Technical Memorandum
Northeast Ohio (AMATS, NOACA, Ashtabula)
1997 Annual NAAQS PM Fine Attainment SIP Inventory
Mobile Source Emissions (PM 2.5 and NOx)

May 2011

By AMATS, NOACA and ODOT

In Coordination with the Ohio Environmental Protection Agency

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1. Overview

This memorandum is intended to document the USEPA MOVES based mobile source air quality analyses performed by the Ohio Department of Transportation (ODOT) for the Akron Metropolitan Area Transportation Study (AMATS) and Ashtabula Township areas, and by the Northeast Ohio Areawide Coordinating Agency for the counties of Cuyahoga, Lake, Lorain and Medina in its area. These analyses were conducted in support of Ohio EPA's intent to submit a redesignation package State Implementation Plan (SIP) submittal for the 1997 Annual $PM_{2.5}$ NAAQS.

The designated northeast Ohio nonattainment areas for the 1997 Annual $PM_{2.5}$ NAAQS includes the counties of Cuyahoga, Lake, Lorain, Medina, Portage, and Summit; and Ashtabula Township in Ashtabula County. USEPA has recently proposed to redesignate these counties to attainment based on several years of monitoring data (76 FR 28393). Despite the potential change in attainment status, Ohio EPA must still continue its efforts to assemble the necessary redesignation submittals.

The inventories include county based, annual totals of $PM_{2.5}$ and Oxides of Nitrogen (NO_X) for the base year 2005, the attainment year 2008, the interim year 2015, and the maintenance period horizon year 2022.

Latest Planning Assumptions

These annual $PM_{2.5}$ inventory runs meet the latest planning assumption requirement. As discussed in Section 2 of this report, the travel forecast modeling processes used to develop vehicle miles of travel (VMT) for the AMATS and NOACA areas is calibrated using the latest population and land use data available and are validated using corresponding traffic count data. Currently, the travel demand models are validated to year 2005.

U.S. EPA's most recent emissions software, MOVES, is used for all mobile source emission analyses with MOVES inputs and output needs being established at various interagency consultation meetings and e-mails between November 2010 and May 2011 (See **Appendix A**). It was also established that annual emission estimates would be based on a single-season approach. Since travel demand models produce average daily conditions, the daily emissions estimates are multiplied by 365 days to produce annual emissions estimates expressed in tons per year.

Finally, the regional emissions analysis includes emissions for Direct $PM_{2.5}$ (exhaust, brake, and tire wear), and Oxides of Nitrogen (NO_X).Sulfur Dioxide (SO_2), Volatile Organic Compounds (VOCs) and Ammonia (NH_3) are considered insignificant at this time. SO_2 emissions are shown to support the assertion that they are insignificant.

On Road Mobile Source Emissions Inventory Summary

Tables 1 to 4 present a summary of emissions by county as well as the entire nonattainment area for NOX, PM2.5 and SO_2 for calendar years 2005, 2008, 2015, and 2022. They also include annual VMT totals. The remainder of this document focuses on the assumptions behind the analyses.

Table 1 – Northeast Ohio On-Road Mobile Source Emissions

	2005 Base			
COUNTY	**NO_X (tons/year)**	**$PM_{2.5}$ (tons/year)**	**SO_2 (tons/year)**	**Annual VMT**
Ashtabula Twp.	294.66	11.50	5.07	79,693,005
Cuyahoga	36,506.02	1,247.92	845.65	10,605,503,693
Lake	8,067.92	282.95	176.88	2,112,119,403
Lorain	9,181.08	319.21	199.86	2,468,649,943
Medina	9,280.85	319.21	207.56	2,100,347,788
Portage	5,707.22	187.71	96.74	1,761,085,222
Summit	17,377.28	611.78	319.72	5,505,977,908
TOTAL	**86,415.03**	**2,980.28**	**1,851.48**	**24,633,376,962**

Table 2 – Northeast Ohio On-Road Mobile Source Emissions

	2008 Attainment			
COUNTY	**NO_X (tons/year)**	**$PM_{2.5}$ (tons/year)**	**SO_2 (tons/year)**	**Annual VMT**
Ashtabula Twp.	232.83	10.04	1.57	80,604,775
Cuyahoga	28,227.20	1,040.28	253.16	10,644,066,125
Lake	6,425	241.78	51.94	2,154,120,865
Lorain	7,354.77	274.43	60.17	2,519,904,703
Medina	7,603.83	317.43	57.65	2,228,836,730
Portage	4,630.98	160.90	30.52	1,811,101,624
Summit	13,609.82	511.43	100.66	5,635,781,676
TOTAL	**68,084.64**	**2,556.29**	**555.66**	**25,074,416,498**

Table 3 – Northeast Ohio On-Road Mobile Source Emissions

	2015 Interim			
COUNTY	**NO_X (tons/year)**	**$PM_{2.5}$ (tons/year)**	**SO_2 (tons/year)**	**Annual VMT**
Ashtabula Twp.	107.68	5.37	0.66	82,946,980
Cuyahoga	12,371.38	430.01	76.36	10,586,598,518
Lake	2,840.39	122.02	15.91	2,178,585,720
Lorain	3,456.51	143.34	18.51	2,550,296,428
Medina	3,306.35	152.50	17.63	2,308,164,735
Portage	2,264.50	87.54	13.23	1,935,234,601
Summit	6,170.32	251.70	42.76	5,992,078,124
TOTAL	**30,517.14**	**1,192.47**	**185.06**	**25,633,905,106**

