Mobile Source Emissions Inventory for Huntington-Ironton-Ashland $PM_{2.5}$ Nonattainment Area

Includes Cabell County, Wayne County, and a portion of Mason County in West Virginia, Lawrence County, Scioto County, a portion of Adams County, and a portion of Gallia County in Ohio, and Boyd County and a portion of Lawrence County in Kentucky

Emission estimates for the Year 2005, 2008, 2015, and 2022 developed in support of the $PM_{2.5}$ State Implementation Plan

April 2011

Prepared for the West Virginia Department of Environmental Protection, the Ohio Environmental Protection Agency, and the Kentucky Division for Air Quality by

KYOVA
interstate planning commission

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Acknowledgments

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Abstract This report was prepared for the West Virginia Department of Environmental Protection, the Ohio Environmental Protection Agency, and the Kentucky Division for Air Quality. The nonattainment area includes Cabell County, Wayne County, and a portion of Mason County in West Virginia, Lawrence County, Scioto County, a portion of Adams County, and a portion of Gallia County in Ohio, and Boyd County and a portion of Lawrence County in Kentucky. This report includes emission estimates for the years 2005, 2008, 2015, and 2022 was generated to support the attainment SIPs for the annual $PM_{2.5}$ standard. EPA's Motor Vehicle Emission Simulation (MOVES) 2010a was used to generate the emission rates.

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Mobile Source Emissions Inventory for the Huntington-Ironton-Ashland $PM_{2.5}$ Nonattainment Area

This report was prepared for the Ohio Environmental Protection Agency (Ohio EPA), the West Virginia Department of Environmental Protection (WVDEP), and the Kentucky Division for Air Quality (KDAQ) to support the attainment State Implementation Plans (SIPs) for the annual $PM_{2.5}$ standard. The Huntington-Ironton-Ashland $PM_{2.5}$ nonattainment area for the on-road emission estimation analysis is divided into a modeled area composed of Cabell, Wayne, and Mason (partial) Counties in West Virginia, Lawrence, Scioto, Adams (partial), and Gallia (partial) Counties in Ohio, and Boyd and Lawrence (partial) Counties in Kentucky. This document includes emissions estimates for the years 2005, 2008, 2015, and 2022. The United States Environmental Protection Agency's (US EPA) Motor Vehicle Emissions Simulator (MOVES) 2010a model was used to generate the emission rates. The MOVES model replaced MOBILE6.2 as the official emissions modeling software of the EPA in December 2009. For the purposes of this analysis, MOVES emission rates were generated for direct $PM_{2.5}$, $PM_{2.5}$ tirewear, $PM_{2.5}$ brakewear, NO_x and SO_2.

The KYOVA Interstate Planning Commission is the Metropolitan Planning Organization (MPO) responsible for the long range planning and air quality conformity for the Huntington, WV and Ironton, OH region. The Ashland MPO is responsible for these activities for the Ashland, KY area. The transportation conformity process was established to ensure a region's transportation activities and associated federal funding are consistent with the air quality goals set forth in the SIPs for the three states in this region. The SIPs include an inventory of projected emissions from vehicles. One or more of the analysis years in the projected inventory may be designated as the motor vehicle emissions budget (MVEB). This budget establishes a maximum allowable limit on future emissions from vehicles (mobile sources). The transportation plans and programs for the region (in this case, KYOVA and the Ashland MPO) must be in conformance with all the provisions in the SIP. The conformity process is a quantitative analysis which uses the MOVES software developed by the US EPA. The objective is to demonstrate that forecasted regional vehicle emissions do not exceed the established budget.

Tables 1a through 1c show the daily and annual mobile source emissions for the West Virginia, Ohio, and Kentucky portions of the Huntington-Ironton-Ashland nonattainment areas. Separate MVEB's are typically designated for these areas. An extensive interagency consultation process was initiated to gain feedback and consensus from agencies including the KYOVA Interstate Planning Commission (KYOVA), WVDEP, Ohio EPA, KDAQ, Ohio Department of Transportation (ODOT), West Virginia Department of Transportation (WVDOT), Kentucky Transportation Cabinet (KYTC), Federal Highway Administration (FHWA), Federal Transit Administration (FTA), and US EPA. Assumptions and methodology used in this analysis are documented in the **Appendix** of this report. For the development of the associated SIPs, it is recommended an additional safety margin be added to the motor vehicle emissions budget (MVEB) to account for any uncertainty with assumptions used in the development of this analysis. Daily and annual mobile source emissions for each county in the nonattainment area are shown in **Tables 2a through 2i**.

Table 1a. Mobile Source Emissions for the Huntington-Ironton-Ashland $PM_{2.5}$ Nonattainment Area, West Virginia Portion (tons)

West Virginia Area (Cabell, Wayne, and Mason (Partial) Counties)

	Pollutant Name		Daily Emissions (tons)		Annual Emissions (tons)
2005	Vehicle Population:	100,782	Daily VMT: 3,965,990		Annual VMT: 1,356,293,075
	Oxides of Nitrogen (NO_x)		17.55		6,013.60
	Sulfur Dioxide (SO_2)		0.3347		114.54
	Primary Exhaust $PM_{2.5}$ - Total		0.6677		228.60
	Primary $PM_{2.5}$ - Brakewear Particulate		0.0381		13.04
	Primary $PM_{2.5}$ - Tirewear Particulate		0.0112		3.84
2008	Vehicle Population:	103,240	Daily VMT: 4,092,426		Annual VMT: 1,403,016,167
	Oxides of Nitrogen (NO_x)		14.45		4,964.74
	Sulfur Dioxide (SO_2)		0.0907		31.12
	Primary Exhaust $PM_{2.5}$ - Total		0.5768		197.97
	Primary $PM_{2.5}$ - Brakewear Particulate		0.0394		13.51
	Primary $PM_{2.5}$ - Tirewear Particulate		0.0116		3.97
2015	Vehicle Population:	108,975	Daily VMT: 4,361,792		Annual VMT: 1,491,649,487
	Oxides of Nitrogen (NO_x)		6.98		2,394.60
	Sulfur Dioxide (SO_2)		0.0386		13.22
	Primary Exhaust $PM_{2.5}$ - Total		0.2749		94.16
	Primary $PM_{2.5}$ - Brakewear Particulate		0.0420		14.36
	Primary $PM_{2.5}$ - Tirewear Particulate		0.0124		4.23
2022	Vehicle Population:	114,711	Daily VMT: 4,923,274		Annual VMT: 1,683,665,856
	Oxides of Nitrogen (NO_x)		3.62		1,243.28
	Sulfur Dioxide (SO_2)		0.0393		13.46
	Primary Exhaust $PM_{2.5}$ - Total		0.1251		42.87
	Primary $PM_{2.5}$ - Brakewear Particulate		0.0474		16.19
	Primary $PM_{2.5}$ - Tirewear Particulate		0.0139		4.77

Table 1b. Mobile Source Emissions for the Huntington-Ironton-Ashland $PM_{2.5}$ Nonattainment Area, Ohio Portion (tons)

Ohio Area (Lawrence, Scioto, Adams (Partial), and Gallia (Partial) Counties)

	Pollutant Name		Daily Emissions (tons)		Annual Emissions (tons)
2005	Vehicle Population:	164,363	Daily VMT: 3,079,755		Annual VMT: 1,053,217,320
	Oxides of Nitrogen (NO_x)		11.52		3,955.84
	Sulfur Dioxide (SO_2)		0.1920		65.73
	Primary Exhaust $PM_{2.5}$ - Total		0.3575		122.67
	Primary $PM_{2.5}$ - Brakewear Particulate		0.0241		8.24
	Primary $PM_{2.5}$ - Tirewear Particulate		0.0080		2.73
2008	Vehicle Population:	168,407	Daily VMT: 3,166,879		Annual VMT: 1,085,708,635
	Oxides of Nitrogen (NO_x)		9.64		3,319.55
	Sulfur Dioxide (SO_2)		0.0633		21.73
	Primary Exhaust $PM_{2.5}$ - Total		0.3037		104.44
	Primary $PM_{2.5}$ - Brakewear Particulate		0.0248		8.50
	Primary $PM_{2.5}$ - Tirewear Particulate		0.0082		2.82
2015	Vehicle Population:	177,836	Daily VMT: 3,557,112		Annual VMT: 1,216,464,596
	Oxides of Nitrogen (NO_x)		5.30		1,824.63
	Sulfur Dioxide (SO_2)		0.0292		10.01
	Primary Exhaust $PM_{2.5}$ - Total		0.1651		56.65
	Primary $PM_{2.5}$ - Brakewear Particulate		0.0279		9.53
	Primary $PM_{2.5}$ - Tirewear Particulate		0.0092		3.16
2022	Vehicle Population:	187,269	Daily VMT: 4,059,935		Annual VMT: 1,388,420,261
	Oxides of Nitrogen (NO_x)		2.68		924.08
	Sulfur Dioxide (SO_2)		0.0304		10.42
	Primary Exhaust $PM_{2.5}$ - Total		0.0939		32.25
	Primary $PM_{2.5}$ - Brakewear Particulate		0.0318		10.86
	Primary $PM_{2.5}$ - Tirewear Particulate		0.0105		3.61

Table 1c. Mobile Source Emissions for the Huntington-Ironton-Ashland $PM_{2.5}$ Nonattainment Area, Kentucky Portion (tons)

Kentucky Area (Boyd and Lawrence (Partial) Counties)

Year	Pollutant Name	Daily Emissions (tons)	Annual Emissions (tons)
2005	Vehicle Population: 52,269	Daily VMT: 1,520,525	Annual VMT: 519,990,431
	Oxides of Nitrogen (NO_x)	8.30	2,843.94
	Sulfur Dioxide (SO_2)	0.0370	12.65
	Primary Exhaust $PM_{2.5}$ - Total	0.3338	114.31
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0168	5.76
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0045	1.55
2008	Vehicle Population: 53,576	Daily VMT: 1,469,006	Annual VMT: 503,622,799
	Oxides of Nitrogen (NO_x)	6.73	2,311.75
	Sulfur Dioxide (SO_2)	0.0360	12.36
	Primary Exhaust $PM_{2.5}$ - Total	0.2827	97.03
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0165	5.65
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0044	1.51
2015	Vehicle Population: 56,625	Daily VMT: 1,585,233	Annual VMT: 542,119,590
	Oxides of Nitrogen (NO_x)	3.57	1,225.13
	Sulfur Dioxide (SO_2)	0.0368	12.61
	Primary Exhaust $PM_{2.5}$ - Total	0.1359	46.54
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0179	6.11
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0048	1.63
2022	Vehicle Population: 59,674	Daily VMT: 1,735,819	Annual VMT: 593,617,125
	Oxides of Nitrogen (NO_x)	1.99	685.60
	Sulfur Dioxide (SO_2)	0.0375	12.83
	Primary Exhaust $PM_{2.5}$ - Total	0.0647	22.18
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0199	6.81
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0053	1.80

Table 2a. Mobile Source Emissions by County for the Huntington-Ironton-Ashland $PM_{2.5}$ Nonattainment Area, Cabell County, WV (tons)

Cabell County, WV

	Pollutant Name	Daily Emissions (tons)	Annual Emissions (tons)
2005	Vehicle Population: 73,091	Daily VMT: 2,808,750	Annual VMT: 960,538,915
	Oxides of Nitrogen (NO_x)	12.44	4,262.48
	Sulfur Dioxide (SO_2)	0.2371	81.13
	Primary Exhaust $PM_{2.5}$ - Total	0.4731	161.97
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0270	9.23
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0079	2.72
2008	Vehicle Population: 74,874	Daily VMT: 2,885,502	Annual VMT: 989,243,546
	Oxides of Nitrogen (NO_x)	10.20	3,504.59
	Sulfur Dioxide (SO_2)	0.0640	21.95
	Primary Exhaust $PM_{2.5}$ - Total	0.4069	139.66
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0278	9.52
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0082	2.80
2015	Vehicle Population: 79,033	Daily VMT: 3,096,762	Annual VMT: 1,059,033,672
	Oxides of Nitrogen (NO_x)	4.96	1,702.34
	Sulfur Dioxide (SO_2)	0.0274	9.39
	Primary Exhaust $PM_{2.5}$ - Total	0.1953	66.88
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0298	10.19
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0088	3.00
2022	Vehicle Population: 83,193	Daily VMT: 3,336,065	Annual VMT: 1,140,870,563
	Oxides of Nitrogen (NO_x)	2.46	847.76
	Sulfur Dioxide (SO_2)	0.0267	9.13
	Primary Exhaust $PM_{2.5}$ - Total	0.0850	29.12
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0321	10.97
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0094	3.23

Table 2b. Mobile Source Emissions by County for the Huntington-Ironton-Ashland $PM_{2.5}$ Nonattainment Area, Wayne County, WV (tons)

Wayne County, WV

	Pollutant Name		Daily Emissions (tons)		Annual Emissions (tons)
2005	Vehicle Population:	25,446	Daily VMT: 1,139,180	Annual VMT:	389,577,827
	Oxides of Nitrogen (NO_x)		5.02		1,720.01
	Sulfur Dioxide (SO_2)		0.0961		32.87
	Primary Exhaust $PM_{2.5}$ - Total		0.1914		65.52
	Primary $PM_{2.5}$ - Brakewear Particulate		0.0109		3.74
	Primary $PM_{2.5}$ - Tirewear Particulate		0.0032		1.10
2008	Vehicle Population:	26,067	Daily VMT: 1,187,259	Annual VMT:	407,030,689
	Oxides of Nitrogen (NO_x)		4.17		1,432.79
	Sulfur Dioxide (SO_2)		0.0263		9.02
	Primary Exhaust $PM_{2.5}$ - Total		0.1670		57.30
	Primary $PM_{2.5}$ - Brakewear Particulate		0.0114		3.92
	Primary $PM_{2.5}$ - Tirewear Particulate		0.0034		1.15
2015	Vehicle Population:	27,515	Daily VMT: 1,241,619	Annual VMT:	424,609,965
	Oxides of Nitrogen (NO_x)		1.97		676.93
	Sulfur Dioxide (SO_2)		0.0110		3.76
	Primary Exhaust $PM_{2.5}$ - Total		0.0781		26.74
	Primary $PM_{2.5}$ - Brakewear Particulate		0.0120		4.09
	Primary $PM_{2.5}$ - Tirewear Particulate		0.0035		1.20
2022	Vehicle Population:	28,963	Daily VMT: 1,560,054	Annual VMT:	533,508,781
	Oxides of Nitrogen (NO_x)		1.13		386.80
	Sulfur Dioxide (SO_2)		0.0124		4.26
	Primary Exhaust $PM_{2.5}$ - Total		0.0394		13.49
	Primary $PM_{2.5}$ - Brakewear Particulate		0.0150		5.13
	Primary $PM_{2.5}$ - Tirewear Particulate		0.0044		1.51

Table 2c. Mobile Source Emissions by County for the Huntington-Ironton-Ashland $PM_{2.5}$ Nonattainment Area, Nonattainment Portion of Mason County, WV (tons)

Mason County (Partial), WV

Year	Pollutant Name	Daily Emissions (tons)	Annual Emissions (tons)
2005	Vehicle Population: 2,244	Daily VMT: 18,060	Annual VMT: 6,176,333
	Oxides of Nitrogen (NO_x)	0.09	31.12
	Sulfur Dioxide (SO_2)	0.0016	0.54
	Primary Exhaust $PM_{2.5}$ - Total	0.0032	1.11
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0002	0.06
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0001	0.02
2008	Vehicle Population: 2,299	Daily VMT: 19,665	Annual VMT: 6,741,932
	Oxides of Nitrogen (NO_x)	0.08	27.36
	Sulfur Dioxide (SO_2)	0.0005	0.16
	Primary Exhaust $PM_{2.5}$ - Total	0.0029	1.01
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0002	0.06
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0001	0.02
2015	Vehicle Population: 2,427	Daily VMT: 23,410	Annual VMT: 8,005,850
	Oxides of Nitrogen (NO_x)	0.04	15.33
	Sulfur Dioxide (SO_2)	0.0002	0.07
	Primary Exhaust $PM_{2.5}$ - Total	0.0016	0.54
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0002	0.08
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0001	0.02
2022	Vehicle Population: 2,555	Daily VMT: 27,155	Annual VMT: 9,286,512
	Oxides of Nitrogen (NO_x)	0.03	8.72
	Sulfur Dioxide (SO_2)	0.0002	0.08
	Primary Exhaust $PM_{2.5}$ - Total	0.0008	0.26
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0003	0.09
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0001	0.03

Table 2d. Mobile Source Emissions by County for the Huntington-Ironton-Ashland $PM_{2.5}$ Nonattainment Area, Lawrence County, OH (tons)

Lawrence County, OH

	Pollutant Name		Daily Emissions (tons)		Annual Emissions (tons)
2005	Vehicle Population: 72,392	Daily VMT:	1,315,020	Annual VMT:	449,711,752
	Oxides of Nitrogen (NO_x)		4.93		1,692.81
	Sulfur Dioxide (SO_2)		0.0820		28.08
	Primary Exhaust $PM_{2.5}$ - Total		0.1529		52.46
	Primary $PM_{2.5}$ - Brakewear Particulate		0.0103		3.52
	Primary $PM_{2.5}$ - Tirewear Particulate		0.0034		1.17
2008	Vehicle Population: 74,172	Daily VMT:	1,334,081	Annual VMT:	457,366,121
	Oxides of Nitrogen (NO_x)		4.07		1,403.49
	Sulfur Dioxide (SO_2)		0.0267		9.16
	Primary Exhaust $PM_{2.5}$ - Total		0.1282		44.10
	Primary $PM_{2.5}$ - Brakewear Particulate		0.0104		3.58
	Primary $PM_{2.5}$ - Tirewear Particulate		0.0035		1.19
2015	Vehicle Population: 78,325	Daily VMT:	1,470,988	Annual VMT:	503,049,909
	Oxides of Nitrogen (NO_x)		2.21		759.82
	Sulfur Dioxide (SO_2)		0.0121		4.14
	Primary Exhaust $PM_{2.5}$ - Total		0.0685		23.51
	Primary $PM_{2.5}$ - Brakewear Particulate		0.0115		3.94
	Primary $PM_{2.5}$ - Tirewear Particulate		0.0038		1.31
2022	Vehicle Population: 82,480	Daily VMT:	1,742,638	Annual VMT:	595,949,049
	Oxides of Nitrogen (NO_x)		1.15		397.98
	Sulfur Dioxide (SO_2)		0.0131		4.48
	Primary Exhaust $PM_{2.5}$ - Total		0.0404		13.87
	Primary $PM_{2.5}$ - Brakewear Particulate		0.0136		4.66
	Primary $PM_{2.5}$ - Tirewear Particulate		0.0045		1.55

Table 2e. Mobile Source Emissions by County for the Huntington-Ironton-Ashland $PM_{2.5}$ Nonattainment Area, Scioto County, OH (tons)

Scioto County, OH

	Pollutant Name	Daily Emissions (tons)	Annual Emissions (tons)
2005	Vehicle Population: 88,852	Daily VMT: 1,616,940	Annual VMT: 552,962,632
	Oxides of Nitrogen (NO_x)	6.06	2,081.20
	Sulfur Dioxide (SO_2)	0.1009	34.53
	Primary Exhaust $PM_{2.5}$ - Total	0.1880	64.50
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0126	4.33
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0042	1.43
2008	Vehicle Population: 91,039	Daily VMT: 1,678,238	Annual VMT: 575,354,151
	Oxides of Nitrogen (NO_x)	5.11	1,761.97
	Sulfur Dioxide (SO_2)	0.0336	11.52
	Primary Exhaust $PM_{2.5}$ - Total	0.1611	55.40
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0131	4.51
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0044	1.49
2015	Vehicle Population: 96,136	Daily VMT: 1,915,776	Annual VMT: 655,158,989
	Oxides of Nitrogen (NO_x)	2.86	983.09
	Sulfur Dioxide (SO_2)	0.0157	5.39
	Primary Exhaust $PM_{2.5}$ - Total	0.0889	30.52
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0150	5.13
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0050	1.70
2022	Vehicle Population: 101,235	Daily VMT: 2,131,162	Annual VMT: 728,816,580
	Oxides of Nitrogen (NO_x)	1.41	486.95
	Sulfur Dioxide (SO_2)	0.0160	5.47
	Primary Exhaust $PM_{2.5}$ - Total	0.0494	16.97
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0167	5.70
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0055	1.89

