OHIO
2005 Base Year SIP Inventory

Ohio Environmental Protection Agency
Lazarus Government Center
50 West Town Street, Suite 700
Columbus Ohio 43215

Prepared by Ohio EPA

Division of Air Pollution Control
Emissions Inventory Unit

June 2007

Table of Contents

2005 Base Year SIP Inventory for Ohio

Introduction

In April 2004, U.S. EPA designated over 400 counties nationwide as non-attainment for the new 8-Hour Ozone ambient air quality standard. Of the 400, thirty- three counties are in Ohio. The 1990 Clean Air Act Amendments (CAAA) requires all states to revise and submit State Implementation Plans (SIP) for areas which are classified as non-attainment 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 a basic non-attainment designation: http://www.epa.state.oh.us/dapc/general/Ohio8-Hour_Non-attainmentAreas0415204_1.pdf

As part of the designation of non-attainment areas for the 8-hour ozone standard, a new attainment demonstration SIP will be necessary. A key element in the overall SIP planning process is the need for an updated emissions inventory. This document presents the 2005 Base Year Ozone SIP Emissions Inventory for Ohio as required by the CAAA of 1990. It includes NOx and VOC emissions for point, area, on-road mobile and non-road mobile for the State of 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 counties in Ohio. 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 the emissions 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 is comprised of 5 sections, one section for each inventory type. The biogenic inventory is not being discussed in this document because Ohio EPA did not participate in the generation of this inventory. Lake Michigan Air Directors Consortium (LADCO) ran EPA's BEIS model in the Emission Modeling System (EMS) to generate Summer Weekday emissions for VOC and NOx.

SECTION 1

POINT SOURCES

Emissions and source specific data for point sources are collected for the 2005 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 the 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 the 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 the United States Environmental Protection Agency's (U.S.EPA) QA/QC software for format and content. The data is finally submitted to LADCO for emissions processing through the Emissions Modeling System. 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 (706 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, employment records, or other reliable data. A more detailed discussion of the area source inventory is provided in Section 2. The point source inventory described herein is considered to be the most current and accurate source of emissions data available for 2005.

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 2005 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 2005 emissions.

1.1.2 Non-reactive VOC Emissions Adjustments

Sources are required to identify emissions of photochemically non-reactive Volatile Organic Compounds (VOC.) Based upon this information, those emissions have been specifically excluded from the 2005 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 2005 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 Electric Generating Units (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

AREA SOURCES

Area sources are sources which are typically small, individual, numerous, and have not been inventoried as specific point, mobile, or biogenic sources. For inventory purposes, they are grouped with other like sources into categories that allow emissions to be calculated collectively using one methodology. Since area sources are traditionally defined at the county level, most 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 oxides of nitrogen (NO_X) and/or VOC into Ohio's atmosphere. Table 2-1 lists the categories included in the 2005 area source inventory:

Table 2-1 Categories included in the 2005 area source inventory

VOC Emissions	NO_X & VOC Emissions	NO_X Emissions
2.1 Agricultural Chemical Applications	2.15 Outdoor Wood Boilers	2.19 Human Cremation
2.2 Architectural Surface Coatings	2.16 Industrial Distillate Oil Combustion	
2.3 Auto Body Refinishing	Industrial Residual Oil Combustion	
2.4 Consumer & Commercial Solvents	Industrial Natural Gas Combustion	
2.5 Solvent Cleaning	2.17 Residential Coal Combustion	
2.6 Fuel Marketing	Residential Distillate Oil Combustion	
2.7 Graphic Arts	Residential LPG Combustion	
2.8 Hospital Sterilizers	Residential Natural Gas Combustion	
2.9 Industrial Rubber & Plastics	Residential Wood Combustion	
2.10 Industrial Surface Coating	2.18 Structure Fires	
2.11 Landfills		
2.12 Portable Fuel Containers		
2.13 POTW		
2.14 Traffic Markings		

2.1 Agricultural Chemical Applications - 2005 (SCC 246850000) VOC

Ohio farmers use mostly Atrizine and 2, 4-D chemicals in their chemical applications for three main crops: corn (SCC 2461850051), soybean (SCC 2461850055), and wheat (SCC 2461850056 for Grains). Other pesticides, as well as many inactive ingredients in pesticide products, are volatile organic compounds (VOC). SCC 246850000 was used to describe all the agricultural chemical use processes.