Table 4 – Northeast Ohio On-Road Mobile Source Emissions

	2022 Maintenance			
COUNTY	**NO_X (tons/year)**	**$PM_{2.5}$ (tons/year)**	**SO_2 (tons/year)**	**Annual VMT**
Ashtabula Twp.	54.49	3.03	0.62	85,561,840
Cuyahoga	6,065.83	320.94	68.07	10,685,893,665
Lake	1,417.15	69.42	14.45	2,250,259,310
Lorain	1,723.02	81.69	16.83	2,632,524,905
Medina	1,677.58	78.48	16.83	2,489,638,720
Portage	1,014.35	49.45	7.40	2,036,373,863
Summit	3,059.45	162.98	39.57	6,246,851,092
TOTAL	**15,011.86**	**765.99**	**163.77**	**26,427,103,395**

2. Urban Travel Demand Models

NOACA maintains a PC-based regional travel demand forecasting model on the Citilabs CUBE platform for use in its urban transportation planning process. This model employs the traditional four step modeling process to project existing and future traffic volumes and travel patterns on the regional transportation networks. The four step process consists of trip generation, trip distribution, mode split, and route assignment. Output from the model is link-by-link directional volumes for four time periods: AM peak, Midday, PM peak, and Night and is added together to create 24-hour traffic volumes for the existing or future regional transportation networks.

The Ohio Department of Transportation (ODOT) holds the transportation model for the AMATS area. AMATS prepares and submits networks for its planning area to ODOT. ODOT prepares networks for Ashtabula County. ODOT's modeling is also run on a PC-based CUBE platform.

These models are uniquely suited to perform emission analyses. The modeling process identifies growth in vehicle miles of travel and changes in regional travel patterns resulting from the projects that are proposed in these areas' transportation plans and programs.

Detailed information about NOACA's travel demand forecast model can be found here: **http://www.noaca.org/traveldemandmemo.pdf**

Landuse and Socio-economic Data

The areas' socio-economic model variables reflect the current and expected future regional land uses as best known to staff.

Socio-economic variables were developed for all areas based on 2000 Census data and 2030 county-level Ohio Department of Development population projections. Minor adjustments to 2005 data have been made in an effort to have this data correspond to 2005 estimates released by the US Census Bureau.

Until new 2010 Census based projections are developed by the Ohio Department of Development (ODOD), the current data represents the best available for this effort.

3. Emission Factor Generation

Base and Attainment Years

Using MOVES, emission factor files were generated for base year-2005, attainment year-2008, interim year 2015, and maintenance year 2022. Assumptions for these runs include an I/M program in all but Ashtabula Township. Programs and corresponding MOVES parameters were developed in consultation with OEPA.

Technical Details

Table 7 summarizes the settings used in the MOVES run specification file and the MOVES County-Data Manager. All inputs for the region's analyses are included in the CD provides to Ohio EPA as part of this document submittal. Further information about specific inputs that are not using default values is also discussed below.

Table 7 – MOVES Inputs

RunSpec Parameter Settings	
MOVES Version	2010/08/26
Scale	County
MOVES Modeling Technique	Emission Factor Method Rates per Distance Rates per Vehicle
Time Span	Time Aggregation: Hour 1 Month representing average annual temperatures All hours of day selected 16 speed bins Weekdays only
Geographic Bounds	Cuyahoga, Lake, Lorain, Medina, Portage and Summit Counties; Ashtabula Township
Vehicles/Equipment	All related source types, gasoline and diesel; CNG-Transit Buses for base year-2005 and attainment year-2008
Road Type	All road types including off-network
Pollutants and Processes	NO_x, All $PM_{2.5}$ categories, SO_2, Total Energy Consumption
Strategies	Alternative Vehicle Fuels and Technologies for interim year 2015, and maintenance year 2022 to offset impact of CNG
General Output	Units = grams, joules and miles
Output Emissions	Time = hour, Location =county, 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 BMV Vehicle Registration Total Local BMV population for motorcycle (11), moped (11), bus (41, 42,43), mobile home (54), house vehicle (54) MOVES default fractions for the rest (21,31,32,51,52,53,61,62) Future year growth rate based on TFM's household growth rates.
Vehicle Type VMT	Travel Demand Forecast Model's daily VMT EPA annual VMT converter

	Hourly VMT fractions - ODOT Hourly Percentage
I/M Program	I/M program information supplied by Ohio EPA
Fuel Formulation	Default
Fuel Supply	Default
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 2005.
Ramp Fraction	Travel Demand Forecast Model
Road Type Distribution	ODOT's 2005 DVMT by FC
Age Distribution	Local data ODOT from 2009 motor vehicle registration The same age distribution will be used for all analysis years
Average Speed Distribution	Default as a place holder
Zone Activity	Default with necessary modification as prescribed in MOVES userguide.

Temperature and Relative Humidity

Temperatures used for the single season approach are representative of 12 months in 2005 based on NOAA data from the National Climate Data Center website. The month of April was used as the representative month. Data for Cleveland Hopkins International Airport (CLE) was used for NOACA's area. Data for Akron-Canton Airport (CAK) was used for AMATS and Ashtabula Twp. Areas. 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 annual hourly temperature and relative humidity distribution profile for Cuyahoga, Lake, Lorain, and Medina Counties can be seen in Table 8a. Table 8b portrays the data for Portage and Summit Counties; and Ashtabula Twp.