Table 2f. Mobile Source Emissions by County for the Huntington-Ironton-Ashland $PM_{2.5}$ Nonattainment Area, Nonattainment Portion of Adams County, OH (tons)

Adams County, OH (Partial)

Year	Pollutant Name		Daily Emissions (tons)		Annual Emissions (tons)	
2005	Vehicle Population:	2,098	Daily VMT:	99,565	Annual VMT:	34,049,176
	Oxides of Nitrogen (NO_x)			0.36		122.49
	Sulfur Dioxide (SO_2)			0.0061		2.10
	Primary Exhaust $PM_{2.5}$ - Total			0.0112		3.84
	Primary $PM_{2.5}$ - Brakewear Particulate			0.0008		0.27
	Primary $PM_{2.5}$ - Tirewear Particulate			0.0003		0.09
2008	Vehicle Population:	2,150	Daily VMT:	103,978	Annual VMT:	35,647,156
	Oxides of Nitrogen (NO_x)			0.30		103.66
	Sulfur Dioxide (SO_2)			0.0021		0.71
	Primary Exhaust $PM_{2.5}$ - Total			0.0097		3.32
	Primary $PM_{2.5}$ - Brakewear Particulate			0.0008		0.28
	Primary $PM_{2.5}$ - Tirewear Particulate			0.0003		0.09
2015	Vehicle Population:	2,270	Daily VMT:	114,277	Annual VMT:	39,080,671
	Oxides of Nitrogen (NO_x)			0.16		54.82
	Sulfur Dioxide (SO_2)			0.0009		0.32
	Primary Exhaust $PM_{2.5}$ - Total			0.0051		1.76
	Primary $PM_{2.5}$ - Brakewear Particulate			0.0009		0.31
	Primary $PM_{2.5}$ - Tirewear Particulate			0.0003		0.10
2022	Vehicle Population:	2,391	Daily VMT:	124,576	Annual VMT:	42,602,717
	Oxides of Nitrogen (NO_x)			0.08		26.21
	Sulfur Dioxide (SO_2)			0.0009		0.32
	Primary Exhaust $PM_{2.5}$ - Total			0.0028		0.95
	Primary $PM_{2.5}$ - Brakewear Particulate			0.0010		0.33
	Primary $PM_{2.5}$ - Tirewear Particulate			0.0003		0.11

Table 2g. Mobile Source Emissions by County for the Huntington-Ironton-Ashland $PM_{2.5}$ Nonattainment Area, Nonattainment Portion of Gallia County, OH (tons)

Gallia County, OH (Partial)

Year	Pollutant Name		Daily Emissions (tons)		Annual Emissions (tons)	
2005	Vehicle Population:	1,021	Daily VMT:	48,230	Annual VMT:	16,493,759
	Oxides of Nitrogen (NO_x)			0.17		59.34
	Sulfur Dioxide (SO_2)			0.0030		1.02
	Primary Exhaust $PM_{2.5}$ - Total			0.0054		1.86
	Primary $PM_{2.5}$ - Brakewear Particulate			0.0004		0.13
	Primary $PM_{2.5}$ - Tirewear Particulate			0.0001		0.04
2008	Vehicle Population:	1,046	Daily VMT:	50,582	Annual VMT:	17,341,207
	Oxides of Nitrogen (NO_x)			0.15		50.43
	Sulfur Dioxide (SO_2)			0.0010		0.34
	Primary Exhaust $PM_{2.5}$ - Total			0.0047		1.62
	Primary $PM_{2.5}$ - Brakewear Particulate			0.0004		0.14
	Primary $PM_{2.5}$ - Tirewear Particulate			0.0001		0.05
2015	Vehicle Population:	1,105	Daily VMT:	56,070	Annual VMT:	19,175,027
	Oxides of Nitrogen (NO_x)			0.08		26.89
	Sulfur Dioxide (SO_2)			0.0005		0.16
	Primary Exhaust $PM_{2.5}$ - Total			0.0025		0.86
	Primary $PM_{2.5}$ - Brakewear Particulate			0.0004		0.15
	Primary $PM_{2.5}$ - Tirewear Particulate			0.0001		0.05
2022	Vehicle Population:	1,163	Daily VMT:	61,559	Annual VMT:	21,051,915
	Oxides of Nitrogen (NO_x)			0.04		12.94
	Sulfur Dioxide (SO_2)			0.0005		0.16
	Primary Exhaust $PM_{2.5}$ - Total			0.0014		0.47
	Primary $PM_{2.5}$ - Brakewear Particulate			0.0005		0.16
	Primary $PM_{2.5}$ - Tirewear Particulate			0.0002		0.05

Table 2h. Mobile Source Emissions by County for the Huntington-Ironton-Ashland $PM_{2.5}$ Nonattainment Area, Boyd County, KY (tons)

Boyd County, KY

	Pollutant Name	Daily Emissions (tons)	Annual Emissions (tons)
2005	Vehicle Population: 49,199	Daily VMT: 1,429,198	Annual VMT: 488,758,339
	Oxides of Nitrogen (NO_x)	7.80	2,673.25
	Sulfur Dioxide (SO_2)	0.0347	11.89
	Primary Exhaust $PM_{2.5}$ - Total	0.3138	107.44
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0158	5.41
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0043	1.46
2008	Vehicle Population: 50,429	Daily VMT: 1,380,484	Annual VMT: 473,274,668
	Oxides of Nitrogen (NO_x)	6.32	2,172.59
	Sulfur Dioxide (SO_2)	0.0339	11.62
	Primary Exhaust $PM_{2.5}$ - Total	0.2657	91.18
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0155	5.31
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0041	1.42
2015	Vehicle Population: 53,299	Daily VMT: 1,494,083	Annual VMT: 510,947,840
	Oxides of Nitrogen (NO_x)	3.36	1,154.59
	Sulfur Dioxide (SO_2)	0.0347	11.89
	Primary Exhaust $PM_{2.5}$ - Total	0.1281	43.86
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0168	5.76
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0045	1.54
2022	Vehicle Population: 56,169	Daily VMT: 1,640,241	Annual VMT: 560,930,984
	Oxides of Nitrogen (NO_x)	1.88	647.64
	Sulfur Dioxide (SO_2)	0.0354	12.12
	Primary Exhaust $PM_{2.5}$ - Total	0.0611	20.95
	Primary $PM_{2.5}$ - Brakewear Particulate	0.0188	6.43
	Primary $PM_{2.5}$ - Tirewear Particulate	0.0050	1.70

Table 2i. Mobile Source Emissions by County for the Huntington-Ironton-Ashland $PM_{2.5}$ Nonattainment Area, Nonattainment Portion of Lawrence County, KY (tons)

Lawrence County, KY (Partial)

Year	Pollutant Name		Daily Emissions (tons)		Annual Emissions (tons)	
2005	Vehicle Population:	3,070	Daily VMT:	91,327	Annual VMT:	31,232,092
	Oxides of Nitrogen (NO_x)			0.50		170.69
	Sulfur Dioxide (SO_2)			0.0022		0.76
	Primary Exhaust $PM_{2.5}$ - Total			0.0200		6.86
	Primary $PM_{2.5}$ - Brakewear Particulate			0.0010		0.35
	Primary $PM_{2.5}$ - Tirewear Particulate			0.0003		0.09
2008	Vehicle Population:	3,147	Daily VMT:	88,522	Annual VMT:	30,348,132
	Oxides of Nitrogen (NO_x)			0.40		139.16
	Sulfur Dioxide (SO_2)			0.0022		0.74
	Primary Exhaust $PM_{2.5}$ - Total			0.0170		5.84
	Primary $PM_{2.5}$ - Brakewear Particulate			0.0010		0.34
	Primary $PM_{2.5}$ - Tirewear Particulate			0.0003		0.09
2015	Vehicle Population:	3,326	Daily VMT:	91,151	Annual VMT:	31,171,751
	Oxides of Nitrogen (NO_x)			0.21		70.54
	Sulfur Dioxide (SO_2)			0.0021		0.73
	Primary Exhaust $PM_{2.5}$ - Total			0.0078		2.68
	Primary $PM_{2.5}$ - Brakewear Particulate			0.0010		0.35
	Primary $PM_{2.5}$ - Tirewear Particulate			0.0003		0.09
2022	Vehicle Population:	3,505	Daily VMT:	95,579	Annual VMT:	32,686,140
	Oxides of Nitrogen (NO_x)			0.11		37.96
	Sulfur Dioxide (SO_2)			0.0021		0.71
	Primary Exhaust $PM_{2.5}$ - Total			0.0036		1.22
	Primary $PM_{2.5}$ - Brakewear Particulate			0.0011		0.37
	Primary $PM_{2.5}$ - Tirewear Particulate			0.0003		0.10

Background

US EPA published a Federal Register notice[1] of availability on March 2, 2010, to approve MOVES2010 (Motor Vehicle Emissions Simulator), hereafter referred to as MOVES. Upon publication of the Federal Register notice, MOVES became U.S. EPA's approved motor vehicle emission factor model for estimating VOCs, NO_x, CO, PM_{10} and $PM_{2.5}$ and other pollutants and precursors from cars, trucks, motorcycles, and buses by state and local agencies. MOVES is a computer program designed by the US EPA to estimate air pollution emissions from mobile sources. MOVES replaces US EPA's previous emissions model for on-road mobile sources, MOBILE6.2. MOVES can be used to estimate exhaust and evaporative emissions as well as brake and tire wear emissions from all types of on-road vehicles.

An updated version of this software, MOVES2010a, was used for the purposes of this analysis. MOVES2010a is a minor update to MOVES2010. MOVES2010a includes general performance improvements from MOVES2010, and also allows users to account for emissions under new car and light truck energy and greenhouse gas standards.

The Clean Air Act (CAA) requires US EPA to regularly update its mobile source emission models. US EPA continuously collects data and measures vehicle emissions to make sure the Agency has the best possible understanding of mobile source emissions. This assessment, in turn, informs the development of US EPA's mobile source emission models. MOVES represents the Agency's most up-to-date assessment of on-road mobile source emissions. MOVES also incorporates several changes to the US EPA's approach to mobile source emission modeling based upon recommendations made to the Agency by the National Academy of Sciences.

US EPA believes that MOVES should be used in ozone, CO, PM, and nitrogen dioxide State Implementation Plan (SIP) development as expeditiously as possible. The CAA requires that SIP inventories and control measures be based on the most current information and applicable models that are available when a SIP is developed.

On March 2, 2010, US EPA and US DOT established a two-year grace period before MOVES is required for new transportation conformity analyses. As a result, MOVES will be the required analysis platform for all conformity analyses after March 2, 2012.

The more detailed MOVES approach to modeling (when compared with the previous MOBILE model) allows US EPA to easily incorporate large amounts of in-use data from a wide variety of sources, such as data from vehicle inspection and maintenance (I/M) programs, remote sensing device (RSD) testing, certification testing, portable emission measurement systems (PEMS), etc. This approach also allows users to incorporate a variety of activity data to better estimate emission differences such as those resulting from changes to vehicle speed and acceleration patterns. MOVES has a graphical user interface which allows users to more easily set up and run the model. MOVES database-centered design provides users much greater flexibility regarding output choices. Unlike earlier models which provided emission factors in grams-per-mile in fixed output formats, MOVES output can be expressed as total mass (in tons, pounds, kilograms, or grams) or as emission factors (grams-per-mile and in some cases grams-per-vehicle). Output can be easily aggregated or disaggregated to examine emissions in a range of scales, from national emissions impacts down to the emissions impacts of individual transportation projects. The database-centered design also allows

[1] http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480ab1f98

US EPA to update emissions data incorporated in MOVES more easily and will allow users to incorporate a much wider array of activity data to improve estimation of local emissions. For example, the improvements in MOVES will allow project-level $PM_{2.5}$ emissions to be estimated.

Mobile Source Emission Forecast Process

The emissions inventory development and emissions projection discussion below identifies procedures used by the KYOVA Interstate Planning Commission regarding emissions of all the counties in the Huntington-Ironton-Ashland nonattainment area. All of these inventories and emissions projections were prepared using similar methodologies. Mobile emissions inventories and projections for all counties were prepared by Kimley-Horn and Associates on behalf of the KYOVA Interstate Planning Commission, with data provided by KYOVA, ODOT, Ohio EPA, WVDOT, WVDEP, KYTC, and KDAQ.

Cabell County, WV, Wayne County, WV, and Lawrence County, OH are represented within the KYOVA Travel Demand Model. Boyd County, KY is represented by the KYTC's Ashland Regional Travel Demand Model. For these areas, information from the travel demand models combined with Highway Performance Monitoring Systems (HPMS) county-level data from each respective area were used in the emissions analysis. For the full or partial counties not included within the available travel demand models, HPMS data was relied upon more heavily for the travel characteristics. The **Appendix** of this report provides a full description of the data sources and analysis procedures used in this analysis effort.

Table 3 summarizes the settings used in the MOVES run specification file. **Table 4** lists the assumptions used in the MOVES County Data Manager. Further details on the use of MOVES are found in the **Appendix**.

Table 3. MOVES Runspec Parameters

MOVES Runspec Parameter	Settings
MOVES2010a, Version 2010/08/26	
Scale	County, Emission Rates
Time Span	Time aggregation = Hour 1 month representing average annual temperatures (April) All hours of the day selected Weekdays only
Geographic Bounds	3 custom domains – 3 West Virginia counties, 4 Ohio counties, 2 Kentucky counties
Vehicles/Equipment	All valid source types, gasoline and diesel
Road Type	All road types including off-network
Pollutants and Processes	NO_x, all $PM_{2.5}$ categories, SO_2, total energy consumption
Strategies	Modified AVFT strategy reflecting 0% CNG buses in the transit fleet
General Output	Units = grams, joules, miles
Output Emissions	Time = hour, location = link, on-road emission rates by road type and source use type
Advanced Performance	None

Table 4. MOVES County Data Manager Parameters

County Data Manager Input	Data Source
Meteorology Data	Local. OH and WV data from ODOT. KY data from KDAQ
Source Type Population	Local and default. Local data from motor vehicle registration data. WV data from WVDEP. Default data used for source types 51, 52, 53, 61, and 62. OH data from ODOT. Default data used for source types 41, 51, 54, 61, and 62. KY data from KYTC. No default data used. 0.8% annual growth factor applied for all areas.
Age Distribution	Local and default. Local data from motor vehicle registration data. WV data from WVDEP. Ohio data used for source types 41, 42, 43, 51, 52, 53, 61, and 62. OH data from ODOT (Lawrence and Scioto Counties). KY data from KYTC (Boyd County).
Vehicle Type VMT – HPMS Vehicle Type VMT	Local. OH and WV data from ODOT. Lawrence County, OH, Cabell County, WV, and Wayne County, WV data from KYOVA Travel Demand Model. Scioto County, OH data from interim statewide model. Adams County, OH, Gallia County, OH, and Mason County, WV data from ODOT and WVDOT roadway inventory data. KY data from KYTC. Ashland Travel Demand Model and HPMS data used to forecast information.
Vehicle Type VMT – Monthly VMT Fraction	Determined using EPA conversion tool for Annual Average Weekly VMT
Vehicle Type VMT – Daily VMT Fraction	Determined using EPA conversion tool for Annual Average Weekly VMT
Vehicle Type VMT – Hourly VMT Fraction	Local and default. OH and WV data from ODOT. Default used for off-network, OH data used for on-road classes. KY data from KYTC. Default used for off-network, road type 4. KY data used for road types 2, 3, and 5.
Average Speed Distribution	Default
Road Type Distribution	Local. ODOT applied HPMS data for Lawrence County, OH, Scioto County, OH, Cabell County, WV, and Wayne County, WV. Assumed to apply to all geographic areas.
Ramp Fraction	Local. OH and WV data from KYOVA Travel Demand Model. KY data from Ashland Travel Demand Model.
Fuel Supply	Local and default. Default for WV and OH. KY data from KDAQ.
Fuel Formulation	Default
I/M Programs	No data entered
Zone Road Activity	Default

Travel Demand Modeling

The latest planning assumptions available for the Huntington-Ironton-Ashland non-attainment area were used. Both the KYOVA Travel Demand Model and the KYTC Ashland Regional Travel Demand Model are the most recent and approved regional travel demand models for their respective areas. For each travel demand model, model validation is a joint process between the MPO and the appropriate state review agencies.

The KYOVA Travel Demand Model is a three step model. Trip generation, trip distribution, and trip assignment components are included in the model. Mode choice is not an element of the current model. The Travel Demand Model covers Cabell County, WV, Wayne County, WV, and Lawrence County, OH. The current base year for the travel demand model is 2000. Socioeconomic data was forecasted to the year 2035 as a part of the most recent regional metropolitan transportation plan. The QRS II modeling platform was used to develop this model. The KYOVA Interstate Planning Commission's currently adopted transportation plan, titled *Huntington-Ironton Area Transportation Study (HIATS), The Year 2035 Long-Range Transportation Plan* was prepared in May 2009. Appendix A of that document contains the assumptions and methodology used to develop the Travel Demand Model.

Similar to the KYOVA Travel Demand Model, the Ashland Regional Travel Demand Model is a traditional three-step model. The model includes trip generation, trip distribution, and trip assignment components. Transit operations are not included in the model; as a result, there is no mode choice component. The Travel Demand Model covers Boyd and Greenup Counties in Kentucky. Updated in 2007, this model has a base year of 2007 and a final horizon year of 2040. 2010, 2020, and 2030 forecast years were also incorporated into the model. The TransCAD modeling platform was used to develop this model. The document titled *Ashland Regional Travel Demand Model, Model Update Report* was developed in January 2008 for the Kentucky Transportation Cabinet. This document contains the assumptions and methodology used to develop the current Travel Demand Model.

For areas of the modeling region in a county with a travel demand model, information from this model was applied for the analysis. Specifically, VMT data in the HPMS vehicle class format and ramp fractions for rural and urban restricted roadways were obtained from the travel demand models. For areas outside of the travel demand model extents, ramp fractions were assumed to mirror those seen in their respective states. HPMS vehicle class VMTs for areas outside the travel demand model limits were derived and forecasted from current HPMS traffic data in those areas.

In addition to the information above, numerous additional data sources were consulted to obtain the needed information for the MOVES software. Source type population and vehicle age distribution data were obtained from ODOT, WVDEP, and KYTC for their respective states. ODOT and KYTC provided data about hourly vehicle distributions. Guidance and data for meteorological, fuel supply, and fuel formulation inputs were obtained from ODOT and KDAQ. The KYOVA Interstate Planning Commission supplied information on the transit vehicle population for the region. Information regarding these parameters is discussed in **Tables 3 and 4**.

<u>Post-Processing</u>

The analysis was performed using the emission rates method. This method was chosen over the inventory method in an attempt to generate a set of MOVES runs that could later be used for other project applications without re-running the entire MOVES program. As a result, post-processing of the data was required to arrive at the overall emissions output. To do this, the rate per distance and rate per vehicle output data were matched with the appropriate geographic area, analysis year, source types, pollutant types, road types, modeling hours, and speed classes and then aggregated with the corresponding source type population and vehicle miles traveled information. The resulting information was summarized by pollutant type for each full or partial county being analyzed to generate the overall emissions in tons per year. The **Appendix** provides additional detail on the data sources gathered, modeling assumptions, and post-processing steps.

APPENDIX

Technical Documentation for Using MOVES2010a to Develop Mobile Source Emissions for the Huntington-Ironton-Ashland $PM_{2.5}$ Nonattainment Area

March 2011

1.0 MOVES2010a

The MOVES2010a software was released by the Environmental Protection Agency in August 2010. This software uses a graphical user interface with a set of input categories. A Runspec can be developed that stores the input values for these categories. The values and information included in the Runspecs developed for this analysis are explained in more detail in the following sections.

1.1 Description

This input window is used to distinguish the individual Runspecs. For this analysis, the description is used to introduce the purpose for the analysis, the area being studied (i.e. West Virginia, Ohio, or Kentucky), and the year of analysis (i.e. 2005, 2008, 2015, and 2022).

