Ohio
2002 Base Year SIP Inventory

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2002 Base Year SIP Inventory for Ohio

Introduction

In April 2004, the United States Protection Agency (U.S. EPA) designated over 400 counties nationwide as non-attainment for the new eight-hour ozone ambient air quality standard, including thirty three counties in Ohio. The 1990 Clean Air Act Amendments (CAAA) requires all states to revise and submit state implementation plans (SIPs) for areas which are classified as nonattainment of the National Ambient Air Quality Standards (NAAQS) for ozone. The following site provides a map of Ohio's counties with either a Moderate or basic non-attainment designation: http://www.epa.state.oh.us/dapc/general/Ohio8-Hour_Non-attainmentAreas0415204_1.pdf

As part of the designation of nonattainment areas for the eight-hour ozone standard, a new attainment demonstration SIP will be necessary. A key element in the overall SIP planning process is an updated emission inventory. This document presents the 2002 Base Year Ozone State Implementation Plan (SIP) Emissions Inventory for Ohio as required by the 1990 CAAA. It includes oxides of nitrogen (NO_x) and volatile organic compounds (VOC) emissions for point, area, on-road mobile, non-road mobile and biogenic emissions for Ohio.

This technical report documents the procedures and the methodologies that were used in the development of summer day volatile organic compound and nitrogen oxides emissions for all Ohio counties. This report describes the following:

1. Identification of stationary and mobile sources included in the inventory;
2. Sources of data, and data collection methods used in the development of the inventory;
3. Methods and procedures used to estimate volatile organic and nitrogen oxides; and
4. Assumptions considered in the development of emission inventories.

The intent of this report is to describe how the inventory was prepared, and what information was considered in the inventory development.

This document comprises of five sections; one section for each inventory category. The biogenic inventory is not being discussed in the document. Ohio EPA did not participate in the generation of the biogenic inventory. The Lake Michigan Air Directors Consortium (LADCO) utilized U.S. EPA's Biogenic Emission Inventory System (BEIS) model in the Emission Modeling System (EMS) to generate summer weekday emissions for VOC and NO_x.

SECTION 1

POINT SOURCES

Emissions and source specific data for point sources are collected for the 2002 base year SIP inventory by the Ohio Environmental Protection Agency (Ohio EPA.) The primary source of data for point sources is facility-reported STARShip files. STARShip is a software package developed by Ohio EPA, Division of Air Pollution Control (DAPC), to assist the regulated community in preparing and submitting a variety of electronic permit applications and reports to DAPC. These data are reported by the Title V facilities annually as part of the emissions fee/inventory process conducted by Ohio EPA and include emissions, process rates, operating schedules, emissions control data and other relevant information. The STARShip files are electronically transferred to DAPC and stored into the division's Oracle database, STARS. The files are reviewed by the local air agencies and Ohio EPA district and central office staff. After review, the data are imported into Excel and linked with an Access® database to further process the information into the federally approved National Emission Inventory (NEI) database format in version 3.0. The files are quality assured again using U.S.EPA QA/QC software for format and content. The data are finally submitted to LADCO for emissions processing through the EMS. The State provided inventory for Electric Generating Units (EGU) is replaced with the federal EGU inventory. The EGU inventory is compiled by U.S. EPA's Acid Rain Program. It is based on facility reported emissions as measured by continuous emissions monitors. In conclusion, the final point source inventory is a hybrid of the federal EGU inventory and the state provided non-EGU units.

A major distinction typically made in emissions inventories is that between point and area sources. In this inventory, point sources are sources for which individual records are maintained for that source. Such records are maintained for all Ohio Title V facilities (753 facilities statewide). The area source inventory accounts for facilities from non-Title V facilities and calculates emissions information using surrogate emissions factors based on energy usage, population or other reliable data. A more detailed discussion of the area source inventory is provided in Section 3. The point source inventory described herein is considered to be the most current and accurate source of emissions data available for 2002.

1.1 Point Source Process Emissions

Ohio EPA defines point source process emissions as those which occur at an identifiable Title V stationary stack or vent. Point source emissions not emitted from discrete stacks or vents are termed fugitive emissions and are discussed in Section 1.2.

1.1.1 Source Identification and Data Collection

The sources to be included in the 2002 base year inventory are identified using the Title V STARS database. Facility production and emissions data are included in this database. This information is facility-reported actual 2002 emissions.

1.1.2 Non-reactive VOC Emission Adjustments

Sources are required to identify emissions of photochemically non-reactive VOC. Based upon this information, those emissions have been specifically excluded from the 2002 base line inventory in accordance with U.S. EPA's "Recommended Policy on the Control of Volatile Organic Compounds." A complete list of the compounds that U.S. EPA has identified as being photochemically non-reactive, and therefore not included in the inventory, are listed below:

- Methane
- Ethane
- Methylene chloride
- Methyl chloroform
- Trichlorofluoromethane (CFC-11)
- Dichlorodifluoromethane (CFC-12)
- Chlorodifluoromethane (CFC-22)
- Trifluoromethane (HFC-23)
- Chlorofluoromethance (HCFC-31)
- Difluoromethane (HFC-32)
- Decafluoropentane (HFC-43-10mee)
- Ethylfluoride (HFC-161)
- Trichlorotrifluoroethane (CFC-113)
- Dichlorotetrafluoroethane (CFC-114)
- Chloropentafluoroethane (CFC-115)
- 2,2-Dichloro-1,1,1-trifluoroethane (HCFC-123)
- 1,1,2-Trifluoroethane (HCFC-123a)
- 2-Chloro-1,1,1,2-tetrafluoroethane (HCFC-124)
- Pentafluoroethane (HFC-125)
- 1,1,2,2,-Tetrafluoroethane (HFC-134)
- 1,1,1,2-Tetrafluoroethane (HFC-134a)
- 1,1-Dichloro-1-fluoroethane (HCFC-141b)
- 1-Chloro-1,1,-difluoroethane (HCFC-142b)
- 1,1,1-Trifluoroethane (HFC-143a)
- Fluoroethane (HCFC-151a)
- 1,1-Difluoroethane (HFC-152a)
- Pentafluoropropane (HFC-225ca)
- Pentafluoropropane (HFC-225cb)
- Hexafluoropropane (HFC-236ea)
- Hexafluoropropane (HFC-236fa)
- Pentafluoropropane (HFC-245ca)
- Pentafluoropropane (HFC-245ea)
- Pentafluoropropane (HFC-245eb)

- Pentafluoropropane (HFC-245fa)
- Pentafluorobutane (HFC-365mfc)
- Parachlorobenzotrifluoride (PCBTF)
- Methoxybutane
- Nonaflourobutane
- Heptafluoropropane ($(CF_3)_2CFCF_2OCH_3$)
- Heptafluoropropane ($(CF_3)CFCF_2OC_2H_5$)
- Perchloroethylene
- Cyclic, branched or linear completely methylated siloxanes
- Methyl acetate
- Volatile methyl siloxanes
- Acetone

1.1.3 Emissions Estimation Methodologies

Since source reported actual annual emissions are used in the 2002 base year inventory, no estimation methods are necessary. The reports are provided to LADCO in National Emissions Inventory Input Format (NIF) 3.0 format. LADCO imported and processed the NIF files in EMS and applied temporal and spatial profiles to the annual emissions to calculate the July weekday emissions rates. The final point source inventory is split into two separate reports, the EGU which is the U.S. EPA inventory for electric generating units and the non-EGU which is the state inventory minus the EGU units.

1.2 Point Source Fugitive Emissions

Another type of emissions data which is required to be filed from point sources is fugitive emissions. Before 1990, fugitive emissions were categorized as area sources due to the lack of detailed information available for fugitive sources. However, since these emissions are now electronically reported in the state's ORACLE database, STARS, these emissions can be classified as point sources.

1.3 References

Recommended Policy on the Control of Volatile Organic Compounds. U.S. Environmental Protection Agency, Research Triangle Park, NC, Revised January 18, 1989.

Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I: General Guidance for Stationary Sources. EPA-450/4-91-016, Office of Air Quality Planning & Standards Research, Triangle Park, NC. May 1991.

Compilation of Air Pollution Emission Factors, Fourth Edition and Supplements, AP-42. U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1985.

Guidance for the Preparation of Quality Assurance Plans for O3/CO SIP Emission Inventories. EPA-450/4-88-023, U.S. EPA Office of Air Quality Planning and Standards, Research Triangle Par, NC, December 1988.