There are two hazardous air pollutants of concern for agricultural chemical use emissions in Ohio: atrazine, and 2,4-D. In Ohio, atrazine and 2,4-D are used on corn, 2,4-D is used on soybeans and winter wheat. In 2005, 2,4-D was applied to 5% of the acreage used to grow soybeans and winter wheat at an annual rate of 0.46 and 0.56 lb per acre, respectively. [5]

The STAPPA-ALAPCO-EPA Emission Inventory Improvement Program (EIIP) Document Series – Volume III, Chapter 9 suggests calculating emissions from pesticides based on the vapor pressure of the active ingredient. The vapor pressures of the atrazine, and 2,4-D, along with the appropriate emission factors are listed in Table 2-2.[4]

Table 2-2. Vapor pressures and emission factors for selected active ingredients.

Pollutant	Vapor Pressure	Emission Factor (lb emitted/ton applied)	
	mm Hg at 20° to 25°C	Surface Application	Soil Incorporation
Atrazine	2.90E-07	700	5.4
2,4-D	8.00E-06	700	--

According to Ohio's Department of Agriculture[6], 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 average atrazine fertilizer applied would be 65.4% atrazine and 3% ethylene glycol. This makes the ratio of ethylene glycol to atrazine equal to about 0.04587. This ratio was multiplied by the amount of atrazine applied to estimate ethylene glycol emissions (for the corn crop).

To estimate the VOC emissions from agricultural chemical use, an alternative method from the EIIP document was used as shown below. An emission factor of 2.45 lb of VOC per lb of active ingredient applied was multiplied by a 90% emission rate and by the total quantity of pesticides applied per acre.

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

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)

2.2 Architectural Surface Coatings - 2005 (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. This category includes emissions from the application of paint, primer, or varnish to architectural surfaces, the use of solvents as thinners, and the use of solvents for associated cleanup. Two types of paint are used to categorize this area source: water-based (2401003000) and solvent-based paint (2401002000). Solvent-based paint typically contains substantially higher volatile solvent contents than water-based paint.

Table 2-3 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 2-3 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.

2.3 Auto Body Refinishing - 2005
(SCC 2401005000)
VOC

Auto body refinishing is categorized as non-industrial surface coating. This category includes 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.

The methodology is based on the per capita emissions factor because it is considered to be a more reliable factor than the employment factor and since, Auto body refinishing facility identifications and activity data were not available, the Ohio Department of Development, Office of Strategic Research, was used to obtain the population estimates by county to determine the emissions estimation.[7]

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. 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.

2.4 Consumer & Commercial Solvents - 2005
(SCC 2465000000)
VOC

This area source includes a wide array of products including personal care products, household cleaning products, household pesticides, automotive aftermarket, adhesives and sealants, FIFRA regulated products, coatings and related products. 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[7] based methodology because this data was more readily available than the costly product use or sales surveys. The Ohio Department of Development, Office of Strategic Research, was used to obtain the population estimates by county to determine the emissions estimation. VOC emissions were calculated using a 7.3 lb/person emissions factor which was obtained from the 1999 NEI document (Vol. III)

The 1999 Base Year Non-point Source National Emissions Inventory for Hazardous Air Pollutants (NEI) document dated 9/28/2001 and published by the Emission Factor and Inventory Group at RTP was consulted.[8]

2.5 Solvent Cleaning – 2005 (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

The Emissions Inventory Improvement Program (EIIP)[9]. Volume III; Chapter 6 - Solvent Cleaning lists several methods of estimating emissions from solvent cleaning. Some of the preferred methods and the alternative methods call for conducting a survey of subset of solvent cleaning users, facilities, or suppliers. Because this would require more resources than the state can devote, Ohio utilized the methodology requiring employment data obtained from the U.S. Census Bureau, County Business Patterns[3] which requires employment data.