1.2 Scale

This input window is used to detail the information needed for the domain/scale of the analysis as well as the calculation type. The county level was selected as the domain for this effort, since it is the appropriate level for use in SIP and regional conformity analysis. The emission rate method was chosen for the calculation type. This calculation type was chosen following a discussion with the involved review agencies to determine the most appropriate calculation method for this analysis.

1.3 Time Spans

The Time Spans input window has a variety of different timescale inputs that are used for understanding the level of temporal aggregation being used in the analysis. The time aggregation level was specified as hours, based on guidance from EPA/FHWA for the preferred aggregation level for SIP runs. Based on the interagency consultation process, the years 2005, 2008, 2015, and 2022 were chosen for the analysis years. 2022 was chosen as the final horizon year because that year must be more than 10 years beyond the current year. Each year was done within a different Runspec. Since the pollutant analysis being conducted is for the annual $PM_{2.5}$ standard, a representative month was chosen to portray average annual temperatures. April was established as the representative month through the consultation process. Weekdays were selected as the representative day type since they are considered to be the worst-case type when compared with weekends. All hours of the day were included in the analysis to represent conditions over a full 24-hour period.

1.4 Geographic Bounds

Rather than looking at each full and partial county within the non-attainment area, a custom domain method was employed. Custom domains were used to represent the areas to be modeled in each of the three states. The custom domains are as follows:

- West Virginia: Cabell, Wayne, and Mason (partial) Counties. CountyID 1.
- Ohio: Lawrence, Scioto, Adams (partial), and Gallia (partial) Counties. CountyID 2.
- Kentucky: Boyd and Lawrence (partial) Counties. CountyID 3.

The component counties within each state's analysis area were listed within this input window. Default information was used for the barometric pressure in each custom domain. This region is not a geographic phase-in area, so that value was kept as zero. Since the region does not have an I/M program, the refueling vapor program adjustment fraction and the refueling spill program adjustment factors were also left as zero.

This input window also asks for the name of the domain input database. A total of twelve input databases were created during this process, reflecting the appropriate Runspec and input data for the following conditions:

- West Virginia, Year 2005
- West Virginia, Year 2008
- West Virginia, Year 2015
- West Virginia, Year 2022
- Ohio, Year 2005
- Ohio, Year 2008
- Ohio, Year 2015
- Ohio, Year 2022
- Kentucky, Year 2005
- Kentucky, Year 2008
- Kentucky, Year 2015
- Kentucky, Year 2022

1.5 Vehicles/Equipment

This input window allows the user to specify which fuel and vehicle types are present within the transportation network. There are thirteen vehicle classes (referred to as source use types) and five fuel types. This analysis considers diesel and gas fuel types only. This was partly to reflect the lack of compressed natural gas and liquefied petroleum gas vehicles in the population, and also to allow for default fuel formulation and fuel supply information to be used in portions of the study area. Within these constraints, all possible vehicle and fuel types were considered. Diesel motorcycles, gas combination long-haul trucks, and gas intercity buses were removed since they are not represented in the vehicle population.

1.6 Road Type

The MOVES software incorporates five different roadway types: off-network, rural restricted access, rural unrestricted access, urban restricted access, and urban unrestricted access. Expressways and freeways in the region are considered as restricted access facilities. For this analysis, all five vehicle types were considered. Off-network emissions are intended to account for vehicle starts and evaporative emissions for parked vehicles. While these emissions are not captured through the information provided by the regional travel demand models, default values can be used to assess their impacts.

1.7 Pollutants and Processes

This input window allows the user to specify different pollutants and processes that are desired for modeling. Since the purpose of this analysis is to assess emissions relating to the annual $PM_{2.5}$ standard, the interagency consultation specified the inclusion of total energy consumption, all $PM_{2.5}$ categories, NO_x, and SO_2.

1.8 Miscellaneous Strategies

The MOVES software includes input windows where provisions can be specified for alternative vehicle fuels and technologies (AVFT), on-road retrofit strategies, and rate of progress information. If no information is entered for AVFT, MOVES assumes a default mix of alternative fuels. KYOVA provided information detailing the makeup of the bus fleet for the Tri-State Transit Authority (TTA). The TTA fleet is composed of standard gas and diesel vehicles as well as a small number of hybrid vehicles. At this time, the MOVES software is not equipped to consider hybrid vehicles in its AVFT element. This element can only be used to reflect compressed natural gas, electric, and advanced internal combustion engines. Therefore, the MOVES default file was modified to reflect only standard fuel types. **Table 1** shows the modified portion of the AVFT file used in this MOVES analysis for the entire region.

Table 1. AVFT Input for All Runspecs (Source Type 42)

sourceTypeID	modelYearID	fuelTypeID	engTechID	fuelEngFraction
42	1960	2	1	1
42	1961	2	1	1
42	1962	2	1	1
42	1963	2	1	1
42	1964	2	1	1
42	1965	2	1	1
42	1966	2	1	1
42	1967	2	1	1
42	1968	2	1	1
42	1969	2	1	1
42	1970	2	1	1
42	1971	2	1	1
42	1972	2	1	1
42	1973	2	1	1
42	1974	2	1	1
42	1975	2	1	1
42	1976	2	1	1
42	1977	2	1	1
42	1978	2	1	1
42	1979	2	1	1
42	1980	2	1	1
42	1981	2	1	1
42	1982	2	1	1
42	1983	2	1	1
42	1984	2	1	1
42	1985	2	1	1
42	1986	2	1	1
42	1987	2	1	1
42	1988	2	1	1
42	1989	2	1	1
42	1990	2	1	1
42	1991	2	1	1
42	1992	2	1	1
42	1993	2	1	1
42	1994	2	1	1
42	1995	2	1	1
42	1996	2	1	1
42	1997	2	1	1
42	1998	2	1	1
42	1999	2	1	1
42	2000	2	1	1
42	2001	2	1	1
42	2002	2	1	1
42	2003	2	1	1
42	2004	2	1	1
42	2005	2	1	1

sourceTypeID	modelYearID	fuelTypeID	engTechID	fuelEngFraction
42	2006	2	1	1
42	2007	2	1	1
42	2008	2	1	1
42	2009	2	1	1
42	2010	2	1	1
42	2011	2	1	1
42	2012	2	1	1
42	2013	2	1	1
42	2014	2	1	1
42	2015	2	1	1
42	2016	2	1	1
42	2017	2	1	1
42	2018	2	1	1
42	2019	2	1	1
42	2020	2	1	1
42	2021	2	1	1
42	2022	2	1	1
42	2023	2	1	1
42	2024	2	1	1
42	2025	2	1	1
42	2026	2	1	1
42	2027	2	1	1
42	2028	2	1	1
42	2029	2	1	1
42	2030	2	1	1
42	2031	2	1	1
42	2032	2	1	1
42	2033	2	1	1
42	2034	2	1	1
42	2035	2	1	1
42	2036	2	1	1
42	2037	2	1	1
42	2038	2	1	1
42	2039	2	1	1
42	2040	2	1	1
42	2041	2	1	1
42	2042	2	1	1
42	2043	2	1	1
42	2044	2	1	1
42	2045	2	1	1
42	2046	2	1	1
42	2047	2	1	1
42	2048	2	1	1
42	2049	2	1	1
42	2050	2	1	1

1.9 Output

Output for the MOVES program is stored in a user-created database. Output databases were created for each of the 12 different Runspec conditions. As specified in the interagency consultation process, grams, joules, and miles were used as the units of measure in the output database. Based on the parameters already established in these Runspecs, the time measurement for this analysis was set as hourly, and the location was automatically set for the link level. To assist with post-processing aggregation, it was further requested that the source use type information be included with the output.

2.0 County Data Manager

Once all of the base parameters have been established for a given MOVES Runspec, the County Data Manager can be used to enter locally-specific data. Input provided in Excel spreadsheet format can be referenced using this tool, which converts the data to MySQL format and incorporates it into the MOVES analysis. For the Huntington-Ironton-Ashland non-attainment area, locally-specific data could consist of data used for the entire region, for one or more state portions, or for a particular county. The following sections detail these input criteria, and the methodology and assumptions used to arrive at the information entered for each.

2.1 Meteorology Data Importer

This importer requires the average temperature and relative humidity information for each hour of the day. As detailed in the MOVES Runspec information, the month of April was assumed to represent average annual conditions. The Protocol Report developed for this analysis indicated all meteorological information would be derived from NOAA information obtained at the Tri-State Airport. However, the presence of specific data in the Kentucky area led to the airport data being used only for the Ohio and West Virginia portions of this analysis. Due to the detail of this data as well as the location of the airport, this data is assumed to appropriately represent the Ohio and West Virginia areas of the analysis.

ODOT supplied the information for Ohio and West Virginia, obtained originally from NOAA. The Ohio and West Virginia data represents the meteorological conditions at the Tri-State Airport. 2002 was chosen for the meteorological base year due to the guidance provided in Federal Register 40 CFR 93.122, which states temperatures should be consistent with those used to establish the budget in the current State Implementation Plan. **Table 2** shows the April portion of the meteorology data used in Ohio and West Virginia.

Meteorological data for the Kentucky portion of the analysis area was obtained from KDAQ. This data provided temperature and humidity information for Boyd County, KY. Data for this county is also anticipated to be applicable for the modeled portion of Lawrence County, KY. The temperature and relative humidity data was obtained from historical data obtained through NOAA. **Table 3** shows the April portion of the meteorology data used in Kentucky.

Table 2. West Virginia and Ohio Meteorology Data

monthID	zoneID	HourID	temperature	relHumidity
4	990010	1	46.8	75.0
4	990010	2	45.5	77.0
4	990010	3	44.6	78.0
4	990010	4	43.9	80.0
4	990010	5	43.3	82.0
4	990010	6	42.7	83.0
4	990010	7	42.2	80.0
4	990010	8	42.6	78.0
4	990010	9	45.3	74.0
4	990010	10	49.5	68.0
4	990010	11	53.8	66.0
4	990010	12	57.4	63.0
4	990010	13	60.7	61.0
4	990010	14	62.4	58.0
4	990010	15	63.0	56.0
4	990010	16	63.2	54.0
4	990010	17	62.8	53.0
4	990010	18	61.5	55.0
4	990010	19	59.4	59.0
4	990010	20	56.7	62.0
4	990010	21	54.0	66.0
4	990010	22	51.7	68.0
4	990010	23	50.0	73.0
4	990010	24	48.3	73.0

Table 3. Kentucky Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
4	990030	1	48.8	61.5
4	990030	2	47.4	63.8
4	990030	3	46.4	66.4
4	990030	4	45.6	68.4
4	990030	5	45.0	70.5
4	990030	6	44.4	72.2
4	990030	7	43.8	73.5
4	990030	8	44.3	73.6
4	990030	9	47.2	68.7
4	990030	10	51.8	62.3
4	990030	11	56.5	56.4
4	990030	12	60.5	51.5
4	990030	13	64.0	48.0
4	990030	14	65.9	45.3
4	990030	15	66.6	43.2
4	990030	16	66.8	42.2
4	990030	17	66.3	41.6
4	990030	18	65.0	41.7
4	990030	19	62.7	42.7
4	990030	20	59.7	45.3
4	990030	21	56.7	48.2
4	990030	22	54.2	51.7
4	990030	23	52.3	55.3
4	990030	24	50.5	58.6

2.2 Source Type Population Importer

This importer provides the user with the opportunity to enter vehicle population data for the local area, sorted by the 13 MOVES vehicle source types. Data for this importer was obtained from West Virginia, Ohio, and Kentucky for their respective areas. The Protocol Report prepared for this analysis indicated that each state's area would use a combination of default data and local information. While this was the case, the source types using default and local data varied by each state. The 0.8% annual growth factor established in the Protocol Report was used to determine future year source type population numbers for all three states. A definition of all source type IDs can be found in the excerpt of the MOVES2010 User Guide found at the back of the Protocol Report.

WVDEP supplied the data for Cabell, Wayne, and Mason Counties. This data was originally obtained from the WVDMV and then cleaned to fit within the MOVES source types. An inventory of the bus population in the three-county area was obtained and used to modify the supplied DMV data. Due to questions about the validity or completeness of some of the data, default values were used for the following source types: 51 (Refuse Truck), 52 (Single Unit Short-Haul Truck), 53 (Single Unit Long-Haul Truck), 61 (Combination Short-Haul Truck), and 62 (Combination Long Haul Truck). Actual data has been used for Motorcycles, Passenger Cars, Passenger Trucks, Light Commercial Trucks, Transit Buses, School Buses, and Motor Homes. For source type 41 (Intercity Bus), the data was obtained by looking at the actual transit bus number, and then applying the ratio found in the MOVES default data between intercity and transit buses. Mason County data was obtained for the entire county, and then reduced by WVDEP to reflect the township in the partial county nonattainment area. Data obtained was from the year 2007. **Table 4** shows the West Virginia source type population data for the year 2008.

Ohio data was obtained from ODOT. This data was cleaned to fit within the MOVES source type classifications. Due to questions about the accuracy or validity of certain source types, default values were employed in some instances. Default values were used for source type 41 (Intercity Bus), 51 (Refuse Truck), 54 (Motor Home), 61 (Combination Short-Haul Truck), and 62 (Combination Long-Haul Truck). This data was provided for the year 2008. **Table 5** shows the Ohio source type population data for the year 2008.

Kentucky data was obtained from the Kentucky Transportation Cabinet. KYTC used the converter tool available from EPA/FHWA to adjust the data currently available in Mobile6 format into MOVES source types. There were no default values used for any of the source types in the Kentucky data set. Kentucky provided data for Boyd County during the year 2010. A factor of 0.0624 was used to estimate Lawrence County data based on Boyd County data. This factor was based on 2009 VMT of 85,757 for the Lawrence nonattainment area and 1,375,095 for Boyd. **Table 6** shows the Kentucky source type population data for the year 2008.

Table 4. 2008 West Virginia Source Type Population

yearID	sourceTypeID	sourceTypePopulation
2008	11	2847
2008	21	44548
2008	31	43905
2008	32	7146
2008	41	63
2008	42	34
2008	43	240
2008	51	43
2008	52	2597
2008	53	296
2008	54	128
2008	61	660
2008	62	732

Table 5. 2008 Ohio Source Type Population

yearID	sourceTypeID	sourceTypePopulation
2008	11	10899
2008	21	105584
2008	31	47800
2008	32	1168
2008	41	33
2008	42	3
2008	43	486
2008	51	20
2008	52	371
2008	53	123
2008	54	5005
2008	61	254
2008	62	291

Table 6. 2008 Kentucky Source Type Population

yearID	sourceTypeID	sourceTypePopulation
2008	11	2278
2008	21	25773
2008	31	19154
2008	32	5781
2008	41	9
2008	42	27
2008	43	46
2008	51	7
2008	52	234
2008	53	16
2008	54	25
2008	61	124
2008	62	100

2.3 Age Distribution Importer

The Age Distribution Importer allows the user to provide vehicle age distribution data sorted by the MOVES vehicle source types. Vehicle age distribution is divided into 30 years based on vehicle model years. For each vehicle type, the sum of all age distributions will equal one. Age distribution information was obtained from each state for their respective area. The Protocol Report indicates a combination of local and default data would be used to determine the overall distribution. Since the type and quality of data available by state varies, these local and default data combinations were established unique to each state. As stated in the Protocol Report, the age distribution determined for each state was used for all analysis years.

West Virginia data was provided by WVDEP, based on information from motor vehicle registration data. 2010 data was used to assess the age distribution of certain vehicle types. Based on the availability and confidence level about some of the vehicle class data, only certain types were distributed using local data. Cabell, Mason, and Wayne age distribution data was used for the following source types: source type 11 (Motorcycle), source type 21 (Passenger Car), source type 31 (Passenger Truck), source type 32 (Light Commercial Truck), and source type 54 (Motor Home). The age distribution data provided from Ohio was used for the remaining source types. **Table 7** shows the age distributions used for the West Virginia area (shown for the year 2008).

Ohio data was obtained from ODOT, based on information from motor vehicle registration data. The data was cleaned and prepared by ODOT to fit within the MOVES format. Data provided was for Scioto and Lawrence Counties, but is expected to be representative of the entire area. This data was provided for 2008. **Table 8** shows the age distributions used for the Ohio area (shown for the year 2008).

Kentucky data was provided by the Kentucky Transportation Cabinet, based on information from motor vehicle registration data. While this data is for Boyd County, it is assumed to also be representative of the Lawrence County area. This data was provided for the year 2010. **Table 9** shows the age distributions used for the Kentucky area (shown for the year 2008).

Table 7. West Virginia Non-Attainment Area Age Distributions

sourceTypeID	yearID	ageID	ageFraction
11	2008	0	0.0267
11	2008	1	0.0620
11	2008	2	0.0904
11	2008	3	0.1036
11	2008	4	0.0895
11	2008	5	0.0806
11	2008	6	0.0581
11	2008	7	0.0797
11	2008	8	0.0620
11	2008	9	0.0482
11	2008	10	0.0383
11	2008	11	0.0326
11	2008	12	0.0210
11	2008	13	0.0201
11	2008	14	0.0186
11	2008	15	0.0156
11	2008	16	0.0132
11	2008	17	0.0099
11	2008	18	0.0063
11	2008	19	0.0048
11	2008	20	0.0048

sourceTypeID	yearID	ageID	ageFraction
11	2008	21	0.0051
11	2008	22	0.0078
11	2008	23	0.0096
11	2008	24	0.0099
11	2008	25	0.0117
11	2008	26	0.0087
11	2008	27	0.0096
11	2008	28	0.0084
11	2008	29	0.0057
11	2008	30	0.0377
21	2008	0	0.0313
21	2008	1	0.0391
21	2008	2	0.0532
21	2008	3	0.0643
21	2008	4	0.0578
21	2008	5	0.0609
21	2008	6	0.0586
21	2008	7	0.0608
21	2008	8	0.0628
21	2008	9	0.0608
21	2008	10	0.0664

source TypeID	yearID	ageID	ageFraction
21	2008	11	0.0600
21	2008	12	0.0510
21	2008	13	0.0446
21	2008	14	0.0360
21	2008	15	0.0351
21	2008	16	0.0260
21	2008	17	0.0214
21	2008	18	0.0171
21	2008	19	0.0142
21	2008	20	0.0110
21	2008	21	0.0084
21	2008	22	0.0065
21	2008	23	0.0052
21	2008	24	0.0040
21	2008	25	0.0028
21	2008	26	0.0027
21	2008	27	0.0012
21	2008	28	0.0007
21	2008	29	0.0011
21	2008	30	0.0348
31	2008	0	0.0309
31	2008	1	0.0326
31	2008	2	0.0514
31	2008	3	0.0555
31	2008	4	0.0599
31	2008	5	0.0670
31	2008	6	0.0698
31	2008	7	0.0644
31	2008	8	0.0646
31	2008	9	0.0565
31	2008	10	0.0617
31	2008	11	0.0541
31	2008	12	0.0498
31	2008	13	0.0457
31	2008	14	0.0363
31	2008	15	0.0345
31	2008	16	0.0301
31	2008	17	0.0209
31	2008	18	0.0170
31	2008	19	0.0144
31	2008	20	0.0113
31	2008	21	0.0125
31	2008	22	0.0110
31	2008	23	0.0077
31	2008	24	0.0069
31	2008	25	0.0064

source TypeID	yearID	ageID	ageFraction
31	2008	26	0.0043
31	2008	27	0.0026
31	2008	28	0.0017
31	2008	29	0.0013
31	2008	30	0.0173
32	2008	0	0.0414
32	2008	1	0.0419
32	2008	2	0.0740
32	2008	3	0.0810
32	2008	4	0.0903
32	2008	5	0.0810
32	2008	6	0.0671
32	2008	7	0.0708
32	2008	8	0.0557
32	2008	9	0.0550
32	2008	10	0.0441
32	2008	11	0.0418
32	2008	12	0.0253
32	2008	13	0.0318
32	2008	14	0.0255
32	2008	15	0.0307
32	2008	16	0.0301
32	2008	17	0.0193
32	2008	18	0.0155
32	2008	19	0.0108
32	2008	20	0.0118
32	2008	21	0.0095
32	2008	22	0.0087
32	2008	23	0.0073
32	2008	24	0.0101
32	2008	25	0.0064
32	2008	26	0.0046
32	2008	27	0.0038
32	2008	28	0.0014
32	2008	29	0.0013
32	2008	30	0.0020
41	2008	0	0.0000
41	2008	1	0.0147
41	2008	2	0.0000
41	2008	3	0.0000
41	2008	4	0.0882
41	2008	5	0.0441
41	2008	6	0.0294
41	2008	7	0.0588
41	2008	8	0.0000
41	2008	9	0.0294