Documentation for the 2002 Electric Generating Unit National Emissions Inventory (NEI). Eastern research group, Inc., 1600 Perimeter Park Drive, Morrisville, NC 27560 and E.H. Pechan and Associates, Inc., 5528–B Hempstead Way

SECTION 2

NON-ROAD SOURCES

The non-road inventory is generated regionally by running U.S. EPA's National Mobile Inventory Model (NMIM) model. The Wisconsin Department of Natural Resources undertook the responsibility of customizing the NMIM input files and submit the output file in NIF format to LADCO and U.S. EPA. LADCO processed the NMIM files in their emissions model and generated summer emissions rates. Below are two e-mails from Grant Heatherington from the Wisconsin Department of Natural Resources that were distributed to the LADCO States. The first e-mail provides a summary of activities to revise the NMIM county profile files while the second e-mail provides an overall description of the modifications related to NMIM.

First e-mail from Grant Heateringtion on NMIM Model and Input Descriptions 11/7/05

2.1 Activity Data

LADCO states: The activity data have been revised to include E. H. Pechan & Associates, Inc. (Pechan), an air quality consulting firm www.pechan.com, construction data. There are 130 source classification codes (SCC) impacted. The revised NMIM files are saved as five separate files: 1700002.act, 1800002.act, 2600002.act, 3900002.act and 5500002.act even though each file is identical. These duplicates simplify the external file structures in NMIM. Non-LADCO states: Minnesota provided revised activity data. The revised activity data are saved as 2700002.act.

2.2 Allocation Data

LADCO states: The allocation data have been revised to include Environ's recreational marine data. The revised NMIM files are saved as 17000wib_rev.alo, 17000wob_rev.alo, 18000wib_rev.alo, 18000wob_rev.alo, 26000wib_rev.alo, 26000wob_rev.alo, 39000wib_rev.alo, 39000wob_rev.alo, 55000wib_rev.alo and 55000wob_rev.alo. ["wib" stands for watercraft inboard and "wob" stands for watercraft outboard.]

Non-LADCO states: Minnesota provided revised watercraft inboard, watercraft outboard and snowmobile allocation data. The revised NMIM files are saved as 27000wib_rev.alo, 27000wob_rev.alo and 27000snm_rev.alo. ["snm" stands for snowmobile.]

2.3 Emission Factor Data

All states: The brake specific fuel consumption (BSFC) emission factor data have been revised to include Pechan's data for diesel tampers/rammers (2270002006). The revised NMIM file is saved as revBSFC.EMF.

2.4 Population Data

LADCO states: The recreational marine and construction population data have been modified by Environ and Pechan respectively. The revised NMIM files are saved as 17000_rev.pop, 18000_rev.pop, 26000_rev.pop, 39000_rev.pop and 55000_rev.pop files.

2.5 Seasonality Data

LADCO states: The recreational marine and agricultural seasonality data have been modified by Environ and Pechan respectively. The revised NMIM files are saved as 17000_rev.sea, 18000_rev.sea, 26000_rev.sea, 39000_rev.sea and 55000_rev.sea.

Non-LADCO states: For Iowa, Minnesota and Missouri, the agricultural seasonality data have been modified by Pechan. The revised NMIM files are saved as 19000_rev.sea, 27000_rev.sea and 29000_rev.sea.

2.6 Growth Data

LADCO states: Pechan revised the growth file. The revised NMIM files are saved as five separate files: 17000_rev.grw, 18000_rev.grw, 26000_rev.grw, 39000_rev.grw and 55000_rev.grw even though each file is identical. These duplicates are needed for the external file structures in NMIM.

2.7 Fuel Data

LADCO states: Pechan revised four tables (countyyear, countyyearmonth, datasource and gasoline) in the National County Database (NCD) used by NMIM to incorporate new fuel data. Additional revisions are incorporated into 2002 data for non-road Stage 2 controls. Depending on the year being modeled, different versions of the revised tables are used. Also, the countynrfile, countyyear and datasource tables are revised to reference the new activity, allocation, growth, population, and seasonality files described above. NCD tables with names ending in “def” are default versions of the table. See Table 2-1 for the appropriate versions of the tables for the selected years.

Non-LADCO states: The countynrfile, countyyear and datasource tables are revised to reference the new activity, allocation and seasonality files described above. See Table 2-1 below for the appropriate versions of the tables for the selected years.

Table 2-1 NMIM NCD Tables for Specific Years and States

States	Year	
	2002	**2007 – 2009, 2012 & 2018**
LADCO states	countynrfile_rev_all, countyyear_rev_2002, countyyearmonth_rev_all, datasource_rev_all, gasoline_rev_all	countynrfile_rev_all, countyyear_rev_post_2002, countyyearmonth_rev_all, datasource_rev_all, gasoline_rev_all
MN	countynrfile_rev_all, countyyear_rev_2002, countyyearmonth_def, datasource_rev_all, gasoline_def	countynrfile_rev_all, countyyear_rev_post_2002, countyyearmonth_def, datasource_rev_all, gasoline_def
IA and MO	countynrfile_rev_all, countyyear_def, countyyearmonth_def, datasource_rev_all, gasoline_def	countynrfile_rev_all, countyyear_def, countyyearmonth_def, datasource_rev_all, gasoline_def

A more recent e-mail by Grant Heatherington on 5/26/2006, provides a synopsis of changes with no references to the file names

Second e-mail mail from Grant Heatherington on NMIM Model and Input Descriptions 5/26/06

The NMIM model developed by U.S. EPA, was used to estimate emissions for all other non-road mobile categories. NMIM consolidates non-road mobile emissions and on-road emissions modeling into a single modeling system. Only the non-road emissions modeling portion of NMIM was used in the development of this emission inventory. NMIM uses the U.S. EPA's non-road model to calculate non-road mobile emissions. The basic non-road algorithm for calculating emissions uses base year equipment populations, average load factors, available engine powers, activity hours and emission factors. Before NMIM was run, modifications and additions were made to the NMIM input data and the non-road model.

a. Revised activity data for construction equipment using updates provided by E.H. Pechan & Associates, Inc. Activity data describes typical usage for different types of non-road mobile equipment.

b. Revised allocation data for recreational marine equipment using updates provided by ENVIRON International Corporation. Allocation data is used to spatially allocate emissions.

c. Added emission factors for diesel tampers/rammers provided by E.H. Pechan & Associates, Inc. Diesel tampers/rammers are a type of construction equipment.

d. Revised seasonality data for construction and recreational marine equipment using updates provided by E.H. Pechan & Associates, Inc. and ENVIRON International Corporation respectively. Seasonality data is used to temporally allocate emissions across the months of the year.

e. Revised population data for construction and recreational marine equipment using updates provided by E.H. Pechan & Associates, Inc. and ENVIRON International Corporation respectively.

f. Revised growth rates using updates provided by E.H. Pechan & Associates, Inc. If equipment populations aren't provided for the modeled year (e.g. 2002), growth rates and scrappage rates are used to adjust the available equipment populations to the modeled year.

g. Revised gasoline parameters using updates provided by the state and E.H. Pechan & Associates, Inc. Gasoline parameters include Reid vapor pressure (RVP), oxygenate content and sulfur content.

h. Replaced the default version of the non-road model included with NMIM with an improved version that generates a more complete estimate of permeation emissions. The new version of the non-road model was provided by Air Improvement Resources, Inc. Permeation emissions are due to the permeation of hydrocarbon molecules through plastic and rubber equipment components.

SECTION 3

AREA SOURCES

Area sources are those sources which are typically small, individual and numerous, and have not been inventoried as specific point, mobile, or biogenic sources. For inventory purposes, these sources are grouped with other like sources into area source categories to allow emissions to be calculated collectively using one methodology. Area sources have been traditionally defined at the county level and therefore, most area source methods are designed to estimate area source emissions at the county level.

Ohio EPA has either used published Emission Inventory Improvement Program (EIIP) methodologies or selected other methodologies which are shared by other states. The decision of which methodology to use was largely based on Ohio's data availability. Data which was not available on a county-level is estimated by assigning a percentage of the state's total activity to each county based on the state's population or employment information.

The area sources discussed in this document are those that emit NO_X and/or VOC into Ohio's atmosphere. Table 3-1 lists the categories included in the 2002 area source inventory:

Table 3-1 Categories included in the 2002 area source inventory

VOC Emissions	NO_X & VOC Emissions	NO_X Emissions
Agricultural Pesticides	Residential Coal Combustion	Human Cremation
Architectural Surface Coatings	Residential Distillate Oil Combustion	
Auto Body Refinishing	Residential LPG Combustion	
Consumer & Commercial Solvents	Residential Natural Gas Combustion	
Degreasing (Solvent Cleaning)	Residential Wood Combustion	
Fuel Marketing	Industrial Distillate Oil Combustion	
Graphic Arts	Industrial Natural Gas Combustion	
Hospital Sterilizers	Industrial Residual Oil Combustion	
Industrial Surface Coating	Structure Fires	
Industrial Rubber & Plastics		
Landfills		
Portable Fuel Containers		
POTW		
Traffic Markings		

3.1 Agricultural Pesticides (SCC 246850000) VOC

Ohio farmers use mostly Atrizine and 2, 4-D chemicals in pesticide formulations for the three main crops: corn, soybean and wheat. According to Ohio's Department of Agriculture, Ohio farmers use Atrizine pesticide with 42.6 percent active ingredient and 56.5 percent inert ingredient. The 2, 4-D pesticide contains 46.8 percent active ingredient and 53.2 percent inert ingredient. While these percentages are not across the board, they represent the majority of what is being used. Ohio farmers use Atrizine and 2, 4-D in a liquid solution formulation type which is mixed with water when ready to use, and spray applied 90 percent of the time.