Each solvent-cleaning SCC identified above has an EF as indicated below in Table 2-4 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 2-4 Solvent Cleaning SCC Emission Factors

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

2.6 Fuel Marketing – 2005 VOC

Currently, there are essentially two types of fuel dispensed at gasoline service stations to consumers in Ohio, unleaded gasoline and diesel. As a result of the low volatility of diesel fuel, the evaporative emissions from diesel fuel at service stations are very small and considered negligible. However, the evaporative emissions from gasoline fuel are significant and will be discussed in this section. The following emissions are covered:

a) Delivery **trucks in transit** (**SCC 2505030120**)
b) **Stage I** (transfer of gasoline from tank trucks to storage tanks at service stations) (**SCC 2501050120 & 2501060053**)
c) **Stage II** (transfer of gasoline from storage tanks at service stations to the vehicle gasoline tank) (**SCC 2501060100**)
d) Gasoline station storage tanks; and
e) Spillage

Truck Transit (SCC 2505030120)

Gasoline tank trucks in transit are considered an evaporative loss of VOC emissions because evaporative emissions of gasoline vapor occur (1) from loaded tank trucks during the transportation of gasoline from the bulk terminals/plants to the gasoline service stations, and (2) from empty tank trucks returning from service stations to bulk terminals/plants. This category consists of the VOC losses during the transit of gasoline in the trucks.

Per the Emission Inventory Improvement Program, the county-level fuel sales statistics should have been obtained to calculate these emissions but the county-level statistics were not available. Therefore, Ohio obtained state total fuel sales data through Ohio Department of Taxation[10] which was then apportioned to the county level based on VMT county data obtained from Ohio Department of Transportation[11]

The emissions from gasoline trucks in transit is estimated using the following equations.

$$GTA = \frac{TGD + TGT}{TGD} \qquad \text{(Eq. 1.1)}$$

Where:

GTA = Gasoline transportation adjustment factor (default value of 1.25)
TGD = Total gasoline dispensed in a county
TGT = Amount of gasoline transported twice within a county

and

$$TTE = \frac{(TGD \text{ x } LEF \text{ x } GTA) + (TGD \text{ x } UEF \text{ x } GTA)}{1{,}000} \qquad \text{(Eq. 1.2)}$$

Where:

TTE = Annual emission of a pollutant from tank trucks in-transit (tons)
LEF = Loaded tank truck in-transit emission factor (lb/1,000 gal throughput)
UEF = Unloaded tank truck in-transit emission factor (lb/1,000 gal throughput)

The total gasoline transported is multiplied with an emission factor 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.

Gasoline Distribution Stage 1

Filling Losses (SCC 2501060050)

Stage I fueling is defined as the gas retail operations from the truck delivery drop losses and underground tank breathing. 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 for controlled counties.

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 gallons of gas throughput is used for all counties except for the 16 original counties which are non-attainment for ozone. The EF used for those 16 counties, is 1.000E-01 lb/1000 gallons of gas throughput. The value for the non-attainment counties was discussed with Mr. Bill Juris[12], Supervisor within Ohio EPA's Division of Air Pollution Control. Mr. Juris is familiar with Ohio's 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 sixteen 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.

2.7 Graphic Arts - 2005
(SCC 2425000000)
VOC

Graphic arts and printing operations emit volatile organic compounds (VOC) during the printing operations of newspaper, books, magazines, fabrics and other materials. The graphic arts industry includes six segments, separated by technology: rotogravure, flexography, offset lithography, letterpress, screen, and plate less printing. Most of the VOC emitted by graphic arts operations come from the fountain solutions, printing inks, and cleaning solutions.

This area source includes printing operations not included in the point source inventory. The emissions estimates do not include large operations accounted for in the point source section of the inventory.

The graphic arts chapter of the EIIP, vol. III provides a VOC emissions factor for the printing industry based on population of 1.3 pounds VOC per capita[13] The emissions factor covers uncontrolled graphic arts emissions from facilities that emit fewer than 100 tons per year VOC.

2.8 Hospital Sterilizers - 2005 (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 as shown below[14]:

Hospital Size	# Beds	Emission Factors (kg EO/yr/bed)
Large	>500	1.05
Medium	200-500	0.63
Small	<200	0.82

The number of hospitals and beds per county for Ohio can be obtained from the Ohio Hospital Association which provided hospital information via the AHA Guide published by Health Forum.[15] 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).

2.9 Industrial Rubber/Plastics - 2005 (SCC 2430000000) VOC

This category is calculated using the 2004 employment data obtained from the United States Census Bureau[3] 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 emissions. Although the point source VOC contribution (1116 annual tons of VOC) is subtracted from the emissions of this area source, this category remains the highest category of VOC emissions. After bringing this issue to the attention of the 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 for this area source. This category is left out from the emissions table but it is kept here for documentation.