Table 8a – Temperature and Relative Humidity Data for NOACA portion of area

Hour	Average Temperature	Average Relative Humidity
1	42.1033	68
2	40.9717	73
3	40.0825	75
4	39.4358	76
5	38.9508	76
6	38.3850	77
7	37.9000	70
8	38.3042	68
9	40.7292	63
10	44.6092	58
11	48.5700	58
12	51.9650	56
13	54.9558	53
14	56.5725	54
15	57.1383	52
16	57.3000	52
17	56.8958	52
18	55.7642	52
19	53.8242	53
20	51.3183	56
21	48.8125	57
22	46.6300	61
23	45.0942	64
24	43.5583	66

Table 8b – Temperature and Relative Humidity Data for AMATS portion of area

Hour	Average Temperature	Average Relative Humidity
1	44.9033	76
2	43.7717	78
3	42.8825	79
4	42.2358	81
5	41.7508	82
6	41.1850	83
7	40.7000	82
8	41.1042	79
9	43.5292	74
10	47.4092	71
11	51.3700	68
12	54.7650	63
13	57.7558	61
14	59.3725	58
15	59.9383	56
16	60.1000	55
17	59.6958	57
18	58.5642	60
19	56.6242	65
20	54.1183	69
21	51.6125	71
22	49.4300	73
23	47.8942	74
24	46.3583	75

Ramp Fraction

Ramp fractions were derived using the base year travel demand model VHT fractions. Ramp fractions can be seen in Table 9. Base year fractions were kept the same for future years.

Table 9 – Ramp Fractions

County	roadTypeID	roadDesc	rampFraction
Cuyahoga	2	Rural Restricted Access	0
	4	Urban Restricted Access	0.116
Lake	2	Rural Restricted Access	0.092
	4	Urban Restricted Access	0.092
Lorain	2	Rural Restricted Access	0.107
	4	Urban Restricted Access	0.107
Medina	2	Rural Restricted Access	0.058
	4	Urban Restricted Access	0.058
Portage	2	Rural Restricted Access	0.014
	4	Urban Restricted Access	0.184
Summit	2	Rural Restricted Access	0.005
	4	Urban Restricted Access	0.091
Ashtabula	2	Rural Restricted Access	0
	4	Urban Restricted Access	0.184

Source Type Population

Source type population is based on a combination of local and MOVES default data. Local data was obtained from ODPS Bureau of Motor Vehicles Motor Vehicle Registrations by county and vehicle type data for the base year 2005 and intermediate year 2008. The MOVES default source type population data was obtained from the national level MOVES inventory runs for each county.

OBMV's vehicle registration data was used as a control total for all source type population and a sub total for Intercity Bus (41), Transit Bus (42), and School Bus (43). The same data was also used to assign source type population of Motorcycle (11) and Motor Home (54). For the rest of source types 21, 31, 32, 51, 52, 53, 61 and 62, the fraction of each source type from the MOVES default data was used and adjusted to match up the control total for source type population.Future year source type growth rate is based on travel demand model's annual household growth rate from year 2005 to year 2022 for corresponding analysis years. Table 10 shows source type population for the analyzed counties in 2005.

Table 10 – Source Type Population for year 2005

sourceTypeID	sourceTypeName	Cuyahoga	Lake	Lorain	Medina	Portage	Summit	Ashtabula Twp
11	Motorcycle	24,754	7,960	10,241	6,585	7,158	17,354	593
21	Passenger Car	579,339	121,433	150,152	89,819	84,140	277,131	7,506
31	Passenger Truck	362,540	76,735	95,416	58,943	60,169	190,713	5,404
32	Light Commercial Truck	121,119	25,636	31,877	19,692	2,413	7,648	217
41	Intercity Bus	289	61	29	16	33	139	10
42	Transit Bus	742	37	17	9	17	74	5
43	School Bus	2,003	422	198	108	198	849	62
51	Refuse truck	314	73	92	73	64	154	6
52	Single Unit Short-haul Truck	17,464	4,049	5,122	4,059	2,651	6,355	246
53	Single Unit Long-haul Truck	1,770	410	519	411	338	812	32
54	Motor Home	5,121	780	1,354	901	2,537	4,821	29
61	Comb Short-haul Truck	3,758	1,043	1,083	1,336	1,283	2,293	118
62	Comb Long-haul Truck	3,870	1,075	1,116	1,376	1,476	2,637	136

I/M Program

I/M program information was supplied by Ohio EPA. The I/M program was applied to all analysis years for every geography with the exception of Ashtabula Township. The I/M program MOVES inputs reflect:

1) ASM 2525 Final Cutpoints, for model years up to 1995
2) Two-mode, 2500 RPM/Idle Test, for model years 1996 & newer

OBD II in Ohio is not an exhaust emission test and is not considered, since the pollutants under current consideration are only SO2, NO_X and $PM_{2.5}$. The compliance rate and failure rates are obtained from Ohio EPA and compliance factors are calculated. These are applied for all counties under consideration and for all model years.

Vehicle Age Distribution

Vehicle age distribution information was derived using ODPS vehicle registration data (2009). The data was given to OEPA who supplied a VIN decoder that allowed ODOT to create correctly formatted MOVES inputs. A different age distribution file is used for each county. Table 11 provides a sample distribution for Cuyahoga County. The distributions for other areas can be found in the electronic input submittals. The same age distributions were used for all analysis years.

