.30	0.00	0.25
C	0.50	0.10	0.40
D	0.70	0.30	0.60
E	0.90	0.50	0.80
F	1.00	1.00	1.00
F+	1.10	1.10	1.10
F++	1.30	1.30	1.30

SPEED VC RATIO BREAKS FOR URBAN STREETS (HIGHEST SPEED FOR GIVEN LOS & FF SPEED)

FFS	B	C	D	E	F
>47	42.	34.	27.	21.	16.
>37	35.	28.	22.	17.	13.
>32	30.	24.	18.	14.	10.
<33	25.	19.	13.	9.	7.

LEVEL OF SERVICE THRESHOLD BY AREA

NUM	LOS	DEFINITION
1	F	CINCINNATI,CLEVELAND,COLUMBUS CENTRAL MPO COUNTIES (CUY,FRA,HAM)
2	E	OTHER TMA MPOS (AKRON,CANTON,DAYTON,TOLEDO,YOUNGSTOWN + NON-CENTRAL COUNTIES FROM 1)
3	E	OTHER MPOS & PARTS OF AREAS 1 & 2 OUTSIDE URBANIZED AREA
4	E	RURAL NON MPO COUNTIES

PEAK SPREADING MODEL INFO (SET MAX ITERATIONS TO 0 TO DISABLE PEAK SPREADING)
MAX VC RATIO FWY: 1.30
MAX VC RATIO ART: 1.30
MAX ITERATIONS : 1000

TRUCK PCE: 2.00

AQ SEASON FACTOR: 1.00

MODEL CLASS PARAMETERS (MAX 4 CLASSES, HOURS 0-23 W/ NO OVERLAP IN CLASS, ALLOCATE ENTIRE CLASS AS TRUCK(1) OR NOT(0))

CLS TRK	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLS BEG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLS END	23	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLS NUM	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix B.2
Ozone EmissionSummaries

Clark County Daily Summary

	2002 (I/M)	
CLARK	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	3.7781	14.2914
Vehicle Emissions	5.8521	2.6580
Intrazonal Emissions	0.0196	0.0503
TOTAL	**9.6498**	**16.9997**

	2005 (I/M)	
CLARK	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	2.9722	12.1557
Vehicle Emissions	5.4320	2.7830
Intrazonal Emissions	0.0150	0.0424
TOTAL	**8.4192**	**14.9811**

	2009 (No I/M)	
CLARK	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	2.0595	9.3562
Vehicle Emissions	4.6749	2.7009
Intrazonal Emissions	0.0104	0.0336
TOTAL	**6.7448**	**12.0907**

	2018 (No I/M)	
CLARK	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	0.7060	3.4341
Vehicle Emissions	2.3862	1.5746
Intrazonal Emissions	0.0031	0.0106
TOTAL	**3.0953**	**5.0193**

	2040 (No I/M)	
CLARK	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	0.4415	1.6157
Vehicle Emissions	1.5770	0.9262
Intrazonal Emissions	0.0016	0.0038
TOTAL	**2.0201**	**2.5457**

Greene County Daily Summary

	2002 (I/M)	
GREENE	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	3.6983	12.6750
Vehicle Emissions	6.3501	2.8685
Intrazonal Emissions	0.0371	0.0948
TOTAL	**10.0855**	**15.6383**

	2005 (I/M)	
GREENE	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	2.9075	10.7301
Vehicle Emissions	5.7586	2.9225
Intrazonal Emissions	0.0293	0.0822
TOTAL	**8.6954**	**13.7348**

	2009 (No I/M)	
GREENE	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	2.0473	8.4135
Vehicle Emissions	4.9910	2.8836
Intrazonal Emissions	0.0206	0.0662
TOTAL	**7.0589**	**11.3633**

	2018 (No I/M)	
GREENE	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	0.7338	3.1705
Vehicle Emissions	2.4794	1.6360
Intrazonal Emissions	0.0073	0.0246
TOTAL	**3.2205**	**4.8311**

	2040 (No I/M)	
GREENE	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	0.4529	1.4776
Vehicle Emissions	1.5378	0.9032
Intrazonal Emissions	0.0040	0.0097
TOTAL	**1.9947**	**2.3905**

Miami County Daily Summary

	2002 (No I/M)	
MIAMI	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	2.6641	9.4498
Vehicle Emissions	4.4407	2.0170
Intrazonal Emissions	0.0449	0.1151
TOTAL	**7.1497**	**11.5819**

	2005 (No I/M)	
MIAMI	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	2.1190	8.1391
Vehicle Emissions	4.0837	2.0922
Intrazonal Emissions	0.0346	0.0979
TOTAL	**6.2373**	**10.3292**

	2009 (No I/M)	
MIAMI	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	1.4639	6.2047
Vehicle Emissions	3.4715	2.0057
Intrazonal Emissions	0.0234	0.0754
TOTAL	**4.9588**	**8.2858**

	2018 (No I/M)	
MIAMI	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	0.4988	2.2291
Vehicle Emissions	1.7245	1.1379
Intrazonal Emissions	0.0077	0.0260
TOTAL	**2.2310**	**3.3930**

	2040 (No I/M)	
MIAMI	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	0.3113	1.0618
Vehicle Emissions	1.0697	0.6282
Intrazonal Emissions	0.0039	0.0094
TOTAL	**1.3849**	**1.6994**

Montgomery County Daily Summary

	2002 (I/M)	
MONTGOMERY	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	12.4577	41.9321
Vehicle Emissions	22.3876	10.1129
Intrazonal Emissions	0.0705	0.1801
TOTAL	**34.9158**	**52.2251**

	2005 (I/M)	
MONTGOMERY	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	9.6580	35.1555
Vehicle Emissions	20.3022	10.3034
Intrazonal Emissions	0.0531	0.1489
TOTAL	**30.0133**	**45.6078**

	2009 (No I/M)	
MONTGOMERY	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	6.6238	26.9760
Vehicle Emissions	17.5961	10.1662
Intrazonal Emissions	0.0353	0.1136
TOTAL	**24.2552**	**37.2558**

	2018 (No I/M)	
MONTGOMERY	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	2.1395	9.1866
Vehicle Emissions	8.7411	5.7679
Intrazonal Emissions	0.0110	0.0373
TOTAL	**10.8916**	**14.9918**

	2040 (No I/M)	
MONTGOMERY	**VOC (tons/day)**	**NOX (tons/day)**
Link Emissions	1.1970	3.9130
Vehicle Emissions	5.4218	3.1844
Intrazonal Emissions	0.0054	0.0130
TOTAL	**6.6242**	**7.1104**