The emission factor of 700 lb/ton for surface application for Atrizine and 2, 4-D is applied. To estimate the VOC emissions for all pesticides for each crop, an alternative method from the EIIP document is used because Ohio lacked the level of detail needed to calculate emissions for each pesticide formulation.

$$E(VOC) = A \times R \times I \times ER \times 2.45$$

E = VOC emissions

A= Harvested acres

R = Pounds of pesticide applied per year per harvested acre (see above).

I = Pounds of active ingredient per pound of pesticide (assume a factor of one)

ER = Evaporation rate (typically 0.9) (Wiens, 1977)

3.2 Architectural Surface Coatings (SCC 2401001000) VOC

Architectural surface coatings is typically considered to be a non-industrial category which homeowners and painting contractors use for coating the interior and exterior of houses, buildings, and other surfaces. Two types of paint are used to categorize this area source: water-based and solvent-based paint. Solvent-based paint typically contains substantially higher volatile solvent contents than water-based paint.

Table 3-2 lists the emission factors in calculating the VOC emissions which are acquired from the "Documentation for the 2002 Non-point Source NEI for Criteria Air Pollutants (CAPS) and Hazardous Air Pollutants (HAPS)", January 2004, by Pechan[1] and prepared for Emission Factor and Inventory Group (EFIG).

Table 3-2 VOC Emission Factors and Paint Usage Factors:

Paint Type	VOC Emission Factor (lb/gal)	Usage Factors (gal/person)
Solvent-Based Paint	3.87	0.4158
Water-Based Paint	0.74	2.0444

The per capita usage factors are estimated by dividing the total volume of each type of coating shipped by the 2002 U.S. population[2] 288,368,698.

3.3 Auto Body Refinishing (SCC 2401005000)
VOC

The repairing of damaged vehicles to any coating applications which occur after those applied at the original manufacturers' assembly plant are included in this category (only auto repair shops not coating of new cars). This area source includes paint and thinning solvents used as well as for surface preparation and clean-up. Since auto body repair shops may also be point sources, the area source emissions estimate will have to be adjusted by removing the total point source emissions. However, in Ohio, there are no point sources identified for this category so no such adjustment is made.

The methodology is based on the per capita emissions factor because it is considered a more reliable factor that the employment factor. The VOC emissions factor (EF) of 1.3 lb/person is applied to each county's population. This EF includes a thirty-three (33) percent promulgated rule reduction.

3.4 Consumer & Commercial Solvents (SCC 2465000000)

VOC

This area source includes a wide array of products including personal care products, household cleaning products and household pesticides. The majority of VOC emitted into the air from this category is a result of evaporation of the solvent contained in the product or from the propellant released during use. This category includes household use as well as businesses, institutions, and industrial manufacturing operations.

Industrial solvent applications may also be point sources so adjustment must be made to the area source emissions by removing emissions due to point sources. However, in Ohio there are no point sources which contributed VOC emissions from this category.

Ohio used the population[2] based methodology. A 7.3 lb/person EF is used to calculate VOC emissions.

3.5 Solvent Cleaning (SCC 2415000000) VOC

This area source (also known as “degreasing”) includes two classifications:

- **Solvent Cleaning**
  - Cold Cleaning for Automobile Repair (2415360000)
  - Cold Cleaning for Manufacturing (2415345000)
  - Vapor/in-line Cleaning for Electronics & Electrical (2415230000)
  - Vapor/in-line Cleaning for Other (2415245000)

- **Solvent Cleanup**
  - Wipe Cleaning of External Surfaces

Ohio utilizes the methodology requiring employment[3] data. Each solvent-cleaning SCC identified above has an EF as indicated below in Table 3-4 which is used to calculate the VOC emissions by county. The resultant emissions are reduced by thirty (30) percent to account for the Maximum Achievable Control Technology (MACT) rules and are also reduced to account for point source emissions.

Table 3-4 Solvent Cleaning SCC Emission Factors

2415360000	270	lb/employee
2415345000	24	lb/employee
2415230000	29	lb/employee
2415245000	9.8	lb/employee

3.6 Fuel Marketing VOC

Truck Transit (SCC 2505030120)

Gasoline tank trucks in transit are considered an evaporative loss of VOC emissions. This category consists of the VOC losses during the transit of gasoline in the trucks. The VOC calculation formula came from EIIP. Because gasoline may go through bulk gasoline plants before distribution to service stations, gasoline throughput figures are multiplied by 1.25 to estimate total gasoline transported. The total gasoline transported is multiplied with an EF of 5.5 E-03 lb/1000 gallon transported for tank transit under loaded conditions and 5.5 E-02 lb/1000 gallon transported for tank transit under unloaded conditions.

Filling Losses (SCC 2501060050)

This category consists of the VOC loading losses from underground storage tanks during the transfer of fuel from the trucks. VOC calculations are based on ninety-five (95) percent submerged fill and five (5) percent splash for all counties. The VOC emissions calculation is also based on a ninety (90) percent rule effectiveness and a hundred (100) percent rule penetration.

Standing Losses (SCC 2501060201)

Breathing emissions losses from storage tanks occur during diurnal changes in barometric pressure, temperature and from gasoline evaporation. To calculate VOC emissions from the storage or breathing losses an EF of 1.000E+00 lb per 1000 gallon gas throughput is used for all counties except of the 16 original non-attainment counties for ozone which employ a 1.000E-01 lb/1000 gallon of gas throughput. The value for the non-attainment counties was discussed with Bill Juris, Ohio EPA-DAPC and familiar with Ohio's gasoline dispensing facilities (GDF) VOC regulations and practices.

Gasoline Distribution Stage 2 (SCC 2501060100 & 250106103)

Vehicles refueling at service stations are the source of VOC emissions as vapors are displaced from automobile tanks during filling (2501060100) and from spillage (2501060103) of gasoline. The quantity of displaced vapors is based on gasoline throughput and is affected by gasoline temperature, gasoline volatility and, most importantly, by the presence of vapor recovery equipment. Stage II vapor recovery equipment is required at all service stations in the 16 original non-attainment counties for ozone that market in excess of 10,000 gallons per month. The VOC emissions factor for filling operations is 1.0E+01 lbs/1000 gallons. For the 16 counties that are subject to controls, a control efficiency of ninety-five (95) percent with ninety (90) percent rule effectiveness and a ninety (90) percent rule penetration is used in the calculation of emissions. The VOC emissions factor for spillage is 0.7 lbs/1000 gallons of gasoline for the 72 unregulated counties and 0.4 lbs/1000 gallons of gasoline for the controlled counties.

Since the actual gallons of gasoline sold in each county could not be obtained, the methodology uses the vehicle miles traveled (VMT) data and the State's consumption of gasoline to apportion the gasoline consumption within a county.

3.7 Graphic Arts (SCC 2425000000) VOC

This area source includes printing of newspaper, books, magazines, fabrics and other materials. VOC emissions from this category are calculated using Ohio's population[5] rather and the per capita emissions factor for VOC of 1.3 lb/year.

3.8 Hospital Sterilizers (SCC 2850000010) VOC

Small amounts of ethylene oxide (EO) are used in sterilization of hospital surgical equipment and plastic devices that cannot be sterilized by steam. EO is used as a sterilizer because of its potency and effectiveness in destroying pathogens without damaging the integrity of the device. The methodology used to calculate EO emissions in Ohio called for the number of beds in each hospital size to use the appropriate EF. Based on national sales of EO in 2002, Ohio's EO emissions are calculated to be 7.3 tons (based on Ohio's share of hospital beds of 3.5 percent).

3.9 Industrial Rubber/Plastics (SCC 2430000000) VOC

This category is calculated using employment[3] data for each county for the following North American Industry Classification System (NAICS):

31332	32613	32614	32615	32616	32621
32622	316211	325991	326113	326121	326122
326191	326199	326291	326299	335121	339991

A VOC EF of 203 lbs/employee is recommended to estimate the area source VOC estimate. Even after subtracting the point source VOC contribution (1116 annual tons of VOC), this category would have been the highest category of emissions. After raising this issue with other states in the LADCO region, it is decided that the emissions factor has a high degree of uncertainty and it will significantly skew the overall VOC estimate from the area source categories. This category is left out from the emissions table but it is kept here for documentation.