Table 11 – Vehicle Age Distribution for Cuyahoga County

yearid	sourcetypeid	ageid	ageFraction
2005	11	30	0.106925
2005	11	29	0.018783
2005	11	28	0.026115
2005	11	27	0.014845
2005	11	26	0.011632
2005	11	25	0.01317
2005	11	24	0.014596
2005	11	23	0.00998
2005	11	22	0.007536
2005	11	21	0.009369
2005	11	20	0.009074
2005	11	19	0.008758
2005	11	18	0.010636
2005	11	17	0.013827
2005	11	16	0.017312
2005	11	15	0.021
2005	11	14	0.02272
2005	11	13	0.021951
2005	11	12	0.02582
2005	11	11	0.03761
2005	11	10	0.044965
2005	11	9	0.05413
2005	11	8	0.060081
2005	11	7	0.075515
2005	11	6	0.063725
2005	11	5	0.066418
2005	11	4	0.076963
2005	11	3	0.068658
2005	11	2	0.044852
2005	11	1	0.021362
2005	11	0	0.001675
2005	21	30	0.031927
2005	21	29	0.001002
2005	21	28	0.001082
2005	21	27	0.001608
2005	21	26	0.002483
2005	21	25	0.003053
2005	21	24	0.003691
2005	21	23	0.005082
2005	21	22	0.006714
2005	21	21	0.010246
2005	21	20	0.013223
2005	21	19	0.017294
2005	21	18	0.023152
2005	21	17	0.028475
2005	21	16	0.034352
2005	21	15	0.044328
2005	21	14	0.040195
2005	21	13	0.048119
2005	21	12	0.050547
2005	21	11	0.056333
2005	21	10	0.057401
2005	21	9	0.054497
2005	21	8	0.058427
2005	21	7	0.059745
2005	21	6	0.059884
2005	21	5	0.060329
2005	21	4	0.058016
2005	21	3	0.060513
2005	21	2	0.05262
2005	21	1	0.04119
2005	21	0	0.014472
2005	31	30	0.002999
2005	31	29	0.000209
2005	31	28	0.000285
2005	31	27	0.000524
2005	31	26	0.000797
2005	31	25	0.001189
2005	31	24	0.001723
2005	31	23	0.002477
2005	31	22	0.003177
2005	31	21	0.00491
2005	31	20	0.006233
2005	31	19	0.008686
2005	31	18	0.011764
2005	31	17	0.02159
2005	31	16	0.026281
2005	31	15	0.03281
2005	31	14	0.031973
2005	31	13	0.036449
2005	31	12	0.043884
2005	31	11	0.049373
2005	31	10	0.053384
2005	31	9	0.052496
2005	31	8	0.068594

yearid	sourcetypeid	ageid	ageFraction
2005	31	7	0.073487
2005	31	6	0.079743
2005	31	5	0.092016
2005	31	4	0.082702
2005	31	3	0.07979
2005	31	2	0.07549
2005	31	1	0.04345
2005	31	0	0.011516
2005	32	30	0.006296
2005	32	29	0.000508
2005	32	28	0.000914
2005	32	27	0.001219
2005	32	26	0.002844
2005	32	25	0.002945
2005	32	24	0.002945
2005	32	23	0.004367
2005	32	22	0.005078
2005	32	21	0.008531
2005	32	20	0.010358
2005	32	19	0.009851
2005	32	18	0.014522
2005	32	17	0.024576
2005	32	16	0.03727
2005	32	15	0.054737
2005	32	14	0.036458
2005	32	13	0.043668
2005	32	12	0.041637
2005	32	11	0.048746
2005	32	10	0.055753
2005	32	9	0.040317
2005	32	8	0.038997
2005	32	7	0.03788
2005	32	6	0.029349
2005	32	5	0.029958
2005	32	4	0.086016
2005	32	3	0.091398
2005	32	2	0.13923
2005	32	1	0.063166
2005	32	0	0.030466
2005	41	30	0.002855
2005	41	29	0.001428
2005	41	28	0.001428
2005	41	27	0.001428
2005	41	26	0.000714

yearid	sourcetypeid	ageid	ageFraction
2005	41	25	0.00571
2005	41	24	0
2005	41	23	0.003569
2005	41	22	0.009279
2005	41	21	0.003569
2005	41	20	0.007852
2005	41	19	0.010707
2005	41	18	0.017131
2005	41	17	0.009993
2005	41	16	0.009279
2005	41	15	0.0207
2005	41	14	0.019986
2005	41	13	0.0207
2005	41	12	0.024982
2005	41	11	0.042827
2005	41	10	0.071378
2005	41	9	0.06424
2005	41	8	0.059957
2005	41	7	0.097787
2005	41	6	0.114918
2005	41	5	0.063526
2005	41	4	0.114918
2005	41	3	0.086367
2005	41	2	0.044254
2005	41	1	0.068522
2005	41	0	0
2005	42	30	0.010638
2005	42	29	0
2005	42	28	0
2005	42	27	0
2005	42	26	0.005319
2005	42	25	0
2005	42	24	0
2005	42	23	0
2005	42	22	0
2005	42	21	0.005319
2005	42	20	0
2005	42	19	0
2005	42	18	0
2005	42	17	0
2005	42	16	0.021277
2005	42	15	0.005319
2005	42	14	0.010638
2005	42	13	0.005319

yearid	sourcetypeid	ageid	ageFraction
2005	42	12	0.047872
2005	42	11	0.079787
2005	42	10	0.026596
2005	42	9	0.058511
2005	42	8	0.079787
2005	42	7	0.079787
2005	42	6	0.079787
2005	42	5	0.074468
2005	42	4	0.170213
2005	42	3	0.074468
2005	42	2	0.12766
2005	42	1	0.037234
2005	42	0	0
2005	43	30	0.000585
2005	43	29	0
2005	43	28	0
2005	43	27	0.001171
2005	43	26	0.001171
2005	43	25	0.005855
2005	43	24	0.002342
2005	43	23	0.007611
2005	43	22	0.008197
2005	43	21	0.005855
2005	43	20	0.008197
2005	43	19	0.014052
2005	43	18	0.007611
2005	43	17	0.009368
2005	43	16	0.009953
2005	43	15	0.011124
2005	43	14	0.010539
2005	43	13	0.044496
2005	43	12	0.050937
2005	43	11	0.088993
2005	43	10	0.104801
2005	43	9	0.067916
2005	43	8	0.100703
2005	43	7	0.058548
2005	43	6	0.050351
2005	43	5	0.052693
2005	43	4	0.052693
2005	43	3	0.0726
2005	43	2	0.049766
2005	43	1	0.059719
2005	43	0	0.042155