source TypeID	yearID	ageID	ageFraction
41	2008	10	0.0441
41	2008	11	0.1471
41	2008	12	0.1324
41	2008	13	0.0588
41	2008	14	0.0000
41	2008	15	0.0441
41	2008	16	0.0588
41	2008	17	0.0147
41	2008	18	0.0000
41	2008	19	0.0000
41	2008	20	0.0294
41	2008	21	0.0000
41	2008	22	0.1471
41	2008	23	0.0147
41	2008	24	0.0000
41	2008	25	0.0000
41	2008	26	0.0147
41	2008	27	0.0000
41	2008	28	0.0000
41	2008	29	0.0000
41	2008	30	0.0295
42	2008	0	0.0000
42	2008	1	0.0000
42	2008	2	0.0000
42	2008	3	0.0000
42	2008	4	0.0000
42	2008	5	0.0000
42	2008	6	0.0000
42	2008	7	0.0000
42	2008	8	0.0000
42	2008	9	0.3333
42	2008	10	0.0000
42	2008	11	0.0000
42	2008	12	0.3333
42	2008	13	0.0000
42	2008	14	0.0000
42	2008	15	0.0000
42	2008	16	0.0000
42	2008	17	0.0000
42	2008	18	0.0000
42	2008	19	0.0000
42	2008	20	0.0000
42	2008	21	0.0000
42	2008	22	0.0000
42	2008	23	0.0000
42	2008	24	0.0000

source TypeID	yearID	ageID	ageFraction
42	2008	25	0.0000
42	2008	26	0.3333
42	2008	27	0.0000
42	2008	28	0.0000
42	2008	29	0.0001
42	2008	30	0.0000
43	2008	0	0.0168
43	2008	1	0.0189
43	2008	2	0.0671
43	2008	3	0.0461
43	2008	4	0.0335
43	2008	5	0.0335
43	2008	6	0.0461
43	2008	7	0.0629
43	2008	8	0.0629
43	2008	9	0.0839
43	2008	10	0.0650
43	2008	11	0.0650
43	2008	12	0.0629
43	2008	13	0.0440
43	2008	14	0.0294
43	2008	15	0.0252
43	2008	16	0.0314
43	2008	17	0.0231
43	2008	18	0.0231
43	2008	19	0.0105
43	2008	20	0.0273
43	2008	21	0.0126
43	2008	22	0.0105
43	2008	23	0.0168
43	2008	24	0.0105
43	2008	25	0.0126
43	2008	26	0.0231
43	2008	27	0.0042
43	2008	28	0.0105
43	2008	29	0.0063
43	2008	30	0.0143
51	2008	0	0.0000
51	2008	1	0.0714
51	2008	2	0.2005
51	2008	3	0.1071
51	2008	4	0.0934
51	2008	5	0.0055
51	2008	6	0.0192
51	2008	7	0.0357
51	2008	8	0.0302

sourceTypeID	yearID	ageID	ageFraction
51	2008	9	0.0302
51	2008	10	0.0440
51	2008	11	0.0659
51	2008	12	0.0330
51	2008	13	0.0385
51	2008	14	0.0385
51	2008	15	0.0467
51	2008	16	0.0330
51	2008	17	0.0357
51	2008	18	0.0330
51	2008	19	0.0082
51	2008	20	0.0110
51	2008	21	0.0000
51	2008	22	0.0027
51	2008	23	0.0055
51	2008	24	0.0000
51	2008	25	0.0082
51	2008	26	0.0000
51	2008	27	0.0000
51	2008	28	0.0000
51	2008	29	0.0000
51	2008	30	0.0029
52	2008	0	0.0000
52	2008	1	0.0714
52	2008	2	0.2005
52	2008	3	0.1071
52	2008	4	0.0934
52	2008	5	0.0055
52	2008	6	0.0192
52	2008	7	0.0357
52	2008	8	0.0302
52	2008	9	0.0302
52	2008	10	0.0440
52	2008	11	0.0659
52	2008	12	0.0330
52	2008	13	0.0385
52	2008	14	0.0385
52	2008	15	0.0467
52	2008	16	0.0330
52	2008	17	0.0357
52	2008	18	0.0330
52	2008	19	0.0082
52	2008	20	0.0110
52	2008	21	0.0000
52	2008	22	0.0027
52	2008	23	0.0055
52	2008	24	0.0000
52	2008	25	0.0082
52	2008	26	0.0000
52	2008	27	0.0000
52	2008	28	0.0000
52	2008	29	0.0000
52	2008	30	0.0029
53	2008	0	0.0000
53	2008	1	0.0714
53	2008	2	0.2005
53	2008	3	0.1071
53	2008	4	0.0934
53	2008	5	0.0055
53	2008	6	0.0192
53	2008	7	0.0357
53	2008	8	0.0302
53	2008	9	0.0302
53	2008	10	0.0440
53	2008	11	0.0659
53	2008	12	0.0330
53	2008	13	0.0385
53	2008	14	0.0385
53	2008	15	0.0467
53	2008	16	0.0330
53	2008	17	0.0357
53	2008	18	0.0330
53	2008	19	0.0082
53	2008	20	0.0110
53	2008	21	0.0000
53	2008	22	0.0027
53	2008	23	0.0055
53	2008	24	0.0000
53	2008	25	0.0082
53	2008	26	0.0000
53	2008	27	0.0000
53	2008	28	0.0000
53	2008	29	0.0000
53	2008	30	0.0029
54	2008	0	0.0128
54	2008	1	0.0128
54	2008	2	0.0256
54	2008	3	0.0321
54	2008	4	0.0577
54	2008	5	0.0449
54	2008	6	0.0256
54	2008	7	0.0449

source TypeID	yearID	ageID	ageFraction
54	2008	8	0.0256
54	2008	9	0.0321
54	2008	10	0.0256
54	2008	11	0.0321
54	2008	12	0.0192
54	2008	13	0.0064
54	2008	14	0.0064
54	2008	15	0.0192
54	2008	16	0.0449
54	2008	17	0.0385
54	2008	18	0.0064
54	2008	19	0.0192
54	2008	20	0.0641
54	2008	21	0.0577
54	2008	22	0.0321
54	2008	23	0.0385
54	2008	24	0.0321
54	2008	25	0.0641
54	2008	26	0.0256
54	2008	27	0.0064
54	2008	28	0.0192
54	2008	29	0.0064
54	2008	30	0.1218
61	2008	0	0.0017
61	2008	1	0.0096
61	2008	2	0.0198
61	2008	3	0.0224
61	2008	4	0.0285
61	2008	5	0.0350
61	2008	6	0.0401
61	2008	7	0.0410
61	2008	8	0.0429
61	2008	9	0.0462
61	2008	10	0.0551
61	2008	11	0.0549
61	2008	12	0.0492
61	2008	13	0.0534
61	2008	14	0.0425
61	2008	15	0.0490
61	2008	16	0.0521
61	2008	17	0.0367
61	2008	18	0.0358
61	2008	19	0.0343
61	2008	20	0.0302
61	2008	21	0.0367
61	2008	22	0.0356
61	2008	23	0.0234
61	2008	24	0.0232
61	2008	25	0.0192
61	2008	26	0.0143
61	2008	27	0.0079
61	2008	28	0.0075
61	2008	29	0.0058
61	2008	30	0.0460
62	2008	0	0.0010
62	2008	1	0.0370
62	2008	2	0.0120
62	2008	3	0.0761
62	2008	4	0.0601
62	2008	5	0.0571
62	2008	6	0.0410
62	2008	7	0.0931
62	2008	8	0.0370
62	2008	9	0.0581
62	2008	10	0.0671
62	2008	11	0.0871
62	2008	12	0.0801
62	2008	13	0.0400
62	2008	14	0.0501
62	2008	15	0.0430
62	2008	16	0.0370
62	2008	17	0.0210
62	2008	18	0.0120
62	2008	19	0.0080
62	2008	20	0.0170
62	2008	21	0.0150
62	2008	22	0.0110
62	2008	23	0.0080
62	2008	24	0.0030
62	2008	25	0.0100
62	2008	26	0.0020
62	2008	27	0.0040
62	2008	28	0.0000
62	2008	29	0.0000
62	2008	30	0.0121

Table 8. Ohio Non-Attainment Area Age Distributions

source TypeID	yearID	ageID	ageFraction
11	2022	0	0.0017
11	2022	1	0.0240
11	2022	2	0.0578
11	2022	3	0.0786
11	2022	4	0.0896
11	2022	5	0.0908
11	2022	6	0.0739
11	2022	7	0.0782
11	2022	8	0.0631
11	2022	9	0.0530
11	2022	10	0.0472
11	2022	11	0.0341
11	2022	12	0.0257
11	2022	13	0.0210
11	2022	14	0.0224
11	2022	15	0.0193
11	2022	16	0.0156
11	2022	17	0.0105
11	2022	18	0.0083
11	2022	19	0.0043
11	2022	20	0.0072
11	2022	21	0.0072
11	2022	22	0.0076
11	2022	23	0.0104
11	2022	24	0.0182
11	2022	25	0.0129
11	2022	26	0.0149
11	2022	27	0.0140
11	2022	28	0.0227
11	2022	29	0.0122
11	2022	30	0.0536
21	2022	0	0.0062
21	2022	1	0.0199
21	2022	2	0.0331
21	2022	3	0.0389
21	2022	4	0.0404
21	2022	5	0.0420
21	2022	6	0.0411
21	2022	7	0.0434
21	2022	8	0.0475
21	2022	9	0.0525
21	2022	10	0.0646
21	2022	11	0.0630
21	2022	12	0.0599
21	2022	13	0.0613
21	2022	14	0.0542
21	2022	15	0.0581
21	2022	16	0.0470
21	2022	17	0.0411
21	2022	18	0.0345
21	2022	19	0.0264
21	2022	20	0.0213
21	2022	21	0.0195
21	2022	22	0.0144
21	2022	23	0.0097
21	2022	24	0.0092
21	2022	25	0.0058
21	2022	26	0.0044
21	2022	27	0.0025
21	2022	28	0.0017
21	2022	29	0.0019
21	2022	30	0.0345
31	2022	0	0.0067
31	2022	1	0.0208
31	2022	2	0.0445
31	2022	3	0.0494
31	2022	4	0.0543
31	2022	5	0.0632
31	2022	6	0.0627
31	2022	7	0.0608
31	2022	8	0.0631
31	2022	9	0.0553
31	2022	10	0.0629
31	2022	11	0.0589
31	2022	12	0.0584
31	2022	13	0.0487
31	2022	14	0.0473
31	2022	15	0.0481
31	2022	16	0.0407
31	2022	17	0.0335
31	2022	18	0.0245
31	2022	19	0.0190
31	2022	20	0.0137
31	2022	21	0.0150
31	2022	22	0.0119
31	2022	23	0.0093
31	2022	24	0.0066
31	2022	25	0.0059

source TypeID	yearID	ageID	ageFraction
31	2022	26	0.0038
31	2022	27	0.0021
31	2022	28	0.0011
31	2022	29	0.0010
31	2022	30	0.0068
32	2022	0	0.0070
32	2022	1	0.0209
32	2022	2	0.0689
32	2022	3	0.0489
32	2022	4	0.0445
32	2022	5	0.0262
32	2022	6	0.0218
32	2022	7	0.0271
32	2022	8	0.0349
32	2022	9	0.0297
32	2022	10	0.0558
32	2022	11	0.0620
32	2022	12	0.0541
32	2022	13	0.0550
32	2022	14	0.0384
32	2022	15	0.0742
32	2022	16	0.0567
32	2022	17	0.0349
32	2022	18	0.0462
32	2022	19	0.0305
32	2022	20	0.0323
32	2022	21	0.0366
32	2022	22	0.0166
32	2022	23	0.0122
32	2022	24	0.0218
32	2022	25	0.0131
32	2022	26	0.0087
32	2022	27	0.0052
32	2022	28	0.0026
32	2022	29	0.0009
32	2022	30	0.0123
41	2022	0	0.0000
41	2022	1	0.0147
41	2022	2	0.0000
41	2022	3	0.0000
41	2022	4	0.0882
41	2022	5	0.0441
41	2022	6	0.0294
41	2022	7	0.0588
41	2022	8	0.0000
41	2022	9	0.0294

source TypeID	yearID	ageID	ageFraction
41	2022	10	0.0441
41	2022	11	0.1471
41	2022	12	0.1324
41	2022	13	0.0588
41	2022	14	0.0000
41	2022	15	0.0441
41	2022	16	0.0588
41	2022	17	0.0147
41	2022	18	0.0000
41	2022	19	0.0000
41	2022	20	0.0294
41	2022	21	0.0000
41	2022	22	0.1471
41	2022	23	0.0147
41	2022	24	0.0000
41	2022	25	0.0000
41	2022	26	0.0147
41	2022	27	0.0000
41	2022	28	0.0000
41	2022	29	0.0000
41	2022	30	0.0295
42	2022	0	0.0000
42	2022	1	0.0000
42	2022	2	0.0000
42	2022	3	0.0000
42	2022	4	0.0000
42	2022	5	0.0000
42	2022	6	0.0000
42	2022	7	0.0000
42	2022	8	0.0000
42	2022	9	0.3333
42	2022	10	0.0000
42	2022	11	0.0000
42	2022	12	0.3333
42	2022	13	0.0000
42	2022	14	0.0000
42	2022	15	0.0000
42	2022	16	0.0000
42	2022	17	0.0000
42	2022	18	0.0000
42	2022	19	0.0000
42	2022	20	0.0000
42	2022	21	0.0000
42	2022	22	0.0000
42	2022	23	0.0000
42	2022	24	0.0000

source TypeID	yearID	ageID	ageFraction
42	2022	25	0.0000
42	2022	26	0.3333
42	2022	27	0.0000
42	2022	28	0.0000
42	2022	29	0.0001
42	2022	30	0.0000
43	2022	0	0.0168
43	2022	1	0.0189
43	2022	2	0.0671
43	2022	3	0.0461
43	2022	4	0.0335
43	2022	5	0.0335
43	2022	6	0.0461
43	2022	7	0.0629
43	2022	8	0.0629
43	2022	9	0.0839
43	2022	10	0.0650
43	2022	11	0.0650
43	2022	12	0.0629
43	2022	13	0.0440
43	2022	14	0.0294
43	2022	15	0.0252
43	2022	16	0.0314
43	2022	17	0.0231
43	2022	18	0.0231
43	2022	19	0.0105
43	2022	20	0.0273
43	2022	21	0.0126
43	2022	22	0.0105
43	2022	23	0.0168
43	2022	24	0.0105
43	2022	25	0.0126
43	2022	26	0.0231
43	2022	27	0.0042
43	2022	28	0.0105
43	2022	29	0.0063
43	2022	30	0.0143
51	2022	0	0.0000
51	2022	1	0.0714
51	2022	2	0.2005
51	2022	3	0.1071
51	2022	4	0.0934
51	2022	5	0.0055
51	2022	6	0.0192
51	2022	7	0.0357
51	2022	8	0.0302

source TypeID	yearID	ageID	ageFraction
51	2022	9	0.0302
51	2022	10	0.0440
51	2022	11	0.0659
51	2022	12	0.0330
51	2022	13	0.0385
51	2022	14	0.0385
51	2022	15	0.0467
51	2022	16	0.0330
51	2022	17	0.0357
51	2022	18	0.0330
51	2022	19	0.0082
51	2022	20	0.0110
51	2022	21	0.0000
51	2022	22	0.0027
51	2022	23	0.0055
51	2022	24	0.0000
51	2022	25	0.0082
51	2022	26	0.0000
51	2022	27	0.0000
51	2022	28	0.0000
51	2022	29	0.0000
51	2022	30	0.0029
52	2022	0	0.0000
52	2022	1	0.0714
52	2022	2	0.2005
52	2022	3	0.1071
52	2022	4	0.0934
52	2022	5	0.0055
52	2022	6	0.0192
52	2022	7	0.0357
52	2022	8	0.0302
52	2022	9	0.0302
52	2022	10	0.0440
52	2022	11	0.0659
52	2022	12	0.0330
52	2022	13	0.0385
52	2022	14	0.0385
52	2022	15	0.0467
52	2022	16	0.0330
52	2022	17	0.0357
52	2022	18	0.0330
52	2022	19	0.0082
52	2022	20	0.0110
52	2022	21	0.0000
52	2022	22	0.0027
52	2022	23	0.0055

sourceTypeID	yearID	ageID	ageFraction
52	2022	24	0.0000
52	2022	25	0.0082
52	2022	26	0.0000
52	2022	27	0.0000
52	2022	28	0.0000
52	2022	29	0.0000
52	2022	30	0.0029
53	2022	0	0.0000
53	2022	1	0.0714
53	2022	2	0.2005
53	2022	3	0.1071
53	2022	4	0.0934
53	2022	5	0.0055
53	2022	6	0.0192
53	2022	7	0.0357
53	2022	8	0.0302
53	2022	9	0.0302
53	2022	10	0.0440
53	2022	11	0.0659
53	2022	12	0.0330
53	2022	13	0.0385
53	2022	14	0.0385
53	2022	15	0.0467
53	2022	16	0.0330
53	2022	17	0.0357
53	2022	18	0.0330
53	2022	19	0.0082
53	2022	20	0.0110
53	2022	21	0.0000
53	2022	22	0.0027
53	2022	23	0.0055
53	2022	24	0.0000
53	2022	25	0.0082
53	2022	26	0.0000
53	2022	27	0.0000
53	2022	28	0.0000
53	2022	29	0.0000
53	2022	30	0.0029
54	2022	0	0.0073
54	2022	1	0.0151
54	2022	2	0.0320
54	2022	3	0.0368
54	2022	4	0.0450
54	2022	5	0.0413
54	2022	6	0.0450
54	2022	7	0.0472

sourceTypeID	yearID	ageID	ageFraction
54	2022	8	0.0415
54	2022	9	0.0377
54	2022	10	0.0495
54	2022	11	0.0405
54	2022	12	0.0336
54	2022	13	0.0340
54	2022	14	0.0293
54	2022	15	0.0320
54	2022	16	0.0254
54	2022	17	0.0275
54	2022	18	0.0175
54	2022	19	0.0130
54	2022	20	0.0197
54	2022	21	0.0202
54	2022	22	0.0191
54	2022	23	0.0218
54	2022	24	0.0173
54	2022	25	0.0200
54	2022	26	0.0228
54	2022	27	0.0175
54	2022	28	0.0128
54	2022	29	0.0079
54	2022	30	0.1697
61	2022	0	0.0017
61	2022	1	0.0096
61	2022	2	0.0198
61	2022	3	0.0224
61	2022	4	0.0285
61	2022	5	0.0350
61	2022	6	0.0401
61	2022	7	0.0410
61	2022	8	0.0429
61	2022	9	0.0462
61	2022	10	0.0551
61	2022	11	0.0549
61	2022	12	0.0492
61	2022	13	0.0534
61	2022	14	0.0425
61	2022	15	0.0490
61	2022	16	0.0521
61	2022	17	0.0367
61	2022	18	0.0358
61	2022	19	0.0343
61	2022	20	0.0302
61	2022	21	0.0367
61	2022	22	0.0356

source TypeID	yearID	ageID	ageFraction
61	2022	23	0.0234
61	2022	24	0.0232
61	2022	25	0.0192
61	2022	26	0.0143
61	2022	27	0.0079
61	2022	28	0.0075
61	2022	29	0.0058
61	2022	30	0.0460
62	2022	0	0.0010
62	2022	1	0.0370
62	2022	2	0.0120
62	2022	3	0.0761
62	2022	4	0.0601
62	2022	5	0.0571
62	2022	6	0.0410
62	2022	7	0.0931
62	2022	8	0.0370
62	2022	9	0.0581
62	2022	10	0.0671
62	2022	11	0.0871
62	2022	12	0.0801
62	2022	13	0.0400
62	2022	14	0.0501
62	2022	15	0.0430
62	2022	16	0.0370
62	2022	17	0.0210
62	2022	18	0.0120
62	2022	19	0.0080
62	2022	20	0.0170
62	2022	21	0.0150
62	2022	22	0.0110
62	2022	23	0.0080
62	2022	24	0.0030
62	2022	25	0.0100
62	2022	26	0.0020
62	2022	27	0.0040
62	2022	28	0.0000
62	2022	29	0.0000
62	2022	30	0.0121