3.9 Industrial Surface Coating VOC

This area source contains several categories as listed below in Table 3-5. The appropriate NAICS codes are used for each category, shown in Table 3-6, to obtain employment data[3] from Bureau of Labor Statistics for each county. Net VOC emissions are calculated by subtracting the portion of VOC contributed from point sources.

Table 3-5 Categories included in Area Sources

CATEGORY	SCC	NAICS	VOC EF
Factory Finished Wood	2401015000	321	131 Lb/employee/year
Furniture and Fixtures	2401020000	337	944 Lb/employee/year
Metal Containers	2401040000	332431	6029 Lb/employee/year
Sheet, Strip and Coil	2401045000	332812	2877 Lb/employee/year
Machinery & Equipment	2401055000	333	77 Lb/employee/year
Large Appliances	2401060000	3352	463 Lb/employee/year
Electrical Insulation	2401065000	334	290 Lb/employee/year
Automobiles (new)	2401070000	3361	794 Lb/employee/year
Other Transportation Equipment	2401075000	336	35 Lb/employee/year
Marine Coatings	2401080000	3366	308 Lb/employee/year
Other Product Coatings	2401090000	339	0.6 Lb/person/year
High Performance Coatings	2401100000	811	0.8 Lb/person/year
Other Special Purpose	2401200000	NOT DONE	0.8 Lb/person/year

Table 3-6 NAICS Codes Used for Area Sources

Automobile Repair	488490, 441110, 441120, 4471, 441222, 441210, 81111
Manufacturing	337, 331, 332, 333, 335, 336, 334, 339
Electronics and Electrical	335
Other	337, 337, 331, 332, 333, 335, 336, 334, 339, 488490, 441110, 441120, 4471, 441222, 441210, 8111

3.10 Municipal Solid Waste (SCC 2620030000) VOC

The methodology for methane gas emissions from landfills requires the tonnage deposited in the landfills for the last 25 years. However, Ohio EPA's Division of Solid and Infectious Waste's input data only spanned 20 years. Therefore, any landfill which did not record or report its waste intake for that period was not included in the database. Landfills with controls are identified as having flares. The preferred method is used which is based on landfill capacity and tonnage input of waste and the number of years the landfill operated and the number of years it has been closed. A seventy five (75) percent collection efficiency and a ninety-five (95) percent control efficiency are used per AP-42 Compilation of Air Pollutant Emission Factors.

The toxic pollutants are calculated using the methane production rate and the EIIP calculation formula that involves the compound molecular weight and the co-disposal factor. The VOC emissions are equal to the emissions from all toxics minus methylene chloride, mercury, and perchloroethylene (PERC.)

3.11 Portable Fuel Containers VOC

RESIDENTIAL 2501011010 / COMMERCIAL 2501012010

This area source's VOC is the sum of emissions obtained from both commercial and residential containers. The residential and commercial container total emissions for the year are based on 250 days per year and include losses from refueling vapor displacement, permeation, diurnal, equipment refueling spillage, and transport-spillage. Emissions estimates are based on population[2] and consistent with California's approach. Although the California methodology generates rather high emissions estimates, it is the only available estimate at the time of generating the 2002 inventory.

3.12 POTW (SCC 2630020000) VOC

Ohio EPA's Division of Surface Water does not review minor flows because they are not mandated by U.S. EPA. Therefore, Ohio's wastewater flow data only represents eighty (80) percent of the total flow for this area source category. A twenty (20) percent increased flow is added to compensate for Publicly Owned Treatment Works (POTW) facilities which are not part of Ohio's database. The VOC emissions factor is based on the Pennsylvania (PA) factor of the 1996 Protocol.

The 1996 EIIP methodology only offered EF for HAPs. Ohio's VOC emissions for this category are calculated based on an EF obtained from the PA 1996 Protocol which was the factor being used at the time of this inventory.

3.13 Traffic Markings (SCC 2401008000) VOC

The number of lane miles per county is obtained from Ohio's Department of transportation. The national gallon of traffic markings are apportioned to the state using the ratio of state dollar disbursements in relation to the national disbursement. The county level apportionment of paint[2] is made using the number of lane miles. The VOC factor (3.36 lb/gal) is calculated based on Ohio's assumption of ninety (90) percent water based and ten (10) percent oil based paint.

3.14 Human Cremation (SCC 2810060100)
NO_X

Not all Ohio counties possess a crematory so only those counties with crematories are used to calculate the number of cremations. These numbers are adjusted to account for the cremation of bodies which are brought in from out of county since the calculations are based on number of deaths per county[2]. Ohio has an eighteen (18) percent cremation rate. Particular matter (PM) emissions are calculated for this category but the methodology did not call for the calculation of NO_X emissions so they are not calculated. Furthermore, since current NOX EF in Ohio's crematory permits vary significantly, the EIS program will develop a less variable one for future use in inventory NO_X calculations.

3.15 Industrial Fuel Combustion
VOC & NO_X

Industrial Distillate Oil Combustion (SCC 2102004000)

Ohio's fuel consumption is apportioned per county based on the county's population[5]. The area source VOC and NO_X emissions are calculated and adjusted to subtract the emissions due to point sources. A heating value of 140 mmbtu/1000 gallon is used and 4,795,000 barrels are consumed in 2002. [MMBTU stand for Million British Thermal Units].

Industrial Residual Oil Combustion (SCC 2102005000)

Ohio's fuel consumption is apportioned per county based on the county's population[5]. The area source VOC and NO_X emissions are calculated and adjusted to subtract the emissions due to point sources. There are 1,806,000 barrels consumed and a heating value of 140 mmbtu/1000 gallon is used.

Industrial Natural Gas Combustion (SCC 2102006000)

Ohio's fuel consumption is apportioned per county based on the county's population[5]. The area source VOC and NO_X emissions are calculated and adjusted to subtract the emissions due to point sources.

3.16 Residential Fuel Combustion
VOC & NO_X

Residential Coal Combustion (SCC 2104001000)

Ohio's household consumption of coal is apportioned per county based on county population[5]. NO_X and VOC emissions are calculated using EF of 9.1 and 10 lb/ton of coal respectively.

Residential Distillate Oil Combustion (SCC 2104004000)

Ohio's household consumption of distillate oil is apportioned per county based on county population[5]. NO_X and VOC emissions are calculated using EF of 18 and

0.71 lb/1000 gallons distillate fuel respectively. A heating value of 140 mmbtu/1000 gallon is used.

Residential Liquid Petroleum Gas Combustion (LPG)
(SCC 2104007000)

Ohio's household consumption of LPG is apportioned per county based on county population[5]. NO_X and VOC emissions are calculated using EF of 13 and 0.49 lb/1000 gallons LPG respectively. There are 11,432 barrels estimated to be used in 2002.

Residential Natural Gas Combustion (SCC 2104006010)

Ohio's household consumption of LPG is apportioned per county based on county population[5]. NO_X and VOC emissions are calculated using EF of 94 and 5.5 lb/MMSCF respectively. [MMSCF stands for Million Standard Cubic Feet].

Residential Wood Combustion

VOC and NO_X emissions from this area source are estimated for seven types of equipment that may be used for residential heating involving wood. They are listed below with the appropriate SCC:

Fireplaces without inserts	2104008001
Fireplaces with inserts catalytic (non-U.S. EPA cert)	2104008002
Fireplaces with inserts non -catalytic	2104008003
Fireplaces with inserts catalytic (U.S. EPA cert)	2104008004
Wood stoves – Conventional	2104008010
Woodstoves – Catalytic	2104008030
Wood stoves – Non catalytic	2104008050

The number of Ohio homes with fireplaces are adjusted for those that burn wood. The following assumptions are applied to those adjusted homes:

92 percent of wood combusted in non-certified units
5.7 percent of wood combusted in non-catalytic units
2.3 percent of wood combusted in catalytic units

A state consumption value is applied which is apportioned to each county based on a county's population. Table 3-7 shows the EF used for each of the seven types of wood burners which make-up this category:

Table 3-7 Emission Factors Used for Wood Burners included in Area Sources

SCC	2104008002	2104008003	2104008004	
SCC	2104008010	2104008050	2104008030	
SCC	2104008001			
RAPIDS Code	Non-Certified	Non-Catalytic	Catalytic	Units
VOC	53	12	15	Lb/ton
NOX	2.80E+00	2.80E+00	2.00E+00	Lb/ton

3.17 Structure Fires (SCC 2810030000) VOC & NO_X

This area source is considered a combustion source for VOC and NO_X emissions which is calculated using EF of 11 and 1.4 lb/ton burned respectively. The residential and commercial structures fires for each county are tabulated and a fuel loading per fire EF of 1.15 ton/fire is applied.