2.10 Industrial Surface Coating – 2005 (SCC see table 2-5) VOC

Surface coating operations involve the application of a thin layer of coating (paint, lacquer, enamel, varnish, ink, etc.) to an object for decorative or protective purposes. The coating can be applied by brushing, rolling, spraying, flow coating or dipping the object. Surface coatings include coatings that are applied during the manufacture of a wide variety of products such as furniture, cans, metal coils, automobiles, other transportation equipment, machinery, appliances, flat wood, wire, and other miscellaneous products.

The Volatile Organic Compound (VOC) emissions result as the thinner or solvent used to facilitate the application of the coatings evaporates. This category does not include architectural surface coatings, traffic markings, automobile refinishing or aerosols. Since the use of surface coatings by manufacturing industries is so widespread, it is extremely difficult to identify all of the industries in which coating materials are consumed.

This area source contains several categories as listed below in Table 2-5. The appropriate NAICS codes are used for each category, as shown in Table 2-6, to obtain employment data[3] from Bureau of Labor Statistics for each county. The VOC emissions factors are obtained from the STAPPA-ALAPCO-EPA EIIP (Emission Inventory Improvement Program), Volume III, September 1997 [16]. To avoid double counting, the net VOC emissions are calculated by subtracting the portion of VOC contributed from Ohio's point sources.

Table 2-5 Categories included in Industrial Surface Coating

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 2-6 NAICS Codes Used for Industrial Surface Coating

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

2.11 Municipal Solid Waste - 2005 (SCC 2620030000) VOC

Landfill gas (LFG) is produced from the biodegradation of the organic matter in the solid waste disposed in landfills. LFG emissions can occur either on-site or in surrounding areas. The principal components of LFG are methane, carbon dioxide, and other Non-

Methane Organic Compounds (NMOC). NMOC emissions account for about 0.10 percent of LFG.

The calculation of LFG emissions is done in two parts. The first part calculates the emissions from non-flaring MSW landfills and the second calculates the emissions from flaring or controlled MSW landfills.

Non-flaring LF means that the generated LFG is emitted directly into the ambient air without any collection systems or methods of control. Therefore, only uncontrolled (fugitive) emissions of non-flaring municipal solid waste landfill are calculated. The controlled LF has a flare system which combusts the gases being emitted from the LF and controls the amount of gas going into the air.

The EIIP methodology[17] to calculate methane gas emissions requires municipal solid waste tonnage deposited in the landfills for the last 25 years. However, the Ohio EPA Division of Solid and Infectious Waste[18] has input data starting only from 1982. Therefore, Landfills which did not record or report its waste intake for that period was not included in the database. Landfills with control are identified as having flares or use which means the gas is collected for use on site or elsewhere, although the method may not be known. Collecting the LF gas and/or flaring are considered a control method and the flare equation is applied.

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. Seventy five (75) percent collection efficiency and ninety-five (95) percent control efficiency are used per AP-42 Compilation of Air Pollutant Emission Factors[19]. The protocol dictates that if a LF closes during an inventory year, then a zero "0" is assigned for the "years closed" since the LF took waste for part of the year prior to closure. Since there was only capacity data available from 1982 (rather than the 25 years required for the methodology), 23 years was the maximum number of years used in the calculation of average waste disposed.

This methodology identifies 2 equations to be used to calculate LF emissions. First for uncontrolled emissions: $Q = L\ R\ (e^{-ks} - e^{-kt})$ where:

Q = Methane emissions in m3/yr
R = Average annual capacity over life of LF (in tons)
c = Years LF is closed to inventory year. "0" if still active
t = Years LF is open.
k = 0.04/yr (factor from AP-42 since Ohio gets about 37 inches of rain/yr per Dana Thompson)
L = 3,530 Ft3/ton (100 m3/Mg) factor from AP-42

For controlled emissions:

P (1-% collection EFF/100) + (P (% collection EFF/100) (1- % control EFF/100))
Where:

P = Uncontrolled emissions
% collection EFF = 75% from AP-42
% control EFF = 95% from AP-42

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.)