yearid	sourcetypeid	ageid	ageFraction
2005	51	30	0.014851
2005	51	29	0.002475
2005	51	28	0
2005	51	27	0
2005	51	26	0
2005	51	25	0.002475
2005	51	24	0.00495
2005	51	23	0.012376
2005	51	22	0
2005	51	21	0.00495
2005	51	20	0.00495
2005	51	19	0.00495
2005	51	18	0.007426
2005	51	17	0.012376
2005	51	16	0.024752
2005	51	15	0.066832
2005	51	14	0.044554
2005	51	13	0.027228
2005	51	12	0.044554
2005	51	11	0.027228
2005	51	10	0.044554
2005	51	9	0.044554
2005	51	8	0.059406
2005	51	7	0.09901
2005	51	6	0.032178
2005	51	5	0.071782
2005	51	4	0.128713
2005	51	3	0.071782
2005	51	2	0.094059
2005	51	1	0.04703
2005	51	0	0
2005	52	30	0.014851
2005	52	29	0.002475
2005	52	28	0
2005	52	27	0
2005	52	26	0
2005	52	25	0.002475
2005	52	24	0.00495
2005	52	23	0.012376
2005	52	22	0
2005	52	21	0.00495
2005	52	20	0.00495
2005	52	19	0.00495
2005	52	18	0.007426

yearid	sourcetypeid	ageid	ageFraction
2005	52	17	0.012376
2005	52	16	0.024752
2005	52	15	0.066832
2005	52	14	0.044554
2005	52	13	0.027228
2005	52	12	0.044554
2005	52	11	0.027228
2005	52	10	0.044554
2005	52	9	0.044554
2005	52	8	0.059406
2005	52	7	0.09901
2005	52	6	0.032178
2005	52	5	0.071782
2005	52	4	0.128713
2005	52	3	0.071782
2005	52	2	0.094059
2005	52	1	0.04703
2005	52	0	0
2005	53	30	0.096774
2005	53	29	0
2005	53	28	0
2005	53	27	0
2005	53	26	0.064516
2005	53	25	0.032258
2005	53	24	0.032258
2005	53	23	0.032258
2005	53	22	0.064516
2005	53	21	0.032258
2005	53	20	0.064516
2005	53	19	0.032258
2005	53	18	0
2005	53	17	0.032258
2005	53	16	0.064516
2005	53	15	0.032258
2005	53	14	0.193548
2005	53	13	0.096774
2005	53	12	0.064516
2005	53	11	0
2005	53	10	0
2005	53	9	0
2005	53	8	0
2005	53	7	0
2005	53	6	0.032258
2005	53	5	0

yearid	sourcetypeid	ageid	ageFraction
2005	53	4	0
2005	53	3	0
2005	53	2	0
2005	53	1	0
2005	53	0	0.032258
2005	54	30	0.155541
2005	54	29	0.007973
2005	54	28	0.012568
2005	54	27	0.014595
2005	54	26	0.023378
2005	54	25	0.021622
2005	54	24	0.02473
2005	54	23	0.024865
2005	54	22	0.026486
2005	54	21	0.028514
2005	54	20	0.023649
2005	54	19	0.017838
2005	54	18	0.023514
2005	54	17	0.027568
2005	54	16	0.032432
2005	54	15	0.037838
2005	54	14	0.032973
2005	54	13	0.034054
2005	54	12	0.036351
2005	54	11	0.045
2005	54	10	0.045811
2005	54	9	0.032297
2005	54	8	0.034595
2005	54	7	0.037027
2005	54	6	0.038378
2005	54	5	0.039054
2005	54	4	0.039595
2005	54	3	0.034595
2005	54	2	0.028784
2005	54	1	0.014865
2005	54	0	0.003514
2005	61	30	0.026394
2005	61	29	0.001795
2005	61	28	0.001969
2005	61	27	0.0027
2005	61	26	0.004162
2005	61	25	0.005771
2005	61	24	0.007714
2005	61	23	0.007951

yearid	sourcetypeid	ageid	ageFraction
2005	61	22	0.01355
2005	61	21	0.017698
2005	61	20	0.017692
2005	61	19	0.018667
2005	61	18	0.023951
2005	61	17	0.030517
2005	61	16	0.044041
2005	61	15	0.043611
2005	61	14	0.038558
2005	61	13	0.047786
2005	61	12	0.044426
2005	61	11	0.056475
2005	61	10	0.062624
2005	61	9	0.052544
2005	61	8	0.054525
2005	61	7	0.065875
2005	61	6	0.064946
2005	61	5	0.065997
2005	61	4	0.06129
2005	61	3	0.052723
2005	61	2	0.042316
2005	61	1	0.018436
2005	61	0	0.003296
2005	62	30	0.001821
2005	62	29	0
2005	62	28	0
2005	62	27	0.00091
2005	62	26	0.000759
2005	62	25	0.002731
2005	62	24	0.001517
2005	62	23	0.001972
2005	62	22	0.00349
2005	62	21	0.005159
2005	62	20	0.0044
2005	62	19	0.003945
2005	62	18	0.007131
2005	62	17	0.016083
2005	62	16	0.021393
2005	62	15	0.028827
2005	62	14	0.034593
2005	62	13	0.025338
2005	62	12	0.059172
2005	62	11	0.080413
2005	62	10	0.107419

yearid	sourcetypeid	ageid	ageFraction
2005	62	9	0.075861
2005	62	8	0.04582
2005	62	7	0.047944
2005	62	6	0.099833
2005	62	5	0.090882
2005	62	4	0.057047
2005	62	3	0.112729
2005	62	2	0.017145
2005	62	1	0.038993
2005	62	0	0.006676

Road Type Distribution

Road type distribution is based on the ODOT's 2005 daily vehicle miles of travel (DVMT) by functional classification (FC). These inputs vary by county. A sample road type distribution input for Cuyahoga County can be seen in Table 12. Cuyahoga County does not contain rural road types 2 and 3. The distributions for other areas can be found in the electronic input submittals.