3.18 Miscellaneous Categories

Although the area sources described above are the categories which contribute VOC & NO_X emissions into Ohio's ambient air, other area sources are calculated as well. These additional sources are listed below and contribute the associated pollutants into Ohio's air.

Dry Cleaning	Perchloroethylene
Lamp breakage	Mercury

The following area sources are attempted to be calculated but due to insufficient Ohio data available or unreliable emissions factors, they remain incomplete.

Asphalt Paving	VOC
Forest Fires	VOC & NO_X
Gas & Oil Production	VOC
Open Burn	VOC

3.19 References

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SECTION 4

MARINE, AIRCRAFT and RAIL (MAR) SOURCES

MAR sources are those non-road sources which are significant enough in terms of emissions to be considered separately from the rest of the non-road sources. The MAR inventory consists of commercial marines, aircraft and locomotive sources. The marine and locomotive inventory is generated by Environ[1] under contract with LADCO and the aircraft inventory is generated by U.S. EPA.

4.1 Marine Vessel Sources

Commercial marines consist of several different categories of vessel types and for each category there are unique activity data sources, engine types and emissions rates. A summary of commercial marine activity categories and data sources is shown at Table 4-1.

Table 4-1 Summary of Commercial Marine Activity Categories and Data Sources

Commercial Marine Activity	Spatial Range	Activity Estimation Data Source
Large Deep Draft	Near Port	Ports and Army Corps of Engineers
Large Deep Draft	Mid Lake	Army Corps of Engineers
Barge Traffic	Inland Rivers	Tennessee Valley Authority Fuel Consumption Estimation
Barge Traffic	Lake Traffic	Army Corps of Engineers Freight Carried
Tug	Near Port	Coast Guard Vessel List and Selected Surveys
Ferries	Regular Route	Coast Guard Vessel List and Selected Surveys
Excursion	Near Home Port	Coast Guard Vessel list
Dredging	Area by Contract	Army Corps of Engineers Contracts
Commercial Fishing	Dock	State Registration
Military	Near shore and Mid-Lake	Coast Guard Fuel Purchases

The procedure that is followed in estimating emissions for each commercial marine category or boat type is documented by Environ[1]. The summary of commercial marine emissions estimate for Ohio is 248 tons of VOC and 10,307 tons of NO_X. This is significantly lower than what is estimated by NEI for 1999 which was 1376 tons of VOC and 44,020 tons of NO_X.

4.2 Locomotive Sources

Locomotives are usually the most important source of NO_X from non-road engines. This category is especially important for Ohio because the State is an important rail center. Rail activity is typically broken into five subcategories. These subcategories are listed in Table 4.2.

Table 4.2 Rail Categories

SCC	Description	Comment
2285002006	Class I operations	Norfolk Southern (NS), CSX
2285002007	Class II/III operations	Regional and local railroads
2285002008	Passenger Trains	AMTRAK
2285002009	Commuter Lines	METRA
2285002010	Yard Operations	Class I yard rail and small switching railroads

Because the Class I railroads are expected to be the most significant rail operations in most areas, every Class I railroad is asked for information about its rail operation. Norfolk Southern (NS) and CSX provided estimates for their fuel consumption by rail line for line-haul estimates but are unable to detail their switching rail activity. They provided activity by county in terms of ton-mile of freight movement and estimated fuel consumption using typical system-wide fuel consumption per ton-mile. The Class II rail estimate which is of lesser importance than the Class I rail is based on national consumption and an employee emissions factor of 10,000 gallons per employee. The passenger rail estimate is based on information provided by AMTRAK on the weekly schedule of trains and emissions are based on 2.35 gallons per train-mile fuel consumption. Emissions factors and detailed calculation procedures are documented on the Environ[1] study and it is referenced at the end of this section.

4.3 Aircraft Vessel Sources

U.S. EPA contracted with ERG Consulting Firm http://www.erg.com/ to generate this inventory. The estimate is based on information collected by the Federal Aviation Administration (FAA) on published (landing and take-off) LTO cycle by engine type for each airline and major airport in the state. The LTO is multiplied by emissions factors developed by the International Civil Aviation Organization (ICAO). Finally, the LTO data are combined and entered into the FAA Emissions and Dispersion Modeling System (EDMS), which is designed to calculate aircraft-specific emissions.

For all of the above three categories, LADCO processed the data in EMS 2003 to calculate summer day emissions for VOC and NO_X. The tables are provided as an attachment.

4.4 References

LADCO Non-road Emissions Inventory Project for Locomotive, Commercial Marine and Recreational Marine Emission Sources, prepared by Christian E. Lindhjem, ENVIRON International Corporation, September 8. 2004.

SECTION 5

ON-ROAD SOURCES

A mobile source of air pollution is a self-propelled or portable emitter of air pollutants, and mobile source emissions are those generated by the engines or motors that power such sources. Most mobile sources, except jet or turboprop aircraft, are powered by internal combustion (IC) piston engines, and nearly all use liquid fuels.

Gaseous fuels, such as compressed natural gas (CNG) or liquefied petroleum gas (LPG), had only a very small fraction of the motor fuel market in Ohio in 2002. Solid fuels have not been used by mobile sources in significant amounts since railroads retired their coal-powered steam locomotives in the 1950s.

5.1 Categories of Mobile Sources

For inventory and planning purposes, mobile sources are divided into two major categories.

1. On-highway mobile sources, i.e., motor vehicles such as cars, vans, trucks, buses and motorcycles used for transportation of goods and passengers on roads and streets.

2. Off-highway (usually referred to as non-road) mobile sources including:

   - Modes of powered transportation that do not use roads, such as aircraft, trains, ships and boats, and motor vehicles used off-road.

   - Self-propelled or portable motorized machines or equipment not used for transportation, ranging from construction equipment and farm tractors to lawnmowers and hand-held power weed choppers.

Mobile Sources: All on-highway mobile sources are self-propelled.

Non-road Mobile Sources: Some non-road mobile sources (e.g., farm tractors), are self-propelled, but many non-road sources are not. A gasoline-powered chain saw is a familiar example of a non-self-propelled non-road mobile source.

Stationary Sources: Not all movable or portable emission sources are mobile sources, however. A small truck-portable cement or hot-mix asphalt plant, for example, may be set up near a construction or road-building site. Such plants are classified as stationary sources, not mobile sources for two reasons: (1) they may operate for weeks or months at a single location, and (2) the trucks that move the plants do not supply power for them.

NOTE: Not all IC or turbine engines are mobile sources. Fixed IC engines, such as those that power pipeline compressors or standby generators in electricity plants and elsewhere, are also classified as stationary sources.

5.1.1 Categories and Components of Mobile Source Emissions

There are three categories of mobile source emissions:

- *Exhaust or tailpipe emissions*, which result from the combustion of fuel in the source's engine

- *Evaporative emissions*, which result from evaporation of fuel from the engine or it's fuel system

- *Refueling emissions*

Exhaust Emissions: Are the result of fuel combustion and occur only when the engine is running.

Evaporative emissions: Are VOC based only and are continuously emitted from an engine's fuel system, whether the engine is running or not. Gasoline is a very volatile fuel, so total VOC emissions from gasoline powered vehicles have a large evaporative component. Diesel and jet fuels are of very low volatility, so evaporative emissions from diesel and turbine engines are a much smaller part of their total VOC emissions. Evaporative emissions for CNG or LPG powered vehicles are negligible because their fuel tanks and systems are of necessity, sealed.

Evaporative and exhaust VOC emissions can be calculated separately for most mobile source categories, but in this inventory these two components are combined into total VOC. Evaporative emissions do not include VOC emissions that occur during refueling.

Refueling Emissions: Are the third category of mobile source emissions. Refueling emissions are entirely VOC. Although they result from the evaporation of fuel, they are distinct from, and not directly related to, evaporative emissions as defined above.

Refueling emissions have two subcomponents:

- Displacement emissions. These occur when new fuel is transferred into a partly filled tank--be it a service station storage tank, a portable fuel container (gas can), or a vehicle or engine's fuel tank; displacing the air in the tank and forcing that vapor-rich air out the inlet pipe or other vent. There are two stages of displacement emissions:

- “Stage I” emissions occur when the underground storage tanks at a service station are being refilled;

- “Stage II” emissions occur when a motor vehicle (or gas can) is being refueled.

NOTE: These emissions are covered in, “Area Sources,” section 3.6.

- Spill emissions. These occur when drops of fuel drip or splash on the ground during or after refueling and evaporate away.