2.12 Portable Fuel Containers - 2005
RESIDENTIAL **(SCC 2501011010)**
COMMERCIAL **(SCC 2501012010)**
VOC

These containers commonly known as "gas cans," and their spouts contribute VOC emissions to the ambient air in several ways, including:

- Permeation of vapors through walls in containers made from a plastic known as High Density Polyethylene (75 % of residential gas cans are made from this plastic.)
- Escaping fumes while fuel is being dispensed
- Spillage and / or over-filling as fuel is being poured into equipment
- Spillage and evaporation through secondary vent holes and
- Evaporation through inadequately capped spouts.

To calculate this area source's VOC emissions, emissions factors for the above variables as well as the diurnal variations where obtained through a spreadsheet provided by the Illinois inventory group[20]. Total VOC emissions are the sum of emissions obtained from both commercial and residential for the year which is based on 250 days. Emissions estimates are based on population[2] and consistent with California Air Resource Board Inventory methodology (September 23, 1999)[21]. Although the California methodology generates rather high emissions estimates, it is the only available estimate at the time of generating the 2005 inventory.

2.13 Publicly Owned Treatment Works - 2005
(SCC 2630020000)
VOC

Publicly Owned Treatment Works (POTW) facilities are municipal treatment facilities where wastewater from industrial, commercial, and residential sources is directed for treatment. POTW wastewater may have large concentrations of many toxic compounds. Specific industrial and commercial activities are the largest source of organic compounds entering the municipal collection systems. However, other residential sources of organic compounds such as home maintenance and cleaning products contribute to the total organic compounds that enter the POTW. These organic compounds produce emissions through volatilization at the surface of the wastewater during treatment processes.

Specific POTW facility data is collected from Wastewater Treatment Plant inventory reports in Ohio EPA Division of Surface Water[22] which does not require minor flow facilities to submit an inventory. Therefore, Ohio's wastewater flow data only represents eighty (80) percent of the actual total flow for this area source which is coming from about 195 major POTW facilities. A twenty (20) percent increased flow is added to compensate for those 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 HAP emissions. 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.

2.14 Traffic Markings - 2005
(SCC 2401008000)
VOC

Traffic marking operations consist of marking of highway center lines, edge stripes, and directional markings and painting on other paved and non-paved surfaces, such as markings in parking lots. There are two types of traffic marking paints, water-based and solvent-based paints. Solvent-based paint typically contains substantially higher volatile solvent contents than water-based paint. VOC emissions result from the evaporation of organic solvents during and shortly after the application of the marking paint. Solvent- and water-based paints have about the same durability; both beginning to deteriorate about a year after their application.

The STAPPA-ALAPCO-EPA EIIP (Emission Inventory Improvement Program) Area Source Document - Traffic Markings[23] contains several methodologies for identifying sources and estimating emissions from traffic marking. The required data and resources for the preferred survey method are not available, so the alternative method is used where the total lane miles per county is obtained from Ohio's Department of Transportation (ODOT)[24]

The National traffic paint sales figure is obtained from the Census Bureau[25] and it is apportioned to the state using the ratio of state dollar disbursements in relation to the national disbursement[26]. The county level apportionment of paint is made using the number of lane miles provided by ODOT. The VOC factor (3.36 lb/gal) is calculated based on Ohio's traffic paint usage of ninety (90) percent water based and ten (10) percent oil based.

2.15 Outdoor Wood Boilers – 2005
(SCC 2104008070)
VOC & NO_X

Outdoor Wood Boilers (OWB), are also known as outdoor water stoves and outdoor wood furnaces, are used as outdoor residential heaters. These boilers have wood burning fireboxes surrounded by a water reservoir vented by a chimney stack. The combustion of the wood in the firebox heats the water in the surrounding reservoir and the heated water is pumped to the residence. OWB units can also supply residential hot water. The water capacity ranges from 60 gallons to 764 gallons. The operational design creates long periods where the fire smolders and creosote is formed[27].

When the water circulating through the furnace reaches an upper set point, the air supply to the fire is cut-off, cooling the fire so the water will not overheat. The furnace operates in this "idle" mode until the water temperature hits a lower set point and the air supply is re-established. The OWB may be in idle mode far longer than in operating mode. This type of operating causes very poor combustion and heavy foul smoke. Most of the smoke emitted is fine condensed organic material that does not burn under cool, oxygen starved conditions. In addition, many owners burn green wood full of moisture which also causes poor combustion[28]. The smoke created from these outdoor wood burning units can contain several pollutants that are harmful to breathe, including fine particle pollution such as PM 2.5[29] in addition to VOC and NOx (research assisted by Deborah Lucas, DAPC intern, 2007)

This new area source category has many unknowns and variables associated with it and Ohio does not possess accurate OWB unit sales data available to calculate emissions on the county level. Therefore, several assumptions are made in agreement with the Great Lake States in order to formulate a homogeneous inventory for the region.