Table 9. Kentucky Non-Attainment Area Age Distributions

sourceTypeID	yearID	ageID	ageFraction
11	2022	0	0.0092
11	2022	1	0.0303
11	2022	2	0.0537
11	2022	3	0.0968
11	2022	4	0.0982
11	2022	5	0.0932
11	2022	6	0.0877
11	2022	7	0.0569
11	2022	8	0.0629
11	2022	9	0.0464
11	2022	10	0.0408
11	2022	11	0.0395
11	2022	12	0.0390
11	2022	13	0.0207
11	2022	14	0.0147
11	2022	15	0.0289
11	2022	16	0.0142
11	2022	17	0.0179
11	2022	18	0.0069
11	2022	19	0.0055
11	2022	20	0.0069
11	2022	21	0.0050
11	2022	22	0.0046
11	2022	23	0.0028
11	2022	24	0.0017
11	2022	25	0.0010
11	2022	26	0.0006
11	2022	27	0.0004
11	2022	28	0.0002
11	2022	29	0.0001
11	2022	30	0.1135
21	2022	0	0.0045
21	2022	1	0.0385
21	2022	2	0.0339
21	2022	3	0.0523
21	2022	4	0.0593
21	2022	5	0.0580
21	2022	6	0.0604
21	2022	7	0.0543
21	2022	8	0.0532
21	2022	9	0.0634
21	2022	10	0.0657
21	2022	11	0.0672
21	2022	12	0.0590

sourceTypeID	yearID	ageID	ageFraction
21	2022	13	0.0522
21	2022	14	0.0446
21	2022	15	0.0393
21	2022	16	0.0383
21	2022	17	0.0279
21	2022	18	0.0240
21	2022	19	0.0174
21	2022	20	0.0124
21	2022	21	0.0090
21	2022	22	0.0112
21	2022	23	0.0077
21	2022	24	0.0053
21	2022	25	0.0037
21	2022	26	0.0025
21	2022	27	0.0018
21	2022	28	0.0012
21	2022	29	0.0008
21	2022	30	0.0308
31	2022	0	0.0039
31	2022	1	0.0315
31	2022	2	0.0280
31	2022	3	0.0520
31	2022	4	0.0592
31	2022	5	0.0592
31	2022	6	0.0657
31	2022	7	0.0644
31	2022	8	0.0626
31	2022	9	0.0582
31	2022	10	0.0576
31	2022	11	0.0575
31	2022	12	0.0483
31	2022	13	0.0457
31	2022	14	0.0417
31	2022	15	0.0313
31	2022	16	0.0332
31	2022	17	0.0319
31	2022	18	0.0206
31	2022	19	0.0172
31	2022	20	0.0162
31	2022	21	0.0137
31	2022	22	0.0143
31	2022	23	0.0119
31	2022	24	0.0108
31	2022	25	0.0126

sourceTypeID	yearID	ageID	ageFraction
31	2022	26	0.0066
31	2022	27	0.0049
31	2022	28	0.0039
31	2022	29	0.0032
31	2022	30	0.0319
32	2022	0	0.0041
32	2022	1	0.0305
32	2022	2	0.0277
32	2022	3	0.0520
32	2022	4	0.0594
32	2022	5	0.0592
32	2022	6	0.0639
32	2022	7	0.0635
32	2022	8	0.0611
32	2022	9	0.0573
32	2022	10	0.0566
32	2022	11	0.0574
32	2022	12	0.0481
32	2022	13	0.0441
32	2022	14	0.0417
32	2022	15	0.0314
32	2022	16	0.0331
32	2022	17	0.0319
32	2022	18	0.0217
32	2022	19	0.0176
32	2022	20	0.0157
32	2022	21	0.0137
32	2022	22	0.0149
32	2022	23	0.0124
32	2022	24	0.0118
32	2022	25	0.0136
32	2022	26	0.0070
32	2022	27	0.0054
32	2022	28	0.0047
32	2022	29	0.0038
32	2022	30	0.0345
41	2022	0	0.0000
41	2022	1	0.0000
41	2022	2	0.0000
41	2022	3	0.0000
41	2022	4	0.0286
41	2022	5	0.0000
41	2022	6	0.0000
41	2022	7	0.0000
41	2022	8	0.0000
41	2022	9	0.0000

sourceTypeID	yearID	ageID	ageFraction
41	2022	10	0.0000
41	2022	11	0.0000
41	2022	12	0.0000
41	2022	13	0.0000
41	2022	14	0.0000
41	2022	15	0.0000
41	2022	16	0.0000
41	2022	17	0.0000
41	2022	18	0.0000
41	2022	19	0.0000
41	2022	20	0.0000
41	2022	21	0.0000
41	2022	22	0.0000
41	2022	23	0.0000
41	2022	24	0.0000
41	2022	25	0.0000
41	2022	26	0.0000
41	2022	27	0.0000
41	2022	28	0.0000
41	2022	29	0.0000
41	2022	30	0.9714
42	2022	0	0.0000
42	2022	1	0.0000
42	2022	2	0.0000
42	2022	3	0.0000
42	2022	4	0.0286
42	2022	5	0.0000
42	2022	6	0.0000
42	2022	7	0.0000
42	2022	8	0.0000
42	2022	9	0.0000
42	2022	10	0.0000
42	2022	11	0.0000
42	2022	12	0.0000
42	2022	13	0.0000
42	2022	14	0.0000
42	2022	15	0.0000
42	2022	16	0.0000
42	2022	17	0.0000
42	2022	18	0.0000
42	2022	19	0.0000
42	2022	20	0.0000
42	2022	21	0.0000
42	2022	22	0.0000
42	2022	23	0.0000
42	2022	24	0.0000

source TypeID	yearID	ageID	ageFraction
42	2022	25	0.0000
42	2022	26	0.0000
42	2022	27	0.0000
42	2022	28	0.0000
42	2022	29	0.0000
42	2022	30	0.9714
43	2022	0	0.0242
43	2022	1	0.0239
43	2022	2	0.0009
43	2022	3	0.0934
43	2022	4	0.0010
43	2022	5	0.0941
43	2022	6	0.0704
43	2022	7	0.0024
43	2022	8	0.0701
43	2022	9	0.0248
43	2022	10	0.1183
43	2022	11	0.0250
43	2022	12	0.0944
43	2022	13	0.0034
43	2022	14	0.0265
43	2022	15	0.0010
43	2022	16	0.0479
43	2022	17	0.0934
43	2022	18	0.0017
43	2022	19	0.0009
43	2022	20	0.0021
43	2022	21	0.0246
43	2022	22	0.0029
43	2022	23	0.0021
43	2022	24	0.0020
43	2022	25	0.0020
43	2022	26	0.0021
43	2022	27	0.0024
43	2022	28	0.0012
43	2022	29	0.0000
43	2022	30	0.1409
51	2022	0	0.0119
51	2022	1	0.0138
51	2022	2	0.0237
51	2022	3	0.0278
51	2022	4	0.0667
51	2022	5	0.0615
51	2022	6	0.0892
51	2022	7	0.0367
51	2022	8	0.0549

source TypeID	yearID	ageID	ageFraction
51	2022	9	0.0291
51	2022	10	0.0693
51	2022	11	0.0343
51	2022	12	0.0555
51	2022	13	0.0492
51	2022	14	0.0446
51	2022	15	0.0263
51	2022	16	0.0330
51	2022	17	0.0179
51	2022	18	0.0378
51	2022	19	0.0083
51	2022	20	0.0149
51	2022	21	0.0085
51	2022	22	0.0220
51	2022	23	0.0371
51	2022	24	0.0308
51	2022	25	0.0138
51	2022	26	0.0136
51	2022	27	0.0131
51	2022	28	0.0122
51	2022	29	0.0111
51	2022	30	0.0312
52	2022	0	0.0167
52	2022	1	0.0148
52	2022	2	0.0221
52	2022	3	0.0348
52	2022	4	0.0403
52	2022	5	0.0539
52	2022	6	0.0591
52	2022	7	0.0419
52	2022	8	0.0399
52	2022	9	0.0329
52	2022	10	0.0711
52	2022	11	0.0355
52	2022	12	0.0563
52	2022	13	0.0586
52	2022	14	0.0541
52	2022	15	0.0234
52	2022	16	0.0324
52	2022	17	0.0225
52	2022	18	0.0319
52	2022	19	0.0122
52	2022	20	0.0262
52	2022	21	0.0153
52	2022	22	0.0301
52	2022	23	0.0318

sourceTypeID	yearID	ageID	ageFraction
52	2022	24	0.0270
52	2022	25	0.0183
52	2022	26	0.0180
52	2022	27	0.0179
52	2022	28	0.0116
52	2022	29	0.0054
52	2022	30	0.0439
53	2022	0	0.0167
53	2022	1	0.0148
53	2022	2	0.0228
53	2022	3	0.0364
53	2022	4	0.0396
53	2022	5	0.0544
53	2022	6	0.0588
53	2022	7	0.0431
53	2022	8	0.0399
53	2022	9	0.0337
53	2022	10	0.0726
53	2022	11	0.0358
53	2022	12	0.0578
53	2022	13	0.0607
53	2022	14	0.0549
53	2022	15	0.0240
53	2022	16	0.0321
53	2022	17	0.0220
53	2022	18	0.0317
53	2022	19	0.0124
53	2022	20	0.0268
53	2022	21	0.0146
53	2022	22	0.0291
53	2022	23	0.0307
53	2022	24	0.0257
53	2022	25	0.0170
53	2022	26	0.0166
53	2022	27	0.0159
53	2022	28	0.0106
53	2022	29	0.0053
53	2022	30	0.0436
54	2022	0	0.0213
54	2022	1	0.0160
54	2022	2	0.0184
54	2022	3	0.0367
54	2022	4	0.0160
54	2022	5	0.0450
54	2022	6	0.0305
54	2022	7	0.0435

sourceTypeID	yearID	ageID	ageFraction
54	2022	8	0.0252
54	2022	9	0.0344
54	2022	10	0.0687
54	2022	11	0.0359
54	2022	12	0.0527
54	2022	13	0.0619
54	2022	14	0.0610
54	2022	15	0.0188
54	2022	16	0.0326
54	2022	17	0.0284
54	2022	18	0.0265
54	2022	19	0.0154
54	2022	20	0.0354
54	2022	21	0.0241
54	2022	22	0.0411
54	2022	23	0.0300
54	2022	24	0.0271
54	2022	25	0.0265
54	2022	26	0.0268
54	2022	27	0.0286
54	2022	28	0.0141
54	2022	29	0.0000
54	2022	30	0.0574
61	2022	0	0.0113
61	2022	1	0.0137
61	2022	2	0.0236
61	2022	3	0.0264
61	2022	4	0.0699
61	2022	5	0.0621
61	2022	6	0.0926
61	2022	7	0.0357
61	2022	8	0.0565
61	2022	9	0.0284
61	2022	10	0.0686
61	2022	11	0.0341
61	2022	12	0.0549
61	2022	13	0.0474
61	2022	14	0.0433
61	2022	15	0.0264
61	2022	16	0.0332
61	2022	17	0.0176
61	2022	18	0.0386
61	2022	19	0.0078
61	2022	20	0.0134
61	2022	21	0.0080
61	2022	22	0.0216

source TypeID	yearID	ageID	ageFraction
61	2022	23	0.0381
61	2022	24	0.0317
61	2022	25	0.0138
61	2022	26	0.0136
61	2022	27	0.0134
61	2022	28	0.0126
61	2022	29	0.0118
61	2022	30	0.0299
62	2022	0	0.0105
62	2022	1	0.0135
62	2022	2	0.0235
62	2022	3	0.0245
62	2022	4	0.0749
62	2022	5	0.0633
62	2022	6	0.0981
62	2022	7	0.0343
62	2022	8	0.0592
62	2022	9	0.0274
62	2022	10	0.0676
62	2022	11	0.0337
62	2022	12	0.0541
62	2022	13	0.0449
62	2022	14	0.0413
62	2022	15	0.0267
62	2022	16	0.0334
62	2022	17	0.0170
62	2022	18	0.0397
62	2022	19	0.0071
62	2022	20	0.0111
62	2022	21	0.0071
62	2022	22	0.0205
62	2022	23	0.0396
62	2022	24	0.0329
62	2022	25	0.0135
62	2022	26	0.0134
62	2022	27	0.0133
62	2022	28	0.0131
62	2022	29	0.0129
62	2022	30	0.0278

2.4 Vehicle Type VMT and VMT Fractions

This data importer asks the user for the VMT in the study area by HPMS vehicle class type, hourly VMT distributions, daily VMT distributions, and monthly VMT distributions. The HPMS vehicle class VMT is asked for an annual basis. To determine this information, data can be pulled from available travel demand models or from regional HPMS data.

HPMS Vehicle Class VMT

To determine the HPMS vehicle type VMTs, additional analysis was necessary. Overall VMTs for West Virginia and Ohio were obtained from ODOT. VMTs for Lawrence County, OH, Cabell County, WV, and Wayne County, WV were obtained from the currently approved KYOVA Regional Travel Demand Model (currently operating on the QRSII platform). Scioto County, OH VMT information was obtained using the interim statewide model. The Portsmouth Bypass was assumed to be in place as of the 2015 analysis year, which increased the total VMT in the county. For the partial counties in Ohio, current mileage figures were obtained from ODOT OTS Roadway Inventory staff. VMTs for these areas were estimated using road lengths and other data fields in the statewide model network. The VMT for the portion of Mason County, WV included in this analysis was based on VMT and growth rates supplied by WVDOT.

The projected VMTs for the four analysis years were totaled over all the complete and partial counties within the Ohio and West Virginia areas. Once these tallies were obtained, the next step was to separate out the total VMT into the six HPMS vehicle classes. ODOT provided a percentage for each analysis year for these vehicle classes. These percentages were obtained by looking at Ohio statewide data obtained through the Automatic Traffic Recorders program, and were then applied to the total Ohio VMT to obtain the needed input data. For West Virginia, VMT splits into the HPMS vehicle classes were obtained from 2003 HPMS data for the portion of the region being analyzed. These percentages were then applied to the total West Virginia VMT to arrive at the needed input data. The EPA conversion tool was used to convert these daily VMT numbers to annual values. **Table 10** shows the annual VMT for the West Virginia area over all analysis years. **Table 11** provides this information for the Ohio area.

For Kentucky, data was supplied by the Kentucky Transportation Cabinet. HPMS VMT data was obtained for the years 2005 and 2008. Travel demand model data was used to forecast the VMT data for 2015 and 2022. Once VMTs were determined for each model year (divided by roadway functional class), a set of HPMS VMT fractions were applied to determine the VMT for each HPMS vehicle class type. The VMTs were summed over each HPMS vehicle class to determine the daily HPMS VMTs. The EPA conversion tool was then used to convert these daily VMT numbers to annual values. **Table 12** shows the annual VMT for the Kentucky area over all analysis years.

Table 10. West Virginia Area Annual VMT by HPMS Vehicle Class

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2005	7528013	0
20	2005	966958093	0
30	2005	230138467	0
40	2005	9176503	0
50	2005	49781926	0
60	2005	92710073	0
10	2008	7787346	0
20	2008	1000268940	0
30	2008	238066533	0
40	2008	9492625	0
50	2008	51496869	0
60	2008	95903853	0
10	2015	8279299	0
20	2015	1063459344	0
30	2015	253106008	0
40	2015	10092307	0
50	2015	54750102	0
60	2015	101962427	0
10	2022	9345073	0
20	2022	1200355849	0
30	2022	285687722	0
40	2022	11391464	0
50	2022	61797948	0
60	2022	115087799	0

Table 11. Ohio Area Annual VMT by HPMS Vehicle Class

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2005	4230446	0
20	2005	754466644	0
30	2005	232789023	0
40	2005	2379414	0
50	2005	17589971	0
60	2005	41761823	0
10	2008	4360953	0
20	2008	777741625	0
30	2008	239970467	0
40	2008	2452818	0
50	2008	18132614	0
60	2008	43050158	0
10	2015	4886159	0
20	2015	871407965	0
30	2015	268871010	0
40	2015	2748220	0
50	2015	20316393	0
60	2015	48234849	0
10	2022	5576852	0
20	2022	994587493	0
30	2022	306877783	0
40	2022	3136699	0
50	2022	23188256	0
60	2022	55053178	0

Table 12. Kentucky Area Annual VMT by HPMS Vehicle Class

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2005	4089356	0
20	2005	341756317	0
30	2005	99443539	0
40	2005	4446556	0
50	2005	23236805	0
60	2005	47017859	0
10	2008	3883519	0
20	2008	330674222	0
30	2008	94738580	0
40	2008	4340952	0
50	2008	22324145	0
60	2008	47661382	0
10	2015	4175112	0
20	2015	355212826	0
30	2015	102229743	0
40	2015	4717645	0
50	2015	24149076	0
60	2015	51635189	0
10	2022	4477945	0
20	2022	387223488	0
30	2022	111097489	0
40	2022	5265797	0
50	2022	26351915	0
60	2022	59200492	0

<u>Daily VMT Fraction</u>

The EPA conversion tool for Annual Average Weekday Vehicles Miles Traveled was used to determine the daily VMT fraction for each analysis year. The daily VMT fractions were the same over all analysis years and areas, months of the year, and vehicle source types. DayIDs are included, indicating either weekday (dayID = 5) or weekend (dayID = 2) analysis. An excerpt of the table developed for the daily VMT fraction is shown as **Table 13**.

Table 13. Daily VMT Fractions, All Scenarios

sourcetypeID	monthID	roadtypeID	dayID	dayVMTFraction
11	4	1	2.0	0.237635
11	4	1	5.0	0.762365
11	4	2	2.0	0.237635
11	4	2	5.0	0.762365
11	4	3	2.0	0.237635
11	4	3	5.0	0.762365
11	4	4	2.0	0.237635
11	4	4	5.0	0.762365
11	4	5	2.0	0.237635
11	4	5	5.0	0.762365

Monthly VMT Fraction

The EPA conversion tool for Annual Average Weekday Vehicles Miles Traveled was used to determine the monthly VMT fraction for each analysis year. The monthly VMT fractions are the same over each geographic area and vehicle source type. Monthly VMT fractions for 2005, 2015, and 2022 are all the same. Since 2008 is a leap year, the monthly VMT fractions are slightly different. For the month of April, the monthly VMT fraction is approximately 0.082098 for 2008, and 0.082302 for 2005, 2015, and 2022.

Hourly VMT Fraction

For Ohio and West Virginia, ODOT provided information for the hourly VMT fraction. This information consisted of hour of the day fractions for four roadway types (rural restricted, rural unrestricted, urban restricted, and urban unrestricted). This information was divided further for cars and trucks. To translate this information into the format needed for MOVES, a few assumptions were made. First, the default mix of off-network hourly distribution percentages was used for all vehicle classes. Second, the hourly distribution percentages for cars and trucks were separated into appropriate MOVES vehicle classes. The data for cars was used for vehicle types 11 (motorcycle), 21 (passenger car), 31 (passenger truck), and 32 (light commercial truck). The data for trucks was used for vehicle types 41 (intercity bus), 42 (transit bus), 43 (school bus), 51 (refuse truck), 52 (single unit short-haul truck), 53 (single unit long-haul truck), 54 (motor home), 61 (combination short-haul truck), and 62 (combination long-haul truck).

Data was obtained for hourly VMT fractions in the Kentucky portion of the study area from the Kentucky Transportation Cabinet. Classification count data for District 9 was obtained that included 24-hour count data over a wide spectrum of roadway functional classes. This data was available by the FHWA Vehicle Class categorizations. To translate this information into the format needed for MOVES, a few assumptions were made. First, the default mix of off-network hourly distribution percentages was used for all vehicle classes. Second, the hourly distribution percentages for the FHWA Vehicle Classes were separated into their appropriate MOVES vehicle classes. Since the Boyd and Lawrence County areas being modeled do not contain any roadway facilities that would be designated as Urban Restricted, default data was also used for this class.