5.2 Ohio On-Highway Mobile Source Inventory

The inventory of on-highway mobile source emissions was developed in conjunction with the Ohio Department of Transportation (Ohio DOT), LADCO, U.S. EPA, and the Ohio EPA. Estimates of the amounts of NO_x and VOC are reported by county in tons per day. Emissions are reported for a typical ozone season weekday in the summer of 2002.

5.2.1 Emission Inventories Developed with MOBILE6.2 Model

MOBILE6.2 Overview:

MOBILE6.2 is a computer program that estimates hydrocarbon (HC), carbon monoxide (CO), NO_x, exhaust particulate matter (which consists of several components), tire wear particulate matter, brake wear particulate matter, sulfur dioxide (SO_2), ammonia (NH_3), six hazardous air pollutant (HAP), and carbon dioxide (CO_2) emission factors for gasoline-fueled and diesel highway motor vehicles, and for certain specialized vehicles such as natural-gas-fueled or electric vehicles that may replace them. The program uses the calculation procedures presented in technical reports posted on U.S. EPA's MOBILE6.2 Web page http://www.epa.gov/otaq/models.htm.

MOBILE6.2 emission factor estimates depend on various conditions, such as ambient temperatures, travel speeds, operating modes, fuel volatility, and mileage accrual rates. Many of the variables affecting vehicle emissions can be specified by the user. MOBILE6.2 will estimate emission factors for any calendar year between 1952 and 2050, inclusive. Vehicles from the 25 most recent model years are considered to be in operation in each calendar year.

5.2.2 MOBILE6 Defaults:

MOBILE6.2 includes default values for a wide range of conditions that affect emissions. These defaults are designed to represent “national average” input data values. Users who desire a more precise estimate of local emissions can substitute information that more specifically reflects local conditions. Use of local input data will be particularly common when the local emission inventory is to be constructed from separate estimates of roadways, geographic areas, or times of day, in which fleet or traffic conditions vary considerably.

A list of MOBILE6.2 input parameters is provided below. Most of these inputs are optional because the model will supply default values unless **alternate data** are provided.

5.2.3 MOBILE6 Input Parameters

- Calendar year
- Month (January, July)
- Hourly Temperature
- Altitude (high, low)
- Weekend/weekday
- Fuel characteristics (Reid vapor pressure, sulfur content, oxygenate content, etc.)
- Humidity and solar load
- Registration (age) distribution by vehicle class
- Annual mileage accumulation by vehicle class
- Diesel sales fractions by vehicle class and model year
- Average speed distribution by hour and roadway
- Distribution of vehicle miles traveled by roadway type
- Engine starts per day by vehicle class and distribution by hour
- Engine start soak time distribution by hour
- Trip end distribution by hour
- Average trip length distribution
- Hot soak duration
- Distribution of vehicle miles traveled by vehicle class
- Full, partial, and multiple diurnal distribution by hour
- Inspection and maintenance (I/M) program description
- Anti-tampering inspection program description
- Stage II refueling emissions inspection program description
- Natural gas vehicle fractions
- HC species output
- Particle size cutoff
- Emission factors for PM and HAPs
- Output format specifications and selections

5.2.4 MOBILE6 References

The following publications provide much of the guidance for the preparation of the on-highway inventory.

EPA-450/4-81-026d (Revised), now EPA/450-R-92-009, *Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources*, December 1992. Hereafter "Procedures Vol. IV". The 1992 version is still the definitive document on inventories. If a previous edition is referred to, the fact will be noted as, for example, "the 1989 Procedures Vol. IV" or "Volume IV, 1989 edition".

EPA420-R-03-010, *User's Guide to MOBILE6.1 and MOBILE6.2: Mobile Source Emission Factor Model*, August 2003. This is the User's Guide for the official MOBILE6.2.03 on-highway mobile source emission factor model and will usually be referred to as the M6.2 (or simply M6) User's Guide (UG). The M6 model in its various versions was developed and published by Assessment & Modeling Division (AMD) of the National Vehicle & Fuels Emissions Laboratory (NVFEL) in Ann Arbor, Michigan. The NVFEL is part of U.S. EPA's Office of Transportation & Air Quality (OTAQ), formerly the Office of Mobile Sources (OMS).

Technical Guidance on the Use of MOBILE6 for Emission Inventory Preparation, August 2004. Hereafter the M6 "Technical Guidance [Document]" or "TGD". The TGD is the primary source of guidance on M6 inputs and an invaluable adjunct to the M6 User's Guide.

U.S. EPA document "Frequently Asked Questions on MOBILE6", 16 January 2002. Hereafter [M6] "FAQ". This document was published along with the M6 TGD.

U.S. EPA memo, "Policy Guidance on the Use of MOBILE6 for SIP Development and Transportation Conformity", dated 18 January 2002, from John Seitz, Director of OAQPS, and Margo Oge, Director of OTAQ, to Regional Air Division Directors.

5.3 Ohio's Alternate Data for MOBILE6.2

5.3.1 Vehicle Registration Distribution by Age

Overview:

The vehicle age distribution determines the fraction of vehicles operating within each emissions control requirement standard and the deterioration of the emission control technology.

Emission rates vary widely between new and older vehicles. Thus, even small changes in fleet age, particularly for older vehicles, may result in large changes in emission totals.

The MOBILE6.2 model requires estimates of a distribution of registered vehicles by age and vehicle category for current and future years. MOBILE6.2 default values were developed using national level vehicle registration data by age and class for July 1, 1996. U.S. EPA developed a methodology to convert the July 1, 1996 registration profile into a general registration distribution by age and by vehicle category for some six composite (gasoline and diesel) vehicle types plus motorcycles. To project future changes, U.S. EPA evaluated general sales growth and vehicle scrappage trends for the total light-duty vehicle in-use fleet and the total heavy duty vehicle in-use fleet, and made minor adjustments, where possible, to reflect some of the differences between vehicle categories.

Description: The MOBILE6.2 model requires estimates of a distribution of registered vehicles by age and vehicle category for current and future years. Ohio EPA chose to use local vehicle registration data provided by the Ohio Bureau of Motor Vehicles (BMV) to LADCO to develop these inputs.

Method Applicability: This approach is most applicable in areas where there are significant differences in the local vehicle fleet age distribution relative to the national average.

Data Sources and Procedures: This approach involves using local vehicle registration data. This is typically available at the county level, but may also be applied using statewide data from the state motor vehicle registration office. The fleet age should be representative of the vehicle fleet over the small urban or rural area under question. If the pollutants of concern are ozone precursors.

Advantages:

- Uses locally specific registration data, which is likely more representative of the local area than the national default.
- Requires minimal additional resources, particularly if data is readily available at the county or local level from the State department of motor vehicle registration.
- Recommended by U.S. EPA and generally is encouraged as a preferred approach over the national default approach.

Details:

Meredith Weatherby of ERG, a subcontractor to LADCO, sent Ohio EPA the files that completed the Ohio registration distribution calculations.

These files contained the registration distribution fractions for each county code as well as for the entire state. Each county file was in a format that was directly useable in the MOBILE6.2 model runs. Additional files contained the fractions as well as the numbers of vehicles for each county in a space-delimited file.

5.3.2 Daily Vehicle Miles Traveled (DVMT)

Overview:

Ohio DOT provided the Daily Vehicle Miles Traveled (DVMT) data. DVMT is a simple mechanism to measure how much traffic is flowing along a roadway during an average 24 hour period. This simple formula multiplies Average Annual Daily Traffic (AADT) by the length of the roadway. For example; if a roadway was 2 miles in length and the AADT was 4000 vehicles per day the DVMT would be computed by multiplying 2*4,000 =8,000 or 8,000 DVMT.

County-by-county DVMT is computed using Ohio DOT roadway information files and the annual Highway Performance Monitoring System (HPMS) summary reports. DVMT's are computed for all of the Federal Functional Class (FC) categories within each of Ohio's 88 counties.

The AADT and roadway length information are very accurate for the state highway system (interstate, highway and state routes,). For roadways that are not part of the state highway system, various representative counts were used, such as: railroad crossing counts, HPMS sample section counts etc. All traffic count data that was not collected during the current year has had a statewide growth factor applied that accounts for systematic growth.

Given the previously mentioned methodologies, the DVMT data is more accurate on roads functionally classified as collector or above.