Table 12 – Road Type Distribution for Cuyahoga County

sourceTypeID	roadTypeID	roadTypeVMTFraction
11	1	0
11	2	0
11	3	0
11	4	0.4761
11	5	0.5239
21	1	0
21	2	0
21	3	0
21	4	0.4761
21	5	0.5239
31	1	0
31	2	0
31	3	0
31	4	0.4761
31	5	0.5239
32	1	0
32	2	0
32	3	0
32	4	0.4761
32	5	0.5239
41	1	0
41	2	0
41	3	0
41	4	0.4761
41	5	0.5239
42	1	0
42	2	0
42	3	0
42	4	0.4761
42	5	0.5239
43	1	0
43	2	0

sourceTypeID	roadTypeID	roadTypeVMTFraction
43	3	0
43	4	0.4761
43	5	0.5239
51	1	0
51	2	0
51	3	0
51	4	0.4761
51	5	0.5239
52	1	0
52	2	0
52	3	0
52	4	0.4761
52	5	0.5239
53	1	0
53	2	0
53	3	0
53	4	0.4761
53	5	0.5239
54	1	0
54	2	0
54	3	0
54	4	0.4761
54	5	0.5239
61	1	0
61	2	0
61	3	0
61	4	0.4761
61	5	0.5239
62	1	0
62	2	0
62	3	0
62	4	0.4761
62	5	0.5239

Vehicle Type VMT and VMT Fractions

VMT by MOVES vehicle types is subdivided into four sections namely HPMS base year VMT, monthly VMT fractions, daily VMT fractions and hourly VMT fractions. For NOACA's counties, HPMS base year VMT was derived by using the converter tool, US EPA's AADVMT Calculator_HPMS.xls. The converter takes average annual daily VMT (AADVMT) and generates MOVES input data based on default factors. AADVMT is computed by using total daily VMT obtained from travel demand model and fractioning it with the MOVES default distance travelled by each source type to come up vehicle type VMTs. The same method was

used to generate for other analysis years. ODOT uses weigh in motion (WIM) data to develop inputs for the counties it models. The inputs for each geographic area can be seen in the supplied input files. Sample HPMS base year VMT for 2005 is provided in Table 13.

Table 13 – Yearly HPMS VMT for 2005

HPMS VType ID	Cuyahoga	Lake	Lorain	Medina	Portage	Summit	Ashtabula TWP
10	32,922,024	6,679,430	7,643,257	6,670,080	7,077,843	22,229,559	320,426
20	5,535,142,837	1,090,354,599	1,260,262,447	989,168,530	1,262,277,469	3,964,466,531	57,145,446
30	3,276,696,376	651,498,431	757,091,949	613,540,515	389,472,936	1,223,227,424	17,632,101
40	13,744,581	3,270,549	3,993,067	4,965,027	3,980,932	12,503,013	180,224
50	206,032,254	44,685,476	52,797,748	54,841,123	29,429,299	92,429,337	1,332,314
60	316,106,345	81,519,583	79,496,762	128,111,534	69,870,561	219,444,226	3,163,159

Output Emission Factors

Table 14 shows the first record in a MOVES sample output (rate per distance) emission file for year 2005. For any given month, day of week, hour of the day, pollutant, and process; the rate per distance varies by road type, and speed bin. Rates per distance emissions are applied to link and intrazonal VMT.

Table 14 – Sample Emission File (Rate per Distance) for year 2005

Heading:	MOVESScenarioID	MOVESRunID	yearID	monthID	dayID	hourID
Record:	Cuyahoga	1	2005	4	5	24
Heading:	linkID	pollutantID	processID	sourceTypeID	SCC	fuelTypeID
Record:	990180516	117	10	0		0
Heading:	modelYearID	roadTypeID	avgSpeedBinID	temperature	relHumidity	ratePerDistance
Record:	0	5	16	43.5583	66	0.000879331

Table 15 shows the first record in a MOVES sample output (rate per vehicle) emission file for year 2005. 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 souce type population.

Table 15 – Sample Emission File (Rate per Vehicle) for year 2005

Heading:	MOVESScenarioID	MOVESRunID	yearID	monthID	dayID
Record:	Cuyahoga	1	2005	4	5
Heading:	hourID	zoneID	pollutantID	processID	sourceTypeID
Record:	24	990180	115	90	0
Heading:	SCC	fuelTypeID	modelYearID	temperature	ratePerVehicle
Record:		0	0	43.5583	0.0000446782

All output files are available in the electronic submittal.

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 ODOT 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.**

The second step (mmoves.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, (mvehicle.exe), calculates vehicle-based emissions 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 mintra.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, and to multiply annual average daily emissions by 365 to produce an annual estimate. Summary emissions for each pollutant, county, and scenario year in northeast Ohio were previously displayed in tables 1-4.