Due to the large file size for these hourly distributions, the full input data sets are not shown here. **Table 14** shows an excerpt of the hourly distribution data from the West Virginia area in 2005.

Table 14. Excerpt of Hourly VMT Fractions, West Virginia Area, 2005

sourceTypeID	roadTypeID	dayID	hourID	hourVMTFraction
11	1	5	1	0.009862
11	1	5	2	0.006272
11	1	5	3	0.005058
11	1	5	4	0.004667
11	1	5	5	0.006995
11	1	5	6	0.018494
11	1	5	7	0.045957
11	1	5	8	0.069644
11	1	5	9	0.060828
11	1	5	10	0.050286
11	1	5	11	0.049935
11	1	5	12	0.054365
11	1	5	13	0.057646
11	1	5	14	0.058032
11	1	5	15	0.062255
11	1	5	16	0.071005
11	1	5	17	0.076973
11	1	5	18	0.077432
11	1	5	19	0.059783
11	1	5	20	0.044392
11	1	5	21	0.035446
11	1	5	22	0.031824
11	1	5	23	0.024942
11	1	5	24	0.017907

2.5 Average Speed Distribution Importer

This importer gives the user the opportunity to enter locally specific average speed data, disaggregated by vehicle source type, road type, weekday/weekend, and hour of the day. The MOVES model uses 16 speed bins, dividing speed distributions into a fraction of driving within each speed bin for each of the criteria listed previously. The Protocol Report indicated local data would be used for this analysis. Based on consultation with ODOT, default data was used instead.

2.6 Road Type Distribution Importer

The road type distribution importer can be used to incorporate locally-specific roadway distribution information. Road type distribution information for this analysis was obtained from ODOT. This information was collected using 2009 HPMS data for Lawrence and Scioto Counties in Ohio and Cabell and Wayne Counties in West Virginia. This information was then cleaned and organized for conversion into the five MOVES roadway types. It is assumed that the data gathered for the four counties is representative not only of the partial county areas within West Virginia and Ohio, but also of Boyd and Lawrence Counties in Kentucky. Road type distributions were assumed to be the same for all analysis areas, analysis years, and vehicle source types. An excerpt of the road type distribution information is provided in **Table 15**.

Table 15. Excerpt of Road Type Distribution Data

sourceTypeID	roadTypeID	roadTypeVMTFraction
11	1	0
11	2	0.18
11	3	0.42
11	4	0.12
11	5	0.28
21	1	0
21	2	0.18
21	3	0.42
21	4	0.12
21	5	0.28
31	1	0
31	2	0.18
31	3	0.42
31	4	0.12
31	5	0.28
32	1	0
32	2	0.18
32	3	0.42
32	4	0.12
32	5	0.28
41	1	0
41	2	0.18
41	3	0.42
41	4	0.12
41	5	0.28
42	1	0
42	2	0.18
42	3	0.42
42	4	0.12
42	5	0.28
43	1	0
43	2	0.18
43	3	0.42
43	4	0.12
43	5	0.28

sourceTypeID	roadTypeID	roadTypeVMTFraction
51	1	0
51	2	0.18
51	3	0.42
51	4	0.12
51	5	0.28
52	1	0
52	2	0.18
52	3	0.42
52	4	0.12
52	5	0.28
53	1	0
53	2	0.18
53	3	0.42
53	4	0.12
53	5	0.28
54	1	0
54	2	0.18
54	3	0.42
54	4	0.12
54	5	0.28
61	1	0
61	2	0.18
61	3	0.42
61	4	0.12
61	5	0.28
62	1	0
62	2	0.18
62	3	0.42
62	4	0.12
62	5	0.28

2.7 Ramp Fraction Importer

This importer allows the user to input the percentage of traffic on urban restricted and rural restricted roadways that is traveling on ramp facilities. The Protocol Report indicated that ramp fractions would need to be considered outside of MOVES due to model limitations. However, the MOVES2010a platform addresses these limitations, thereby allowing ramps to be considered within the model.

To determine this factor, data was obtained from both the KYOVA Regional Travel Demand Model as well as the Ashland Regional Travel Demand Model for their respective parts of the study area. Lawrence County, OH data from the travel demand model was used to represent all of the Ohio area. Information from Cabell and Wayne Counties, WV was summed to determine the overall percentage for the West Virginia area. These numbers were determined using VHT information forecasted in each of the analysis years. **Tables 16 and 17** show the ramp fractions for West Virginia and Ohio, respectively.

Information obtained from Boyd County was used to represent all of the Kentucky area. Since the portion of Lawrence County, KY being modeled does not contain any restricted access facilities, the information from Boyd accurately represents the entire area. A ramp fraction of 5.6% was applied for this area, pulled from the data gathered for previous Mobile6 runs in the area. This fraction was applied to all study years. **Table 18** shows the ramp fractions for Kentucky.

Table 16. West Virginia Ramp Fractions

Year	roadTypeID	rampFraction
2005	2	0.085
2005	4	0.085
2008	2	0.087
2008	4	0.087
2015	2	0.092
2015	4	0.092
2022	2	0.097
2022	4	0.097

Table 17. Ohio Ramp Fractions

Year	roadTypeID	rampFraction
2005	2	0.085
2005	4	0.085
2008	2	0.081
2008	4	0.081
2015	2	0.085
2015	4	0.085
2022	2	0.093
2022	4	0.093

Table 18. Kentucky Ramp Fractions

Year	roadTypeID	rampFraction
2005	2	0.056
2005	4	0.056
2008	2	0.056
2008	4	0.056
2015	2	0.056
2015	4	0.056
2022	2	0.056
2022	4	0.056

2.8 Fuel Formulation and Fuel Supply Importer

The fuel formulation and fuel supply importers are used to input locally-specific fuel properties into the model. The Protocol Report stated that default information would be used for this category. Default files were used for fuel supply for WV and OH, while default files were used for fuel formulation in all three states. The availability of locally-specific fuel supply data for Kentucky resulted in a customized file for that area.

Since default files are created specific to county, separate default files were used to obtain the needed information for Kentucky, Ohio, and West Virginia. The West Virginia default file was from Cabell County, assumed for this analysis as representative of the entire WV analysis area. The Ohio default file was from Lawrence County, assumed for this analysis as representative of the entire OH analysis area. One modification was made to the 2005 fuel supply, changing the fuel formulation ID from 20317 to 20311. This provided the proper sulfur content reference for 2005. The other years had accurate sulfur content information in their default file. Direction for this modification came from ODOT. The Kentucky default file for fuel formulation was from Boyd County.

The Kentucky Division for Air Quality supplied fuel supply information for the Kentucky portion of the analysis area. Data provided was for 2008, but is also expected to appropriately represent the fuel supply conditions in 2005, 2015, and 2022. As referenced above, the Kentucky default file developed using Boyd County information was used to develop fuel supply data for all model years. **Tables 19-21** provide the fuel supply information used for West Virginia, Ohio, and Kentucky, respectively. Since default fuel formulation data was used for all areas, that information is not displayed within this report.

Table 19. West Virginia Fuel Supply Data (same beginning in 2012)

countyID	fuelYearID	monthGroupID	fuelFormulationID	marketShare	marketShareCV
99001	2005	4	5661	0.03	0.5
99001	2005	4	6099	0.1658	0.5
99001	2005	4	4950	0.8042	0.5
99001	2005	4	20311	1	0.5
99001	2008	4	2451	0.428571	0.5
99001	2008	4	7852	0.571429	0.5
99001	2008	4	20043	1	0.5
99001	2012	4	3930	1	0.5
99001	2012	4	20011	1	0.5

Table 20. Ohio Fuel Supply Data (same beginning in 2012)

countyID	fuelYearID	monthGroupID	fuelFormulationID	marketShare	marketShareCV
99002	2005	4	6146	0.102668	0.5
99002	2005	4	1060	0.247235	0.5
99002	2005	4	5010	0.650096	0.5
99002	2005	4	20311	1	0.5
99002	2008	4	7775	0.432171	0.5
99002	2008	4	2380	0.567829	0.5
99002	2008	4	20043	1	0.5
99002	2012	4	3883	1	0.5
99002	2012	4	20011	1	0.5

Table 21. Kentucky Fuel Supply Data (same for all years)

countyID	fuelYearID	monthGroupID	fuelFormulationID	marketShare	marketShareCV
99003	2005	4	20043	1	0.5
99003	2005	4	2337	0.428571	0.5
99003	2005	4	7736	0.571429	0.5

2.9 Inspection and Maintenance (I/M) Importer

This importer would allow local inspection and maintenance data to be entered for the study area. The Huntington-Ironton-Ashland non-attainment area has no I/M program in place. When default data is exported for this, the file indicates there are no I/M programs in place for the area. Since this is an accurate representation of the I/M program in the area, no further data was entered.

2.10 Zone Road Activity Importer

This importer is required for use if the geographic area has been generated using the Custom Domain option. The default file for zone road activity was exported for use in this category, and was then modified to reflect the custom domain numbers established earlier in the MOVES run. **Tables 22-24** show the zone road activity data entered for West Virginia, Ohio, and Kentucky, respectively. Values for zone road activity data are the same for all analysis years.

Table 22. West Virginia Zone Road Activity Data

zoneID	roadTypeID	SHOAllocFactor
990010	1	1
990010	2	1
990010	3	1
990010	4	1
990010	5	1

Table 23. Ohio Zone Road Activity Data

zoneID	roadTypeID	SHOAllocFactor
990020	1	1
990020	2	1
990020	3	1
990020	4	1
990020	5	1

Table 24. Kentucky Zone Road Activity Data

zoneID	roadTypeID	SHOAllocFactor
990030	1	1
990030	2	1
990030	3	1
990030	4	1
990030	5	1

3.0 Post-Processing of MOVES Output

Once the appropriate data was input into the MOVES Runspecs and the County Data Manager, the 12 scenarios were run using the MOVES program. The following MOVES output databases were produced:

- westvirginia_2005_out2
- westvirginia_2008_out2
- westvirginia_2015_out2
- westvirginia_2022_out2
- ohio_2005_out2
- ohio_2008_out2
- ohio_2015_out2
- ohio_2022_out2
- kentucky_2005_out2
- kentucky_2008_out2
- kentucky_2015_out2
- kentucky_2022_out2

Since the emission rates method was used for this analysis, only two tables within each output database are used. The tables are called rateperdistance and ratepervehicle. Ultimately, information from both tables will be used to determine overall emissions, aggregating the information for the running emissions (rateperdistance) and idling emissions (ratepervehicle). The rateperdistance table for each output database contains 299,520 records, while the ratepervehicle table for each output database contains 4,056 records.

The rateperdistance and ratepervehicle tables all represent scenarios for one geographic area (West Virginia, Ohio, or Kentucky), one analysis year (2005, 2008, 2015, or 2022), one month (April), and one day type (weekdays). Results within the rateperdistance tables are disaggregated by hour of the day, pollutant type, process type, vehicle source type, roadway type, and speed category. Temperature and relative humidity data vary by the hour of the day. Results within the ratepervehicle tables are disaggregated by hour of the day, pollutant type, process type, and vehicle source type. Temperature data within these tables varies by the hour of the day.

The final output desired for this analysis summarizes the total emissions by pollutant type for each analysis year and geographic area. As a result, the information contained in each scenario's rateperdistance and ratepervehicle has to be matched with corresponding vehicle miles traveled (VMT) and source population data. To do this, a set of supporting tables were created that match these criteria with information contained in the rateperdistance and ratepervehicle tables such as vehicle source types, road types, speed categories, and hour of the day. The creation of those tables and the process used to calculate total emissions are detailed in the subsequent sections.

3.1 VMT and Source Type by County

This table displays the daily and annual VMTs and the source type population for all of the counties and analysis years in this effort. The daily VMTs were pulled for each area from the spreadsheets used to develop the HPMS vehicle type VMTs. Annual VMTs for each county were determined using the EPA converter spreadsheet. Source types for each state's area were broken out by county, and then forecasted for each analysis year using the 0.8% growth rate established in the Protocol Report. **Table 25** shows the VMT and source type population information for each county and analysis year.

3.2 Source Type Population Fraction and VMT Fraction

This table separates the vehicle population into the different source types, and then determines the fraction of the population represented in each type as well as the fraction of total VMT represented in each type. The source type populations were pulled from the local data used for the MOVES runs. Within the MOVES format, VMTs were gathered by the six HPMS vehicle classes rather than the 13 MOVES source types. As a result, a translation was needed to match up the appropriate HPMS vehicle classes with the MOVES source types. One the two classification types were matched to one another, the source type fractions established based on the vehicle populations were used to factor VMTs of different source type classifications that fell within the same HPMS vehicle class. **Table 26** shows the source type population fractions and VMT fractions for each state's area and the four analysis years.

3.3 Hourly Distribution Fractions

This table provides the hourly VMT fractions, separated out by source type, road type, hour of the day, and state. Hourly distribution fractions were pulled from the table created for use in the MOVES program. Distribution fractions remain consistent for all analysis years. Due to the size of the input table, only an excerpt of this information is shown in the body of this report. **Table 27** shows the hourly distribution fractions for each of the three states for vehicle source type 21 (passenger cars) and roadway type 2 (rural restricted access).

3.4 Road Type Distribution Fractions

This table provides the road type VMT fractions separated by vehicle source types. Road type fractions were pulled directly from the MOVES input file developed earlier. It should be noted that road type distribution fractions have been assumed to be equal for all geographic areas of this study. **Table 28** shows the road type distribution fractions.

3.5 Average Speed Distribution Fractions

This table provides the average speed fraction sorted by source type, road type, hour of the day, and speed class. This file is the same as the MOVES input file used earlier in this analysis. As stated previously, the same average speed distribution is used for each geographic area. Due to the size of the input table, only an excerpt of this information is shown in the body of the report. **Table 29** shows the average speed distribution fractions for vehicle source type 21 (passenger cars), road type 3 (rural unrestricted access), and hour 1 (hour beginning at midnight).

Table 25. VMT and Source Type Population by County and Year

County	State	Full/Partial	Year	Daily VMT	Annual VMT	Source Type Pop
Cabell	WV	Full	2005	2,808,750	960,538,915	73,091
Cabell	WV	Full	2008	2,885,502	989,243,546	74,874
Cabell	WV	Full	2015	3,096,762	1,059,033,672	79,033
Cabell	WV	Full	2022	3,336,065	1,140,870,563	83,193
Wayne	WV	Full	2005	1,139,180	389,577,827	25,446
Wayne	WV	Full	2008	1,187,259	407,030,689	26,067
Wayne	WV	Full	2015	1,241,619	424,609,965	27,515
Wayne	WV	Full	2022	1,560,054	533,508,781	28,963
Mason	WV	Partial	2005	18,060	6,176,333	2,244
Mason	WV	Partial	2008	19,665	6,741,932	2,299
Mason	WV	Partial	2015	23,410	8,005,850	2,427
Mason	WV	Partial	2022	27,155	9,286,512	2,555
Lawrence	OH	Full	2005	1,315,020	449,711,752	72,392
Lawrence	OH	Full	2008	1,334,081	457,366,121	74,172
Lawrence	OH	Full	2015	1,470,988	503,049,909	78,325
Lawrence	OH	Full	2022	1,742,638	595,949,049	82,480
Scioto	OH	Full	2005	1,616,940	552,962,632	88,852
Scioto	OH	Full	2008	1,678,238	575,354,151	91,039
Scioto	OH	Full	2015	1,915,776	655,158,989	96,136
Scioto	OH	Full	2022	2,131,162	728,816,580	101,235
Adams	OH	Partial	2005	99,565	34,049,176	2,098
Adams	OH	Partial	2008	103,978	35,647,156	2,150
Adams	OH	Partial	2015	114,277	39,080,671	2,270
Adams	OH	Partial	2022	124,576	42,602,717	2,391
Gallia	OH	Partial	2005	48,230	16,493,759	1,021
Gallia	OH	Partial	2008	50,582	17,341,207	1,046
Gallia	OH	Partial	2015	56,070	19,175,027	1,105
Gallia	OH	Partial	2022	61,559	21,051,915	1,163
Boyd	KY	Full	2005	1,429,198	488,758,339	49,199
Boyd	KY	Full	2008	1,380,484	473,274,668	50,429
Boyd	KY	Full	2015	1,494,083	510,947,840	53,299
Boyd	KY	Full	2022	1,640,241	560,930,984	56,169
Lawrence	KY	Partial	2005	91,327	31,232,092	3,070
Lawrence	KY	Partial	2008	88,522	30,348,132	3,147
Lawrence	KY	Partial	2015	91,151	31,171,751	3,326
Lawrence	KY	Partial	2022	95,579	32,686,140	3,505

Table 26. Source Type Population Fractions and VMT Fractions by State and Year

State	Source Type	Source Type ID	2005		
			Source Type Population	Source Type Fraction	Source Type VMT Fraction
WV	Motorcycle	11	2779	0.02757	0.00555
WV	Passenger Car	21	43487	0.43150	0.71294
WV	Passenger Truck	31	42860	0.42528	0.14593
WV	Light Commercial Truck	32	6975	0.06921	0.02375
WV	Intercity Bus	41	61	0.00061	0.00126
WV	Transit Bus	42	33	0.00033	0.00069
WV	School Bus	43	234	0.00232	0.00481
WV	Refuse Truck	51	42	0.00042	0.00052
WV	Single Unit Short-haul Truck	52	2535	0.02515	0.03110
WV	Single Unit Long-haul Truck	53	289	0.00287	0.00355
WV	Motor Home	54	125	0.00124	0.00154
WV	Combination Short-haul Truck	61	644	0.00639	0.03240
WV	Combination Long-haul Truck	62	715	0.00709	0.03596
OH	Motorcycle	11	10638	0.06336	0.00402
OH	Passenger Car	21	103050	0.61373	0.71634
OH	Passenger Truck	31	46653	0.27785	0.21575
OH	Light Commercial Truck	32	1140	0.00679	0.00527
OH	Intercity Bus	41	32	0.00019	0.00014
OH	Transit Bus	42	3	0.00002	0.00001
OH	School Bus	43	474	0.00282	0.00210
OH	Refuse Truck	51	20	0.00012	0.00006
OH	Single Unit Short-haul Truck	52	362	0.00216	0.00112
OH	Single Unit Long-haul Truck	53	120	0.00071	0.00037
OH	Motor Home	54	4885	0.02909	0.01514
OH	Combination Short-haul Truck	61	248	0.00148	0.01848
OH	Combination Long-haul Truck	62	284	0.00169	0.02117
KY	Motorcycle	11	2222	0.04252	0.00786
KY	Passenger Car	21	25145	0.48106	0.65724
KY	Passenger Truck	31	18687	0.35751	0.14690
KY	Light Commercial Truck	32	5640	0.10790	0.04434
KY	Intercity Bus	41	9	0.00017	0.00095
KY	Transit Bus	42	27	0.00051	0.00285
KY	School Bus	43	45	0.00085	0.00475
KY	Refuse Truck	51	7	0.00014	0.00118
KY	Single Unit Short-haul Truck	52	229	0.00438	0.03698
KY	Single Unit Long-haul Truck	53	16	0.00030	0.00253
KY	Motor Home	54	25	0.00047	0.00399
KY	Combination Short-haul Truck	61	121	0.00231	0.04992
KY	Combination Long-haul Truck	62	98	0.00187	0.04050