Functional class categories:

01 - Rural Interstate 02 - Rural Principal Arterial 06 - Rural Minor Arterial 07 - Rural Major Collector 08 - Rural Minor Collector 09 – Rural Local	11 - Urban Interstate 12 - Urban Freeway & Expressway 14 - Urban Principal Arterial 16 - Urban Minor Arterial 17 - Urban Collector 19 - Urban Local

For PDF web based tables of DVMT by county see:

www.dot.state.oh.us/techservsite/availpro/Road_%20Infor/KDVMT/vmt2002.pdf

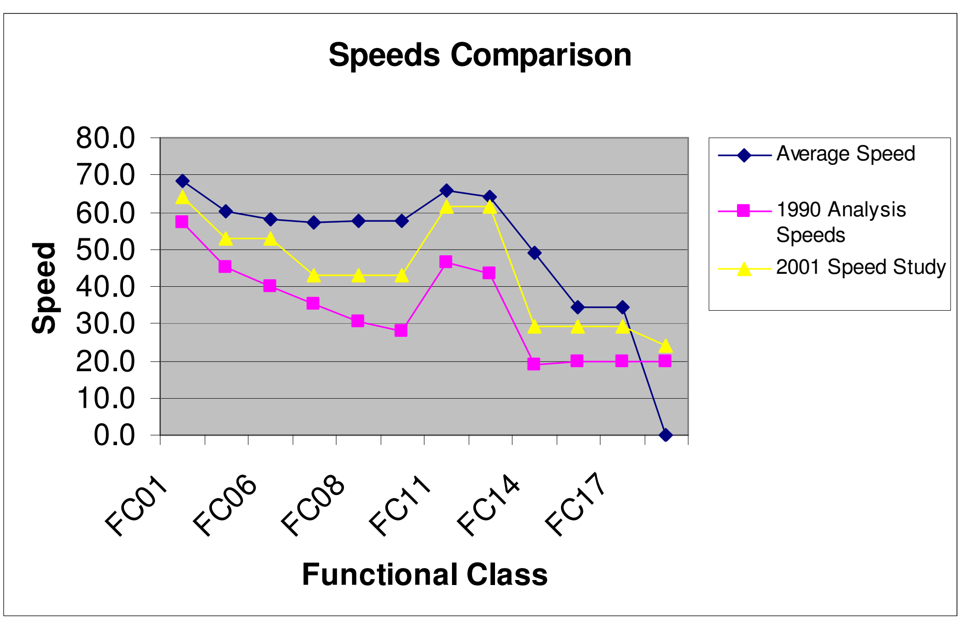
Disclaimer by Ohio DOT:

The above PDF web based tables contain the State of Ohio's adjusted county DVMT's and road mileage for the years 1990 - 2004. Please be aware that the numbers are estimates only. The factoring process used annual, estimated, and statewide ADT (average daily traffic) growth factors, derived from the output of a limited number of traffic counting stations around the state. Although the growth factors are available by functional class, they are more reliable for major roads such as interstates or expressways, which are relatively well-sampled, than for local roads or collectors. The numbers also do no allow for periodic, large-scale functional reclassification actions which reassign selected roads or road segments from one functional class to another. Ohio DOT therefore does not warrant the accuracy, completeness, or reliability of these estimates for your research. We also do not assume responsibility for any incorrectness that may occur.

5.3.3 Speed Distribution Profile

Overview:

According to Mark Byram of Ohio DOT, the speeds that have been used to date for air quality analysis were developed by Chuck Gebhardt of Ohio DOT and Harry Judson of OHIO EPA for addressing "1 hour standards" conformity rules established due to 1990 emissions exceedances. No documentation was found in Ohio DOT's files on the origin of these average speed values or how they were estimated. Therefore, staff believed that it was best to use the most recent available data to estimate average speeds. Year 2002 speed data was obtained from Ohio DOT's Traffic Monitoring Section's automatic traffic recorder data and summarized for comparison with space mean speeds from Ohio DOT's travel time study done in 2001 (Statewide Travel Time Study, May 2001 by Greg Giaimo, Ohio DOT.) These speeds were compared with those developed for addressing the one hour standards. The graph below shows the comparison.



CAUTION: It should be noted that speeds on facilities falling in any one of the federal functional classifications vary greatly between roadways, between hour of the day, and day of the week. So these provide only very rough estimates of speed and should be used with caution. In addition, it is expected that these average statewide speeds are higher than the average speeds in the non-attainment areas because the non-attainment counties tend to be more populated and more congested. The document "Highway Vehicle Speed Estimation Procedures for Use in Emission Inventories", September 1991 by Earl Ruiter or Cambridge Systematics Inc. is referenced by U.S. EPA's documented procedures for emission inventory preparation. This document suggests post processing travel demand model traffic assignment results to estimate average speeds.

The Ohio DOT Modeling & Forecasting Section recommends that Ohio's travel demand forecasting models and Ohio DOT's conformity analysis methods be used to establish the roadway mobile source portion of Ohio's SIP budget to assure consistent methods are used for transportation conformity analysis and budgets.

Research:

Time Mean Sped-- Summarizing Automatic Traffic Recorder (ATR) Speed Data by Functional Class

Year 2002 speed data for July 2002 was provided by the Traffic Monitoring (TM) Section as requested by the Modeling & Forecasting Section (MF).

The TM section generated reports for each ATR in the state of Ohio, grouped the reports by federal functional class and provided the summary reports to the MF section. The report includes average speed for each day in July 2002, a 31 day period. The data was imported to a spreadsheet where a minimum speed, maximum speed and average speed over the 31 day period for all ATR's located on a given functional class was computed, see Table 1

Table 1 – Comparison of Average Daily speeds from ATR Data with Daily 1990 Air Quality Speeds

	Average	Min. Avg	Max. Avg.	1990 AQ
	Speed	Speed	Speed	Speeds
FC01	68.33810	53.9	76.3	57.3
FC02	60.14802	36.2	71.8	45.3
FC06	58.05665	53.5	62.1	39.9
FC07	57.06160	52.9	60.9	35.1
FC08	57.45161	55.2	59.3	30.5
FC09	57.45161	55.2	59.3	28.0
FC11	65.64372	49.7	73.0	46.3

FC12	63.89579	50.3	73.2	43.3
FC14	48.97748	31.3	70.1	18.9
FC16	34.52353	30.6	53.2	19.6
FC17	34.52353	30.6	53.2	19.6
FC19	_-	_-	_-	19.6

The ATR speeds represent our best estimate of "time mean speed". The speeds represent the speed at a point in the middle of a roadway section and does not account for slowdowns and delays created by vehicles turning into driveways, stopping at intersections, slowing due to incidents, etc.

Estimating SPACE MEAN SPEED by Functional Class

Greg Giaimo generated average speed by urban and rural area facility types as shown in Table 2 Below.

Table 2 Speed by Facility Type

Facility Type	Facility Type Description	Average Speed
1	rural freeway	64
2	rural arterial	53
3	rural 4+ lane collector	42
4	rural 2 lane collector, flat	47
5	rural 2 lane collector, hilly	44
6	rural local, flat	46
7	rural local, hilly	37
8	rural local, township, flat	40
9	rural local, township, hilly	30
11	urban freeway	63
12	urban arterial	30
13	urban collector	30
16	urban local	25
21	cbd freeway	50
22	cbd arterial	23
23	cbd collector	21
26	cbd local	12
41	rural ramp, off	36
42	rural ramp, on	44
51	urban ramp, off	32
52	urban ramp, on	46

Information from Table 2 was used to estimate space mean speed by functional class by assigning federal functional classes as shown in Table 3 with consultation with Giaimo. Some speed classes were ignored based on recommendation by Giaimo because of the small number miles of those types of roadways.

Table 3 – Functional Class Equivalents

FT	Facility Type	Speed (mph)	FunClass Equiv
1	rural freeway	64	01 Rural Interstate
2	rural arterial	53	02 06 - Principal & 06Minor Arterial
3	rural 4+ lane collector	42	Ignore
4	rural 2 lane collector, flat	47	07 08- Major Collector, Minor
5	rural 2 lane collector, hilly	44	Ignore
6	rural local, flat	46	09 - local
7	rural local, hilly	37	ignore
8	rural local, township, flat	40	09 - local
9	rural local, township, hilly	30	ignore
11	urban freeway	63	11Urban Interstate & 12 EXPY
12	urban arterial	30	14,16 Princ, Major, Minor Art
13	urban collector	30	17 - Collector
16	urban local	25	19 - local
21	cbd freeway	50	11 &12 urban interstate, 50-55mph
22	cbd arterial	23	14,16 - Major&minorArt
23	cbd collector	21	17 - Collector
26	cbd local	12	19 – local

The following formulas were used to estimate the speed:

Where:
S=Speed
FT=Facility Type
FC=Functional Class

S(FC01) = S(FT1)
S(FC02) = S(FT2)
S(FC06) = S(FT2)
S(FC07) = AVERAGE(FT3,FT4,FT8)
S(FC08) = AVERAGE(FT3,FT4,FT8)
S(FC07) = AVERAGE(FT6,FT8)
S(FC09) = AVERAGE(FT6,FT8)
S(FC11) = 0.91*S(FT11)+0.09*S(FT21)
S(FC12) = 0.91*S(FT11)+0.09*S(FT21)
S(FC14) = 0.94*S(FT12)+0.06*S(FT22)
S(FC16) = 0.94*S(FT12)+0.06*S(FT22)
S(FC17) = 0.94*S(FT13)+0.06*S(FT23)
S(FC19) = 0.93*S(FT16)+0.07*S(FT26)