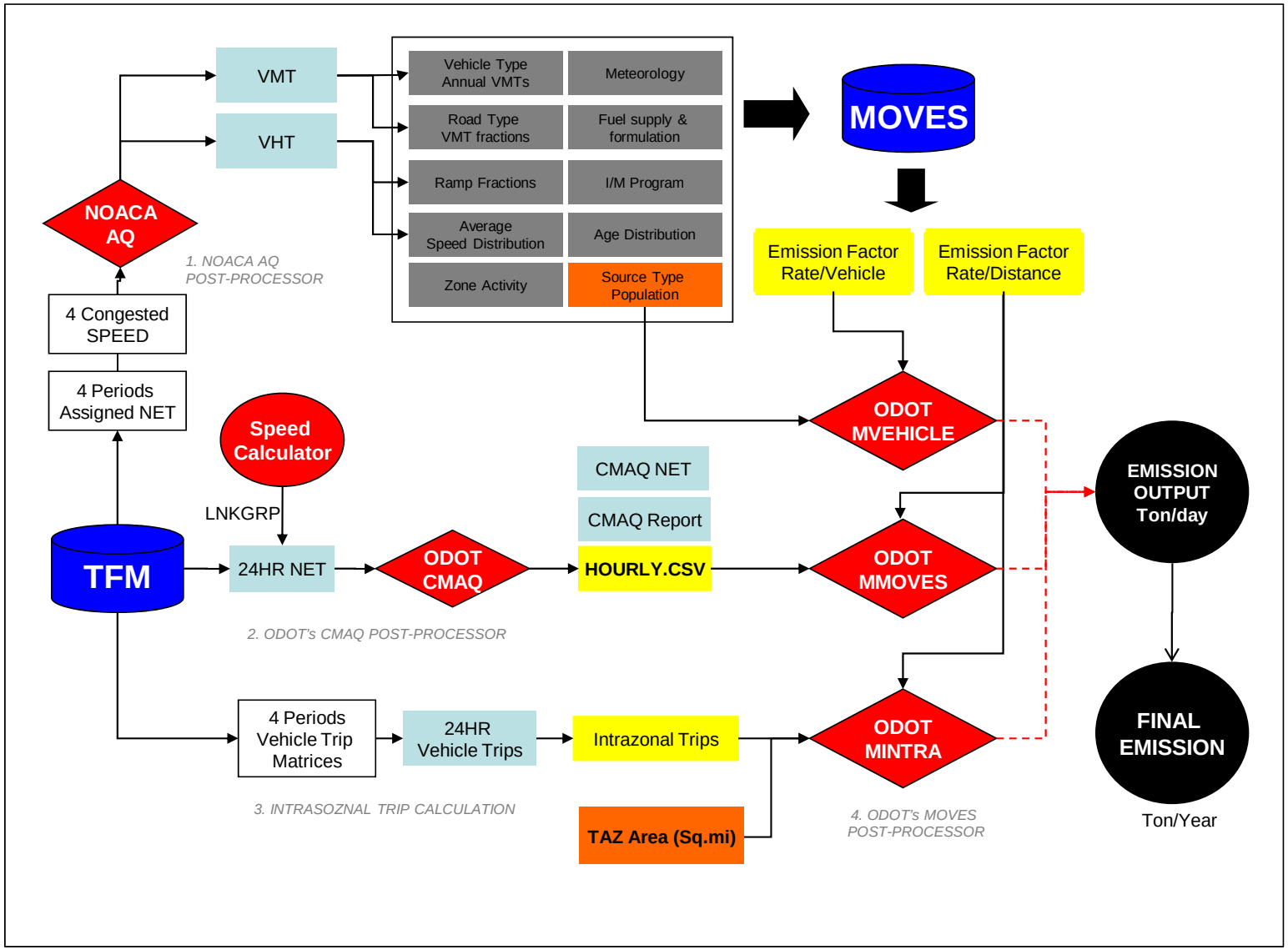

Figure 4 – Emission Calculation Process

5. Multiple MPO Coordination Issues

AMATS, NOACA, ODOT, and OEPA have a long history of working together in air quality issues. All parties have have had an opportunity to review and approve this summary document.

Appendix A

Interagency Consultation Documentation

-----Original Message-----
From: Carolina Prado [mailto:Carolina.Prado@epa.state.oh.us]
Sent: Thursday, October 21, 2010 9:00 AM
To: Jividen, Phyllis; Nino.Brunello@dot.state.oh.us; Bill Davis
Cc: Jennifer Hunter
Subject: Cleveland-Akron-Lorain area PM2.5 redesignation effort

Nino, Bill and Phyllis ,

Ohio EPA is starting to work on PM2.5 redesignations in all Ohio's nonattainment areas, and Jennifer Hunter and I would like to have a small conference call with you and start discussion on the mobile emission modeling portion of the redesignation effort in the Cleveland-Akron-Lorain area.

Since historically, NOACA has modeled a portion of the area and ODOT and AMATS another, it would be useful to agree and be consistent among what's modeled and the assumptions used, as well as to have a sense of timing and other inputs needed.

We would like to schedule a conference call on Monday October, 25 at 10:00 AM.

We will be calling you so please verify the following information:
Nino: (614) 752-5742
Bill: (216) 241-2414, Ext. 251
Phyllis: (330) 375-2436

Please let us know if this time/day will work for you ASAP so we can make changes accordingly. The other available day we have is Friday October 29.

Thanks,

Carolina M. Prado
State Implementation Plan (SIP) Development Ohio EPA, Division of Air Pollution Control 614-644-2310 Carolina.Prado@epa.state.oh.us

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-----Original Message-----
From: Carolina Prado [mailto:Carolina.Prado@epa.state.oh.us]
Sent: Friday, October 29, 2010 11:05 AM
To: PJividen@akronohio.gov; Leigh.Oesterling@dot.gov; Nino.Brunello@dot.state.oh.us; Patricia Morris; Jennifer Hunter; B Davis
Subject: Cleveland-Akron-Lorain area PM2.5 redesignation effort

Interagency Consultancy Group,

On Monday, November 15, 2010 from 10:30 AM to 12:30PM, we will have an Interagency Consultation Group call to agree on parameters and timing for the PM2.5 redesignation for the Cleveland-Akron-Lorain area PM2.5 nonattainment area. The Cleveland-Akron-Lorain area includes the counties of Ashtabula (partial), Lake, Cuyahoga, Lorain, Medina, Summit and Portage. For the purpose of redesignations and maintenance plans we have to include emissions/projections for all these areas.