State	Source Type	Source Type ID	2008		
			Source Type Population	Source Type Fraction	Source Type VMT Fraction
WV	Motorcycle	11	2847	0.02757	0.00555
WV	Passenger Car	21	44548	0.43150	0.71294
WV	Passenger Truck	31	43905	0.42528	0.14593
WV	Light Commercial Truck	32	7146	0.06921	0.02375
WV	Intercity Bus	41	63	0.00061	0.00126
WV	Transit Bus	42	34	0.00033	0.00069
WV	School Bus	43	240	0.00232	0.00481
WV	Refuse Truck	51	43	0.00042	0.00052
WV	Single Unit Short-haul Truck	52	2597	0.02515	0.03110
WV	Single Unit Long-haul Truck	53	296	0.00287	0.00355
WV	Motor Home	54	128	0.00124	0.00154
WV	Combination Short-haul Truck	61	660	0.00639	0.03240
WV	Combination Long-haul Truck	62	732	0.00709	0.03596
OH	Motorcycle	11	10899	0.06335	0.00402
OH	Passenger Car	21	105584	0.61373	0.71634
OH	Passenger Truck	31	47800	0.27785	0.21575
OH	Light Commercial Truck	32	1168	0.00679	0.00527
OH	Intercity Bus	41	33	0.00019	0.00014
OH	Transit Bus	42	3	0.00002	0.00001
OH	School Bus	43	486	0.00282	0.00210
OH	Refuse Truck	51	20	0.00012	0.00006
OH	Single Unit Short-haul Truck	52	371	0.00216	0.00112
OH	Single Unit Long-haul Truck	53	123	0.00071	0.00037
OH	Motor Home	54	5005	0.02909	0.01515
OH	Combination Short-haul Truck	61	254	0.00148	0.01848
OH	Combination Long-haul Truck	62	291	0.00169	0.02117
KY	Motorcycle	11	2278	0.04252	0.00771
KY	Passenger Car	21	25773	0.48106	0.65659
KY	Passenger Truck	31	19154	0.35751	0.14450
KY	Light Commercial Truck	32	5781	0.10790	0.04361
KY	Intercity Bus	41	9	0.00017	0.00096
KY	Transit Bus	42	27	0.00051	0.00287
KY	School Bus	43	46	0.00085	0.00479
KY	Refuse Truck	51	7	0.00014	0.00117
KY	Single Unit Short-haul Truck	52	234	0.00438	0.03669
KY	Single Unit Long-haul Truck	53	16	0.00030	0.00251
KY	Motor Home	54	25	0.00047	0.00396
KY	Combination Short-haul Truck	61	124	0.00231	0.05225
KY	Combination Long-haul Truck	62	100	0.00187	0.04239

State	Source Type	Source Type ID	2015		
			Source Type Population	Source Type Fraction	Source Type VMT Fraction
WV	Motorcycle	11	3005	0.02757	0.00555
WV	Passenger Car	21	47023	0.43150	0.71294
WV	Passenger Truck	31	46345	0.42528	0.14593
WV	Light Commercial Truck	32	7543	0.06921	0.02375
WV	Intercity Bus	41	66	0.00061	0.00126
WV	Transit Bus	42	36	0.00033	0.00069
WV	School Bus	43	253	0.00232	0.00481
WV	Refuse Truck	51	46	0.00042	0.00052
WV	Single Unit Short-haul Truck	52	2741	0.02515	0.03110
WV	Single Unit Long-haul Truck	53	313	0.00287	0.00355
WV	Motor Home	54	136	0.00124	0.00154
WV	Combination Short-haul Truck	61	697	0.00639	0.03240
WV	Combination Long-haul Truck	62	773	0.00709	0.03596
OH	Motorcycle	11	11510	0.06336	0.00402
OH	Passenger Car	21	111497	0.61373	0.71634
OH	Passenger Truck	31	50477	0.27785	0.21576
OH	Light Commercial Truck	32	1233	0.00679	0.00527
OH	Intercity Bus	41	34	0.00019	0.00014
OH	Transit Bus	42	3	0.00002	0.00001
OH	School Bus	43	513	0.00282	0.00211
OH	Refuse Truck	51	22	0.00012	0.00006
OH	Single Unit Short-haul Truck	52	392	0.00216	0.00112
OH	Single Unit Long-haul Truck	53	130	0.00072	0.00037
OH	Motor Home	54	5285	0.02909	0.01514
OH	Combination Short-haul Truck	61	268	0.00148	0.01845
OH	Combination Long-haul Truck	62	308	0.00170	0.02120
KY	Motorcycle	11	2408	0.04252	0.00770
KY	Passenger Car	21	27240	0.48106	0.65523
KY	Passenger Truck	31	20244	0.35751	0.14485
KY	Light Commercial Truck	32	6110	0.10790	0.04372
KY	Intercity Bus	41	10	0.00017	0.00097
KY	Transit Bus	42	29	0.00051	0.00290
KY	School Bus	43	48	0.00085	0.00483
KY	Refuse Truck	51	8	0.00014	0.00118
KY	Single Unit Short-haul Truck	52	248	0.00438	0.03687
KY	Single Unit Long-haul Truck	53	17	0.00030	0.00252
KY	Motor Home	54	27	0.00047	0.00398
KY	Combination Short-haul Truck	61	131	0.00231	0.05259
KY	Combination Long-haul Truck	62	106	0.00187	0.04266

State	Source Type	Source Type ID	2022 Source Type Population	2022 Source Type Fraction	2022 Source Type VMT Fraction
WV	Motorcycle	11	3163	0.02757	0.00555
WV	Passenger Car	21	49497	0.43150	0.71294
WV	Passenger Truck	31	48784	0.42528	0.14593
WV	Light Commercial Truck	32	7940	0.06921	0.02375
WV	Intercity Bus	41	70	0.00061	0.00126
WV	Transit Bus	42	38	0.00033	0.00069
WV	School Bus	43	266	0.00232	0.00481
WV	Refuse Truck	51	48	0.00042	0.00052
WV	Single Unit Short-haul Truck	52	2885	0.02515	0.03110
WV	Single Unit Long-haul Truck	53	329	0.00287	0.00355
WV	Motor Home	54	143	0.00124	0.00154
WV	Combination Short-haul Truck	61	733	0.00639	0.03240
WV	Combination Long-haul Truck	62	814	0.00709	0.03596
OH	Motorcycle	11	12120	0.06335	0.00402
OH	Passenger Car	21	117410	0.61373	0.71634
OH	Passenger Truck	31	53154	0.27785	0.21576
OH	Light Commercial Truck	32	1298	0.00678	0.00527
OH	Intercity Bus	41	36	0.00019	0.00014
OH	Transit Bus	42	3	0.00002	0.00001
OH	School Bus	43	540	0.00282	0.00211
OH	Refuse Truck	51	23	0.00012	0.00006
OH	Single Unit Short-haul Truck	52	412	0.00215	0.00112
OH	Single Unit Long-haul Truck	53	137	0.00072	0.00037
OH	Motor Home	54	5566	0.02909	0.01514
OH	Combination Short-haul Truck	61	282	0.00147	0.01845
OH	Combination Long-haul Truck	62	324	0.00169	0.02120
KY	Motorcycle	11	2537	0.04252	0.00754
KY	Passenger Car	21	28707	0.48106	0.65231
KY	Passenger Truck	31	21334	0.35751	0.14376
KY	Light Commercial Truck	32	6439	0.10790	0.04339
KY	Intercity Bus	41	10	0.00017	0.00099
KY	Transit Bus	42	31	0.00051	0.00296
KY	School Bus	43	51	0.00085	0.00493
KY	Refuse Truck	51	8	0.00014	0.00118
KY	Single Unit Short-haul Truck	52	261	0.00438	0.03674
KY	Single Unit Long-haul Truck	53	18	0.00030	0.00251
KY	Motor Home	54	28	0.00047	0.00397
KY	Combination Short-haul Truck	61	138	0.00231	0.05506
KY	Combination Long-haul Truck	62	112	0.00187	0.04467

Table 27. Excerpt of Hourly Distribution Fractions by State

Source Type ID	Road Type ID	Hour ID	WV Hour VMT Fraction	OH Hour VMT Fraction	KY Hour VMT Fraction
21	2	1	0.00890	0.00890	0.00942
21	2	2	0.00564	0.00564	0.00760
21	2	3	0.00424	0.00424	0.00600
21	2	4	0.00427	0.00427	0.00691
21	2	5	0.00695	0.00695	0.01320
21	2	6	0.01798	0.01798	0.02545
21	2	7	0.03806	0.03806	0.04436
21	2	8	0.05700	0.05700	0.05558
21	2	9	0.05773	0.05773	0.05484
21	2	10	0.05538	0.05538	0.05294
21	2	11	0.05554	0.05554	0.05365
21	2	12	0.05558	0.05558	0.05484
21	2	13	0.05584	0.05584	0.05766
21	2	14	0.06051	0.06051	0.06160
21	2	15	0.06765	0.06765	0.07013
21	2	16	0.07755	0.07755	0.07870
21	2	17	0.08428	0.08428	0.08010
21	2	18	0.07970	0.07970	0.07385
21	2	19	0.06012	0.06012	0.05386
21	2	20	0.04522	0.04522	0.04211
21	2	21	0.03646	0.03646	0.03548
21	2	22	0.02912	0.02912	0.02902
21	2	23	0.02142	0.02142	0.01944
21	2	24	0.01486	0.01486	0.01325

Table 28. Road Type Distribution Fractions

Source Type ID	Road Type ID	Road Type VMT Fraction
11	1	0
11	2	0.18
11	3	0.42
11	4	0.12
11	5	0.28
21	1	0
21	2	0.18
21	3	0.42
21	4	0.12
21	5	0.28
31	1	0
31	2	0.18
31	3	0.42
31	4	0.12
31	5	0.28
32	1	0
32	2	0.18
32	3	0.42
32	4	0.12
32	5	0.28
41	1	0
41	2	0.18
41	3	0.42
41	4	0.12
41	5	0.28
42	1	0
42	2	0.18
42	3	0.42
42	4	0.12
42	5	0.28
43	1	0
43	2	0.18
43	3	0.42
43	4	0.12
43	5	0.28

Source Type ID	Road Type ID	Road Type VMT Fraction
51	1	0
51	2	0.18
51	3	0.42
51	4	0.12
51	5	0.28
52	1	0
52	2	0.18
52	3	0.42
52	4	0.12
52	5	0.28
53	1	0
53	2	0.18
53	3	0.42
53	4	0.12
53	5	0.28
54	1	0
54	2	0.18
54	3	0.42
54	4	0.12
54	5	0.28
61	1	0
61	2	0.18
61	3	0.42
61	4	0.12
61	5	0.28
62	1	0
62	2	0.18
62	3	0.42
62	4	0.12
62	5	0.28

Table 29. Excerpt of Average Speed Distribution Fractions

Source Type ID	Road Type ID	Hour ID	Speed Bin ID	Average Speed Fraction
21	3	1	1	0.00226828
21	3	1	2	0.0105519
21	3	1	3	0.0170857
21	3	1	4	0.0381731
21	3	1	5	0.0460688
21	3	1	6	0.0245757
21	3	1	7	0.0420755
21	3	1	8	0.0564427
21	3	1	9	0.164311
21	3	1	10	0.157075
21	3	1	11	0.171162
21	3	1	12	0.10283
21	3	1	13	0.0851272
21	3	1	14	0.0441349
21	3	1	15	0.0286281
21	3	1	16	0.00948987

3.6 Aggregation Tables

Once the supporting tables were created, the information within them needed to be combined in a way that matched the independent variables shown in the rateperdistance and ratepervehicle tables. Due to the large number of records and computations required to perform this exercise, some sort of advanced database and/or scripting tool was necessary. Since the KYOVA Regional Travel Demand Model is in the process of being converted to the TransCAD platform, it was determined that a programming script developed and run in TransCAD would be an effective way to summarize this information.

In an effort to create a step within this scripting process that could later be referenced and checked, two intermediate tables were developed. The tables developed were designated as the VMT Summary Table and the Source Type Population Summary Table. Each table's intent and composition is described below, along with an example of the information produced within the tables.

<u>VMT Summary Table</u>

The VMT Summary Table contains many of the same independent variables found in the rateperdistance output tables; namely, state, analysis year, source type, road type, hour of the day, and average speed bin. This table further divides the information by the individual counties in the analysis. The intent of this table is to determine the proportion of daily and annual VMT for a given county and analysis year that is represented within each combination of vehicle source type, road type, hour of the day, and speed category. This table references the source type VMT fraction generated in the Source Type Population Fraction and VMT Fraction table, the road type VMT fraction generated in the Road Type Distribution table, the hour VMT fraction generated in the Hourly Distribution Fractions table, and the average speed fraction from the Average Speed Distribution Fraction table. These four values are multiplied together to determine an overall fraction, which is then multiplied by the corresponding daily and annual VMT established in the VMT and Source Type table. When the daily VMT proportions and annual VMT proportions are summed for a particular county and analysis year combination, they will equal the corresponding VMT values shown in the VMT and Source Type table.

Source Type Population Summary Table

The Source Type Population Summary Table contains many of the same independent variables found in the ratepervehicle output tables; namely, state, analysis year, source type, road type, and hour of the day. This table further divides the information by the individual counties in the analysis. The intent of this table is to determine the proportion of the source type population for a given county and analysis year that is represented within each combination of vehicle source type, road type, and hour of the day. This table references the source type population fraction generated in the Source Type Population and VMT Fraction table and the hour VMT fraction generated in the Hourly Distribution Fractions table. These two values are multiplied together to get an overall fraction, which is then multiplied by the corresponding source type population information found in the VMT and Source Type table. The population proportion, when summed for a particular county and analysis year combination, should be equal to the corresponding source type population value shown in the VMT and Source Type table.

3.7 Summarizing Results

As mentioned in the previous section, a TransCAD script was developed to quickly match the information in the rateperdistance and ratepervehicle tables with corresponding VMT and source type population information. This script also summed the matched information by county, analysis year, and pollutant type to create the final output format needed for this process. The script created for this process is included as **Figure 1** below. Results from this script are produced in a form that is easily formatted to show the overall emissions information contained in the main body of this report.