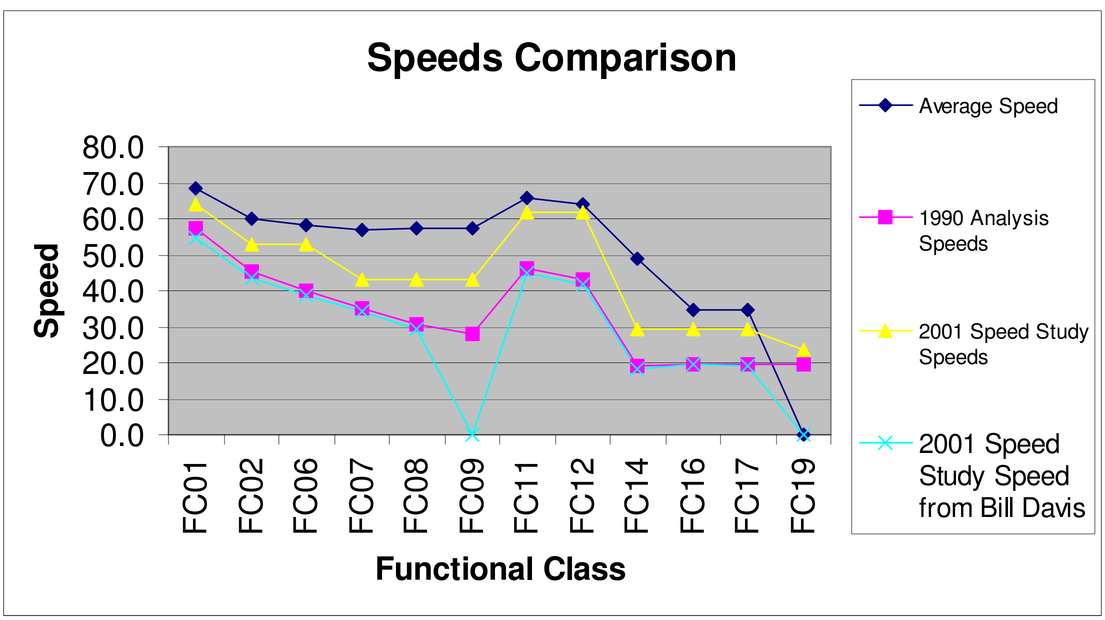
Percentage splits for the urban federal functional classes (11trhu 19) were derived by summarizing VMT by Facility Types 1 to 26 using the statewide travel demand model. The results are shown in Table 4 along with speeds previously used for comparison purposes.

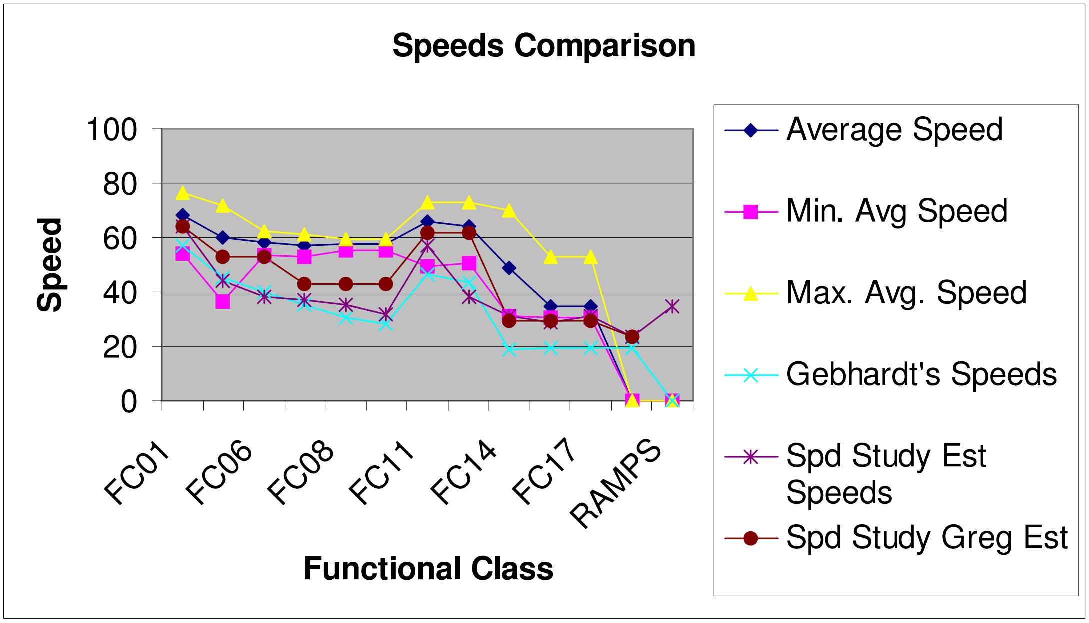
Table 4 – Speed by Federal Functional Class

	1990 Analysis	2001 Speed Study	
	Speeds	Speeds	NOACA*
FC01	57.3	64.0	54.7
FC02	45.3	53.0	43.7
FC06	39.9	53.0	38.7
FC07	35.1	43.1	34.2
FC08	30.5	43.1	29.4
FC09	28	43.1	-
FC11	46.3	61.6	44.9
FC12	43.3	61.6	42
FC14	18.9	29.3	18.4
FC16	19.6	29.3	19.6
FC17	19.6	29.2	19
FC19	19.6	23.8	-

* From informal documentation found in files, labeled “Speeds From Bill Davis”

Figure 1 - Speed Comparison Graphs





In discussions with James McQuirt, Greg Giaimo and Ansen Wu, it was decided that because there is no record of the origin of the speeds established for the 1990 exceeded emissions/one hour emissions standard, Ohio DOT would be best served to use the speeds estimated from the speed study if the origin is well documented.

Conclusion:

It was decided by mutual agreement among individuals in the Modeling & Forecasting Section that these new space mean speed based average speed estimates were reproducible and defensible if documented and should therefore be the speeds used with HPMS VMT if any year 2002 emissions budget work is done using only HPMS VMT.

Results:

Speeds used in the speed distribution files from Ohio DOT for the 2002 inventory were taken from the 2001 space mean speed study. (See Table 4)

Reference:

"Draft Technical Memorandum Estimation of Average Speed by Functional Class for MOBILE6 Runs," by Mark Byram, Ohio DOT, Office of Technical Services, May 26, 2004

5.4 Ohio's Non-Alternate (Default) Data for MOBILE6.2

Per conversation with Mark Janssen at LADCO on 5/14/04, he recommended Ohio use the national defaults for the rest of the MOBILE6.2 inputs with the exception of providing an RVP value for Ohio.

5.4.1 Ohio's Fuel Characteristics

Background:

Tom Darlington of Hyper Anemo was contracted by LADCO to evaluate the fuel parameters at the county level. In a memo to Mike Koerber, at LADCO he states;

"As a part of our project to evaluate the benefits of lower RVP in various nonattainment areas in the LADCO 5-state area, we obtained the LADCO county-by-county MOBILE6.2 inputs and reviewed the various fuel input commands. This memo reviews plots of those inputs, and requests that the various states verify these inputs. The inputs that we have selected to review have a direct bearing on the baseline RVP of the fuel in each of the counties, and thus the benefits of any lower RVP proposal such as 7 RVP."

Tom summarized his study saying, "Evaluation of the fuels inputs for the LADCO modeling system has shown perhaps a need to reevaluate some of the fuels inputs, so that the baseline VOC inventories are correct, and so that the benefits of RVP control will be accurately estimated.

In particular, ethanol market fractions for Michigan, Wisconsin, Indiana, and Ohio should be developed by the states or LADCO and utilized. This will also involve a change in the July RVP waiver for these states. In addition, areas with RFG should be checked to ensure that the appropriate counties have RFG."

Process:

Fuel data parameters were collected from Ohio's MPOs and analyzed. Variations in data suggested the need to determine the source of input values. After considerable effort it was determined that the origins of input values were unclear. The reevaluation process resulted in establishing the following guidelines.

Guidelines:

- No MTBE (ether oxygenated fuel) in Ohio

- 40 percent of Ohio's fuel is ethanol oxygenated with 10 percent oxygen content by volume

- Reid Vapor Pressure (RVP) is 9.0
- RVP waiver switch is 1.0 psi

5.5 LADCO Data Processing

LADCO processed Ohio's data using the Emissions Modeling System (EMS-2003). A description of LADCO's methodology should be forthcoming from LADCO in the near future.