As you all know we have to use MOVES to model our mobile emission for PM2.5, NOx, and SO2, and to fulfill our redesignation/maintenance plan, the following years will need mobile inventories - 2005 base nonattainment year, 2008 attainment year, 2015 interim (BUDGET) year and 2022 maintenance (BUDGET) year. During this call we would like to agree and be consistent among what's modeled and the assumptions used, as well as to have a sense of timing and other inputs needed.

Please call 614-387-7405

If you think I am forgetting somebody, please forward this email.

Thanks,

Carolina M. Prado
State Implementation Plan (SIP) Development Ohio EPA, Division of Air Pollution Control 614-644-2310

****

-----Original Message-----
From: Carolina Prado [mailto:Carolina.Prado@epa.state.oh.us]
Sent: Monday, December 20, 2010 12:43 PM
To: PJividen@akronohio.gov; Leigh.Oesterling@dot.gov; Dave Moore; Nino.Brunello@dot.state.oh.us; PatriciaMorris; B Davis
Cc: Jennifer Hunter
Subject: RE: NEXT: Cleveland-Akron-Lorain area PM2.5 redesignation effort

You are right.
This is our schedule:

1. ODOT is expected to submit all post-processor information to NOACA (for the 4 counties in its jurisdiction, Lake, Cuyahoga, Lorain and Medina) by January 10, 2011.

2. ODOT and NOACA will submit the final mobile emission numbers (for Lake, Cuyahoga, Lorain and Medina, Portage, Summit and Ashtabula-partial counties) to the rest of the IAC group by the end of January 2011

3. ODOT and NOACA will submit to IAC group in a document the final mobile emission number for review and comment. February 1, 2011.

4. IAC group call on Feb 7, 2011, discuss final mobile emission numbers for the 7 county area, make changes if needed, and propose budgets for 2015 and 2022.

Thanks

>>> B Davis <BDavis@mpo.noaca.org> 12/20/2010 12:35 PM >>>
I believe ODOT's deadline for providing NOACA with the post-processor was January 10th?

Bill Davis
NOACA
(216)-241-2414, Ext. 251

****

-----Original Message-----
From: Carolina Prado [mailto:Carolina.Prado@epa.state.oh.us]
Sent: Monday, December 20, 2010 12:13 PM
To: PJividen@akronohio.gov; Leigh.Oesterling@dot.gov; Dave Moore; Nino.Brunello@dot.state.oh.us; Patricia Morris; B Davis
Cc: Jennifer Hunter
Subject: NEXT: Cleveland-Akron-Lorain area PM2.5 redesignation effort

Thanks for all your input on today's call.
Our next call will be on February 7, 2011 from 11:00AM to 12:30PM EST.
Please call 614-387-7405

During the call we will discuss the final mobile emission numbers for the 7 county area, make changes if needed, and propose budgets for 2015 and 2022.

As discussed during today's call, ODOT is expected to submit all post-processor information to NOACA (for the 4 counties in its jurisdiction, Lake, Cuyahoga, Lorain and Medina) by January 1, 2011.

ODOT and NOACA will submit the final mobile emission numbers (for Lake, Cuyahoga, Lorain and Medina, Portage, Summit and Ashtabula-partial counties) to the rest of the IAC group by the end of January 2011 so that by the Feb 7, 2011 meeting, we all had time to review the numbers.

Thanks,

Carolina M. Prado
State Implementation Plan (SIP) Development
Ohio EPA, Division of Air Pollution Control
614-644-2310

****

-----Original Message-----
From: Carolina Prado [mailto:Carolina.Prado@epa.state.oh.us]
Sent: Wednesday, May 11, 2011 12:42 PM
To: Nino.Brunello@dot.state.oh.us; Chandra Parasa; NGILL@morpc.org; B Davis; E Kang; Ana Ramirez
Cc: Jennifer Hunter
Subject: Clarification: Mobile emission estimate
Importance: High

** High Priority **

Hi everybody,

Thanks for reworking the post-processor information and thanks for committing to a fast turn around. We really appreciate all your effort!

I just want to clarify a couple of issues so we don't waste more time.

For all our redesignation documents we are stating that "...Mobile source emissions were calculated from MOVES2010 -produced emission factors. Only PM2.5 and NOx necessitate emissions inventory analysis. As documented in Ohio EPA's attainment demonstration SIP, Ohio EPA in consultation with U.S. EPA determined mobile sources are insignificant contributors for SO2. Consistent with Ohio EPA's attainment demonstration, Ohio EPA continues to consider mobile source SO2 to be an insignificant contributor to fine particles for this nonattainment area...."

However we still need to show SO2 emission estimations per county, so that USEPA can agree with us that SO2 is indeed insignificant.
So we will need SO2 mobile emission as well (not only PM2.5 and NOx), just like what you did previously for Dayton and Columbus, for example.
We also need the Annual VMT.

We should have something like this for every county:

Hamilton County, Ohio Emissions Estimations for On-Road Mobile Sources
 2005200820152021PM2.5 (tpy)1,222.0201,080.540826.00571.48NOx (tpy)31,127.0927,020.9315,925.199,530.16SO2 (tpy)88.8598.3094.43100.82Annual VMT7,241,536,8127,421,012,5947,630,239,6507,811,745,310

Please let us know if you have any question!

Thanks!!
Carolina

Carolina M. Prado
State Implementation Plan (SIP) Development
Ohio EPA, Division of Air Pollution Control
614-644-2310
Carolina.Prado@epa.state.oh.us

Appendix B
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	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