Figure 1. TransCAD Script for Post-Processing MOVES Output

```
macro "KYOVA MOVES PP"
  runmacro("G30 File Close All")

  //constants
  States = {"WV", "OH", "KY"}
  Counties = {"Cabell_WV", "Wayne_WV", "Mason_WV", "Lawrence_OH", "Scioto_OH", "Adams_OH",
"Gallia_OH","Boyd_KY", "Lawrence_KY"}

  Years = {2005, 2008, 2015, 2022}
  SourceTypes = {11,21,31,32,41,42,43,51,52,53,54,61,62}
  RoadTypes = {1,2,3,4,5}
  Hours = {1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24}
  Speeds = {1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16}
  Pollutants = {3,31,110,111,112,115,116,117}
        Pollutant_Names = {"Oxides of Nitrogen (NOx)",
                           "Sulfur Dioxide (SO2)",
                           "Primary Exhaust PM2.5 - Total",
```

```
                              "Primary PM2.5 - Organic Carbon",
                              "Primary PM2.5 - Elemental Carbon",
                              "Primary PM2.5 - Sulfate Particulate",
                              "Primary PM2.5 - Brakewear Particulate",
                              "Primary PM2.5 - Tirewear Particulate"}

    path = SplitPath(GetInterface())

    in_vmt_bin = path[1]+path[2]+"VMT Source Type By County.bin"
    in_source_type_bin = path[1]+path[2]+"Source Type Pop VMT Fraction.bin"
    in_hourly_bin = path[1]+path[2]+"Hourly Distribution Fractions.bin"
    in_road_type_bin = path[1]+path[2]+"Road Type Distribution.bin"
    in_speed_bin = path[1]+path[2]+"Average Speed Distribution.bin"

    out_vmt_summary = path[1]+path[2]+"Summary_VMT.bin"
    out_veh_summary = path[1]+path[2]+"Summary_VEHICLE.bin"
    out_em_vmt_summary = path[1]+path[2]+"Summary_VMT_County.bin"
    out_em_veh_summary = path[1]+path[2]+"Summary_VEH_County.bin"
    out_em_total_summary = path[1]+path[2]+"Summary_Total_Emissions.bin"

    CreateProgressBar("MOVES Post Processor.......", "TRUE")
    UpdateProgressBar("Computing fractions.......", 10)

        ///---------------------------------Summarize VMT, write results to summary table---------------------------------
    vw_vmt =OpenTable("VMT", "FFB", {in_vmt_bin,})
    vw_st =OpenTable("ST", "FFB", {in_source_type_bin,})
    vw_hr =OpenTable("HR", "FFB", {in_hourly_bin,})
    vw_rt =OpenTable("RT", "FFB", {in_road_type_bin,})
    vw_spd =OpenTable("SPD", "FFB", {in_speed_bin,})

        // ----------------primary keys
        //vw_vmt Year       County    State
        //vw_st             Year                State             Source Type ID
        //vw_hr                                       State             Source Type ID
        Road Type ID              Hour ID
        //vw_rt                                                                 Source Type ID
        Road Type ID
        //vw_spd                                                                Source Type ID
        Road Type ID              Hour ID             Speed Bin ID
        //----------------
        jv1 = JoinViewsMulti("JV1", {vw_vmt+".Year", vw_vmt+".State"}, {vw_st+".Year", vw_st+".State"}, {{"O", }})
        jv2 = JoinViewsMulti("JV2", {jv1+"."+vw_vmt+".State", jv1+".[Source Type ID]"}, {vw_hr+".State",
vw_hr+".[Source Type ID]"}, {{"O", }})
        jv3 = JoinViewsMulti("JV3", {jv2+"."+vw_hr+".[Source Type ID]", jv2+".[Road Type ID]"}, {vw_rt+".[Source
Type ID]", vw_rt+".[Road Type ID]"}, {{"O", }})
        jv4 = JoinViewsMulti("JV4", {jv3+"."+vw_hr+".[Source Type ID]", jv3+"."+vw_hr+".[Road Type ID]",
jv3+".[Hour ID]"}, {vw_spd+".[Source Type ID]", vw_spd+".[Road Type ID]", vw_spd+".[Hour ID]"}, {{"O", }})

        //-------------------VMT Table
        kept_fields = {jv4+"."+vw_vmt+".Year",
                                  jv4+".County",
                                  jv4+"."+vw_vmt+".State",
                                  jv4+".[Daily VMT]",
                                  jv4+".[Annual VMT]",
                                  jv4+"."+vw_st+".[Source Type ID]",
                                  jv4+".[Source Type VMT Fraction]",
```

```
                                        jv4+"."+vw_hr+".[Road Type ID]",
                                        jv4+"."+vw_hr+".[Hour ID]",
                                        jv4+".[Hour VMT Fraction]",
                                        jv4+".[Road Type VMT Fraction]",
                                        jv4+".[Average Speed Bin ID]",
                                        jv4+".[Average Speed Fraction]"
                                        }
        idx_fields = {jv4+"."+vw_vmt+".Year",
                                        jv4+".County",
                                        jv4+"."+vw_vmt+".State",
                                        jv4+"."+vw_st+".[Source Type ID]",
                                        jv4+"."+vw_hr+".[Road Type ID]",
                                        jv4+"."+vw_hr+".[Hour ID]",
                                        jv4+".[Average Speed Bin ID]"
                                        }
  add_fields = {{"Combined Factor", "Real", 24,4,},
         {"Daily VMT Proportion", "Real", 24,4,},
         {"Annual VMT Proportion", "Real", 24,4,},
         {"Aggregation_Key", "String", 32,0,},
         {"Aggregation_Key_CTY", "String", 32,0,}
        }
        for p = 1 to Pollutants.length do
                add_fields = add_fields + {{"RatePerDist_"+i2s(Pollutants[p]), "Real", 24,4,},

        {"Daily_Emission_RatePerDist_"+i2s(Pollutants[p]), "Real", 24,4,},

        {"Annual_Emission_RatePerDist_"+i2s(Pollutants[p]), "Real", 24,4,}}
        end
//      SetView(jv4)
//      SelectByQuery("No_RT_1", "Several", "Select * where [Road Type ID] <> 1",)

        ExportView(jv4+"|", "FFB", out_vmt_summary, kept_fields,{{"Additional Fields", add_fields},{"Indexed
Fields",idx_fields}})

        //-------------------Vehicle Pop Table
        kept_fields = {jv3+"."+vw_vmt+".Year",
                                        jv3+".County",
                                        jv3+"."+vw_vmt+".State",
                                        jv3+".[Source Type Pop]",
                                        jv3+"."+vw_st+".[Source Type ID]",
                                        jv3+".[Source Type Fraction]",
                                        jv3+"."+vw_hr+".[Road Type ID]",
                                        jv3+"."+vw_hr+".[Hour ID]",
                                        jv3+".[Hour VMT Fraction]"
                                        }
        idx_fields = {jv3+"."+vw_vmt+".Year",
                                        jv3+".County",
                                        jv3+"."+vw_vmt+".State",
                                        jv3+"."+vw_st+".[Source Type ID]",
                                        jv3+"."+vw_hr+".[Road Type ID]",
                                        jv3+"."+vw_hr+".[Hour ID]"
                                        }
  add_fields = {{"Combined Factor", "Real", 24,4,},
         {"Population Proportion", "Real", 24,4,},
         {"Aggregation_Key", "String", 32,0,},
         {"Aggregation_Key_CTY", "String", 32,0,}
```

```
            }
            for p = 1 to Pollutants.length do
                        add_fields = add_fields + {{"RatePerVeh_"+i2s(Pollutants[p]), "Real", 24,4,},

            {"Daily_Emission_RatePerVeh_"+i2s(Pollutants[p]), "Real", 24,4,},

            {"Annual_Emission_RatePerVeh_"+i2s(Pollutants[p]), "Real", 24,4,}}
            end
            ExportView(jv3+"|", "FFB", out_veh_summary, kept_fields,{{"Additional Fields", add_fields}, {"Indexed
Fields",idx_fields}})

            CloseView(jv4)
            CloseView(jv3)
            CloseView(jv2)
            CloseView(jv1)
            CloseView(vw_vmt)
            CloseView(vw_st)
            CloseView(vw_hr)
            CloseView(vw_rt)
            CloseView(vw_spd)

            //--------------------------VMT calculation
  UpdateProgressBar("Computing VMT.......", 20)
  order = {"Sort Order", {{"Year", "Ascending"},{"County", "Ascending"},{"State", "Ascending"},{"[Source Type ID]",
"Ascending"},{"[Road Type ID]", "Ascending"},{"[Hour ID]", "Ascending"},{"[Average Speed Bin ID]", "Ascending"}}}
  vw_vmt =OpenTable("VMT", "FFB", {out_vmt_summary,})

  st_frac = GetDataVector(vw_vmt+"|", "[Source Type VMT Fraction]",{order})
  hr_frac = GetDataVector(vw_vmt+"|", "[Hour VMT Fraction]",{order})
  rt_frac = GetDataVector(vw_vmt+"|", "[Road Type VMT Fraction]",{order})
  spd_frac = GetDataVector(vw_vmt+"|", "[Average Speed Fraction]",{order})

            combo_frac = st_frac * rt_frac * hr_frac * spd_frac
            SetDataVector(vw_vmt+"|", "[Combined Factor]", combo_frac,{order})

  daily_vmt = GetDataVector(vw_vmt+"|", "[Daily VMT]",{order})
  annual_vmt = GetDataVector(vw_vmt+"|", "[Annual VMT]",{order})
            daily_vmt_prop = daily_vmt * combo_frac
            annual_vmt_prop = annual_vmt * combo_frac
            SetDataVector(vw_vmt+"|", "[Daily VMT Proportion]", daily_vmt_prop,{order})
            SetDataVector(vw_vmt+"|", "[Annual VMT Proportion]", annual_vmt_prop,{order})

  vy = GetDataVector(vw_vmt+"|", "Year",)
  vs = GetDataVector(vw_vmt+"|", "State",)
  id1 = GetDataVector(vw_vmt+"|", "[Source type ID]",)
  id2 = GetDataVector(vw_vmt+"|", "[Road Type ID]",)
  id3 = GetDataVector(vw_vmt+"|", "Hour ID",)
  id4 = GetDataVector(vw_vmt+"|", "Average Speed Bin ID",)
  id_string = i2s(vy) +"_" + vs + "_" + i2s(id1) + "_" + i2s(id2)+ "_" + i2s(id3)+ "_" + i2s(id4)
            SetDataVector(vw_vmt+"|", "Aggregation_Key", id_string,)
  vc = GetDataVector(vw_vmt+"|", "County",)
  id_string = i2s(vy) +"_" + vs +"_" + vc
            SetDataVector(vw_vmt+"|", "Aggregation_Key_CTY", id_string,)

            //----------------------Veh pop calculation
  UpdateProgressBar("Computing Veh Population .......", 25)
```

```
   order1 = {"Sort Order", {{"Year", "Ascending"},{"County", "Ascending"},{"State", "Ascending"},{"[Source Type ID]",
"Ascending"},{"[Road Type ID]", "Ascending"},{"[Hour ID]", "Ascending"}}}
   vw_veh =OpenTable("VMT", "FFB", {out_veh_summary,})

   st_frac = GetDataVector(vw_veh+"|", "[Source Type Fraction]",{order1})
   hr_frac = GetDataVector(vw_veh+"|", "[Hour VMT Fraction]",{order1})

         combo_frac = st_frac * hr_frac
         SetDataVector(vw_veh+"|", "[Combined Factor]", combo_frac,{order1})

   st_pop = GetDataVector(vw_veh+"|", "[Source Type Pop]",{order1})
         pop_prop = st_pop * combo_frac
         SetDataVector(vw_veh+"|", "[Population Proportion]", pop_prop,{order1})

   vy = GetDataVector(vw_veh+"|", "Year",)
   vs = GetDataVector(vw_veh+"|", "State",)
   id1 = GetDataVector(vw_veh+"|", "[Source type ID]",)
   id2 = GetDataVector(vw_veh+"|", "Hour ID",)
   id_string = i2s(vy) +"_" + vs + "_" + i2s(id1) + "_" + i2s(id2)
         SetDataVector(vw_veh+"|", "Aggregation_Key", id_string,)
   vc = GetDataVector(vw_veh+"|", "County",)
   id_string = i2s(vy) +"_" + vs +"_" + vc
         SetDataVector(vw_veh+"|", "Aggregation_Key_CTY", id_string,)

         CloseView(vw_vmt)
         CloseView(vw_veh)

         //------------------------Read MOVES Rates Tables
   UpdateProgressBar("Reading Rates from MOVES.......", 30)
   add_fields = {{"Aggregation_Key", "String", 32,0,}}
         for s = 1 to States.length do
                  for y = 1 to Years.length do
                           ds = States[s]+"_"+i2s(Years[y])

                           vw = OpenTable("RD", "ODBC", {ds, "rateperdistance"},{{"Read Only", True}})
                           bin_name = path[1]+path[2]+"MOVES_RatePerDist_"+ds+".bin"
                           ExportView(vw+"|", "FFB", bin_name, ,{{"Additional Fields", add_fields}})
                           CloseView(vw)
                     //add aggregation field values
                     //aggregate by - {sourceTypeID, roadTypeID, hourID,avgSpeedBinID,pollutantID}
                     vw = OpenTable("RD", "FFB", {bin_name,})
                     id1 = GetDataVector(vw+"|", "sourceTypeID",)
                     id2 = GetDataVector(vw+"|", "roadTypeID",)
                     id3 = GetDataVector(vw+"|", "hourID",)
                     id4 = GetDataVector(vw+"|", "avgSpeedBinID",)
                     id5 = GetDataVector(vw+"|", "pollutantID",)
                     id_string = i2s(id1) + "_" + i2s(id2)+ "_" + i2s(id3)+ "_" + i2s(id4)+ "_" + i2s(id5)
                           SetDataVector(vw+"|", "Aggregation_Key", id_string,)

                           CloseView(vw)

                           vw = OpenTable("RD", "ODBC", {ds, "ratepervehicle"},{{"Read Only", True}})
                           bin_name = path[1]+path[2]+"MOVES_RatePerVeh_"+ds+".bin"
                           ExportView(vw+"|", "FFB", bin_name, ,{{"Additional Fields", add_fields}})
                           CloseView(vw)
                     //add aggregation field values
```

```
                                //aggregate by - {sourceTypeID, hourID,pollutantID}
                                vw = OpenTable("RD", "FFB", {bin_name,})
                                id1 = GetDataVector(vw+"|", "sourceTypeID",)
                                id2 = GetDataVector(vw+"|", "hourID",)
                                id3 = GetDataVector(vw+"|", "pollutantID",)
                                id_string = i2s(id1) + "_" + i2s(id2)+ "_" + i2s(id3)
                                        SetDataVector(vw+"|", "Aggregation_Key", id_string,)
                                        CloseView(vw)
                        end
        end

        //------------------------Aggregate MOVES Rates Per Distance Tables
    //aggregate by - {sourceTypeID, roadTypeID, hourID,avgSpeedBinID,pollutantID}
    UpdateProgressBar("Aggregate Distance Rates .......", 40)
    vw_vmt =OpenTable("VMT", "FFB", {out_vmt_summary,})
        field_names = {      {"sourceTypeID","MIN",},
                                        {"roadTypeID","MIN",},
                                        {"hourID","MIN",},
                                        {"avgSpeedBinID","MIN",},
                                        {"pollutantID","MIN",},
                                        {"ratePerDistance","SUM",}
                                        }
        add_fields = {{"Aggregation_Key_VMT", "String", 32,0,}}

        for s = 1 to States.length do
                for y = 1 to Years.length do
                        ds = States[s]+"_"+i2s(Years[y])
                        bin_name = path[1]+path[2]+"MOVES_RatePerDist_"+ds+".bin"
                    vw = OpenTable("RD", "FFB", {bin_name,})
                        temp_name = path[1]+path[2]+"Agg_RateVmt_"+ds+".bin"
                    avw = AggregateTable("AGG", vw+"|", "FFB", temp_name, "Aggregation_Key",
field_names,{"Missing as zero", "Yes"})
                        CloseView(vw)

                        temp_name = path[1]+path[2]+"temp1.bin"
                        for p = 1 to Pollutants.length do
                                SetView(avw)
                                query = "Select * where [Low pollutantID] = " + i2s(Pollutants[p])
                                svw = "Pneeded"
                                n1 = SelectByQuery(svw, "Several", query,)
                                if n1> 0 then do
                                        temp_name = path[1]+path[2]+"temp1.bin"
                                        ExportView(avw+"|"+svw, "FFB", temp_name, ,{{"Additional Fields",
add_fields}})
                                  tvw = OpenTable("RD", "FFB", {temp_name,})

                                id1 = GetDataVector(tvw+"|", "Low sourceTypeID",)
                                  id2 = GetDataVector(tvw+"|", "Low roadTypeID",)
                                  id3 = GetDataVector(tvw+"|", "Low hourID",)
                                  id4 = GetDataVector(tvw+"|", "Low avgSpeedBinID",)

                                  vsy = Vector(id1.length, "String",{{"Constant", i2s(Years[y]) + "_" +
States[s]}})
                                  id_string = vsy+ "_" + i2s(id1) + "_" + i2s(id2)+ "_" + i2s(id3)+ "_" + i2s(id4)
                                        SetDataVector(vw+"|", "Aggregation_Key_VMT", id_string,)
```

```
                                        jv1 = JoinViews("JV1", vw_vmt + ".Aggregation_Key", tvw +
".Aggregation_Key_VMT", {{"O", }})
                                        //set rates in vmt table
                                        SetView(jv1)
                                        svw2 = "Subset"
                                        query = "Select * where ratePerDistance <> null"
                                        n1 = SelectByQuery(svw2, "Several", query,)
                                        if (n1 > 0) then do
                                                vr = GetDataVector(jv1+"|"+svw2, "ratePerDistance",)
                                                SetDataVector(jv1+"|"+svw2,
"RatePerDist_"+i2s(Pollutants[p]), vr,)
                                        end
                                        CloseView(jv1)
                                        CloseView(tvw)
                                end
                        end

                        CloseView(avw)
                end
        end
   CloseView(vw_vmt)

        //------------------------Aggregate MOVES Rates Per Vehicle Tables
   //aggregate by - {sourceTypeID, hourID,pollutantID}
   UpdateProgressBar("Aggregate Vehicle Rates .......", 60)
   vw_veh = OpenTable("VMT", "FFB", {out_veh_summary,})
        field_names = {      {"sourceTypeID","MIN",},
                                        {"hourID","MIN",},
                                        {"pollutantID","MIN",},
                                        {"ratePerVehicle","SUM",}
                                        }
        add_fields = {{"Aggregation_Key_VEH", "String", 32,0,}}

        for s = 1 to States.length do
                for y = 1 to Years.length do
                        ds = States[s]+"_"+i2s(Years[y])
                        bin_name = path[1]+path[2]+"MOVES_RatePerVeh_"+ds+".bin"
                   vw = OpenTable("RD", "FFB", {bin_name,})
                        temp_name = path[1]+path[2]+"Agg_RateVeh_"+ds+".bin"
                   avw = AggregateTable("AGG", vw+"|", "FFB", temp_name, "Aggregation_Key",
field_names,{"Missing as zero", "Yes"})
                        CloseView(vw)

                        temp_name = path[1]+path[2]+"temp1.bin"
                        for p = 1 to Pollutants.length do
                                SetView(avw)
                                query = "Select * where [Low pollutantID] = " + i2s(Pollutants[p])
                                svw = "Pneeded"
                                n1 = SelectByQuery(svw, "Several", query,)
                                if n1> 0 then do
                                        temp_name = path[1]+path[2]+"temp1.bin"
                                        ExportView(avw+"|"+svw, "FFB", temp_name, ,{{"Additional Fields",
add_fields}})
                                   tvw = OpenTable("RD", "FFB", {temp_name,})

                                id1 = GetDataVector(tvw+"|", "Low sourceTypeID",)
```

```
                                        id2 = GetDataVector(tvw+"|", "Low hourID",)
                                        vsy = Vector(id1.length, "String",{{"Constant", i2s(Years[y]) + "_" +
States[s]}})
                                        id_string = vsy+ "_" + i2s(id1) + "_" + i2s(id2)
                                            SetDataVector(vw+"|", "Aggregation_Key_VEH", id_string,)

                                            jv1 = JoinViews("JV1", vw_veh + ".Aggregation_Key", tvw +
".Aggregation_Key_VEH", {{"O", }})
                                            //set rates in vmt table
                                            SetView(jv1)
                                            svw2 = "Subset"
                                            query = "Select * where ratePerVehicle <> null"
                                            n1 = SelectByQuery(svw2, "Several", query,)
                                            if (n1 > 0) then do
                                                vr = GetDataVector(jv1+"|"+svw2, "ratePerVehicle",)
                                                SetDataVector(jv1+"|"+svw2,
"RatePerVeh_"+i2s(Pollutants[p]), vr,)
                                            end
                                            CloseView(jv1)
                                            CloseView(tvw)
                                    end
                            end
                            CloseView(avw)
                    end
            end
    CloseView(vw_veh)
            temp_name = path[1]+path[2]+"temp1.bin"
    if GetFileInfo(temp_name) <> null then DeleteFile(temp_name)
            temp_name = path[1]+path[2]+"temp1.dcb"
    if GetFileInfo(temp_name) <> null then DeleteFile(temp_name)


    ///-------------------------------Calculate Emissions--------------------------------
    UpdateProgressBar("Calculate Emissions .......", 70)
    vw_vmt =OpenTable("VMT", "FFB", {out_vmt_summary,})
            daily_vmt = nz(GetDataVector(vw_vmt+"|", "[Daily VMT Proportion]",))
            annual_vmt = nz(GetDataVector(vw_vmt+"|", "[Annual VMT Proportion]",))
            for p = 1 to Pollutants.length do
                    rate = nz(GetDataVector(vw_vmt+"|", "RatePerDist_"+i2s(Pollutants[p]),))
                    daily_em = rate * daily_vmt
                    annual_em = rate * annual_vmt
                    SetDataVector(vw_vmt+"|", "Daily_Emission_RatePerDist_"+i2s(Pollutants[p]), daily_em,)
                    SetDataVector(vw_vmt+"|", "Annual_Emission_RatePerDist_"+i2s(Pollutants[p]), annual_em,)
            end
            CloseView(vw_vmt)

    vw_veh =OpenTable("VEH", "FFB", {out_veh_summary,})
            pop = nz(GetDataVector(vw_veh+"|", "[Population Proportion]",))
            for p = 1 to Pollutants.length do
                    rate = nz(GetDataVector(vw_veh+"|", "RatePerVeh_"+i2s(Pollutants[p]),))
                    daily_em = rate * pop
                    annual_em = rate * pop * 365
                    SetDataVector(vw_veh+"|", "Daily_Emission_RatePerVeh_"+i2s(Pollutants[p]), daily_em,)
                    SetDataVector(vw_veh+"|", "Annual_Emission_RatePerVeh_"+i2s(Pollutants[p]), annual_em,)
            end
    CloseView(vw_veh)
```

```
///-------------------------------Aggregate results to county---------------------------------
UpdateProgressBar("Calculate Emissions .......", 90)
vw_vmt =OpenTable("VMT", "FFB", {out_vmt_summary,})
        field_names = {     {"Year","MIN",}}
        for p = 1 to Pollutants.length do
                field_names = field_names + {{"Daily_Emission_RatePerDist_"+i2s(Pollutants[p]), "SUM"},

        {"Annual_Emission_RatePerDist_"+i2s(Pollutants[p]), "SUM"}}
        end
        vw_vmt_cty = AggregateTable("VMT_CTY", vw_vmt+"|", "FFB", out_em_vmt_summary,
"Aggregation_Key_CTY", field_names,{"Missing as zero", "Yes"})
        CloseView(vw_vmt)
        xls_name = path[1]+path[2]+"Summary_VMT_County.xls"
        ExportView(vw_vmt_cty+"|", "EXCEL", xls_name,,)

vw_veh =OpenTable("VEH", "FFB", {out_veh_summary,})
        field_names = {     {"Year","MIN",}}
        for p = 1 to Pollutants.length do
                field_names = field_names + {{"Daily_Emission_RatePerVeh_"+i2s(Pollutants[p]), "SUM"},

        {"Annual_Emission_RatePerVeh_"+i2s(Pollutants[p]), "SUM"}}
        end
        vw_veh_cty = AggregateTable("VEH_CTY", vw_veh+"|", "FFB", out_em_veh_summary,
"Aggregation_Key_CTY", field_names,{"Missing as zero", "Yes"})
        CloseView(vw_veh)
        xls_name = path[1]+path[2]+"Summary_VEH_County.xls"
        ExportView(vw_veh_cty+"|", "EXCEL", xls_name,,)

        //---------------------add together
bin_fields = {{"Year", "Integer", 12,0,},
                                        {"State", "String", 2,0,},
                                        {"County", "String", 12,0,},
                                        {"Pollutant", "String", 32,0,},
                                {"Daily Emission (grams/day)","Real", 24,4,},
                                {"Annual Emission (grams/year)","Real", 24,4,}
                                }
vw_sum = CreateTable("Emission Summary", out_em_total_summary, "FFB", bin_fields)

        order = {"Sort Order", {{"Aggregation_Key_CTY", "Ascending"}}}
        dim daily[Years.length, Counties.length, Pollutans.length]
        dim annual[Years.length, Counties.length, Pollutans.length]

        key = GetDataVector(vw_vmt_cty+"|", "Aggregation_Key_CTY",{order})
        dim em_daily[Pollutants.length]
        dim em_annual[Pollutants.length]
        for p = 1 to Pollutants.length do
                vd1 = GetDataVector(vw_vmt_cty+"|", "Daily_Emission_RatePerDist_"+i2s(Pollutants[p]),{order})
                vd2 = GetDataVector(vw_veh_cty+"|", "Daily_Emission_RatePerVeh_"+i2s(Pollutants[p]),{order})
                em_daily[p] = vd1 + vd2
                vd1 = GetDataVector(vw_vmt_cty+"|", "Annual_Emission_RatePerDist_"+i2s(Pollutants[p]),{order})
                vd2 = GetDataVector(vw_veh_cty+"|", "Annual_Emission_RatePerVeh_"+i2s(Pollutants[p]),{order})
                em_annual[p] = vd1 + vd2
        end
        for i = 1 to key.length do
                subs = ParseString(key[i], "_")
```

```
                my_year = s2i(subs[1])
                my_state = subs[2]
                my_county = subs[3]
                for p = 1 to Pollutants.length do
                        my_pollutant = Pollutant_Names[p]
                        my_day_em = em_daily[p][i]
                        my_anu_em = em_annual[p][i]

            r= null
            r.Year = my_year
            r.County= my_county
            r.State = my_state
            r.Pollutant = my_pollutant
            r.[Daily Emission (grams/day)]= my_day_em
            r.[Annual Emission (grams/year)] = my_anu_em
                AddRecord(vw_sum, r)
          end
        end

        xls_name = path[1]+path[2]+"Summary_Total_Emissions.xls"
        ExportView(vw_sum+"|", "EXCEL", xls_name,,)

        CloseView(vw_sum)
        CloseView(vw_veh_cty)
        CloseView(vw_vmt_cty)
  DestroyProgressBar()

endMacro
```