The assumptions are as follows:

- 100% of wood combusted in non-certified units.
- OWB units to be 90% in rural counties and 10% in urban counties
- 11.68 cords of wood consumption per unit per year (includes heating efficiency of 30-40%)
- 5 months heating season = 3650 hours (24/7)
- $PM^{2.5}$ emissions factor (g/kg wood) =13.82 (Average of indoor and outdoor) or 27.64 lb/ton of wood

The agreed upon methodology requires that total number of OWB sold in Ohio be apportioned to each county based on rural or urban designation while observing the 9:1 ratio in area sales. The guesstimated factors (see above) are applied to calculate the emissions from this outdoor wood burner. Total emissions obtained from this category are subtracted from the Residential Wood Combustion category (discussed below) to allow for accurate emissions from the indoor wood burning units.

2.16 Industrial Fuel Combustion -2005
VOC & NO_X

Industrial Distillate Oil Combustion (SCC 2102004000)

Ohio's fuel consumption is apportioned per county based on the county's population[2]. The area source VOC and NO_X emissions are calculated and adjusted by subtracting the emissions due to point sources. A heating value of 140 mmbtu/1000 gallon is used and 84,408 thousand gallons[31] are consumed in 2005. [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[2]. The area source VOC and NO_X emissions are calculated and adjusted by subtracting the emissions due to point sources. 54,652 thousand gallons[31] are consumed in 2005 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[2]. The area source VOC and NO_X emissions are calculated and adjusted by subtracting the emissions due to point sources. 293,857 MMCF[30] are consumed in 2005.

2.17 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[2]. 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[2]. 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[2]. NO_X and VOC emissions are calculated using EF of 13 and 0.49 lb/1000 gallons LPG respectively.

Residential Natural Gas Combustion (SCC 2104006010)

Ohio's household consumption of LPG is apportioned per county based on county population[2]. 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 calculated for seven types of residential heating units that utilize wood for fuel. 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 its population[2]. Table 2-7 shows the EF used for each of the seven types of indoor wood burners which make-up this category:

Table 2-7 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

To avoid double counting of wood consumption for fuel, this category is adjusted by subtracting the wood consumption from OWB (discussed above) to allow this category to account only for indoor wood burning emissions.

2.18 Structure Fires - 2005
(SCC 2810030000)
VOC & NO_X

The Structure Fires category includes residential and commercial fires resulting from unintentional actions. Intentional fires, forest and wildfires, agricultural, and vehicle burning are not included in this area source. The State Fire Marshall Office, Fire Prevention Bureau[31] provided data on the number of structure fires per county in 2005.

This area source is considered a combustion source for VOC and NO_X emissions which are 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 of 1.15 ton/fire[32] is applied.

2.19 Human Cremation – 2005
(SCC 2810060200)
NO_X

Not all Ohio counties possess a crematory so only those counties with crematories are used to calculate the number of cremations and their resulting NOx emissions. The 2005 cremation data is obtained from the Ohio Department of Health, Vital Statistics[33]. It is estimated that 3% of deaths occur outside the State of Ohio with no available data to account for their disposition at the time this area source is being calculated. Therefore, those deaths are not accounted for in this category.

The methodology does not offer an EF for NOx for this category nor is NOx required to be calculated for this area source. Ohio feels that it is a combustion source and NOx needs to be included in the inventory along with the other combustion sources. Through its Permits-to-Install for human cremation, Ohio has selected a NOx EF of 10.13lb/ton cremated to calculate emissions from this area source.

2.20 Categories with Growth Factors Applied

Area source projections can be made using surveys or growth indicators to approximate future emissions from certain emissions contributing activities. The most commonly used growth indicators are those parameters typically projected by local metropolitan planning organizations (MPO) such as population, housing, land use, and employment.[34]

Area sources rarely have detailed information based on surveys of individual emitters. While growth indicators are reasonable estimators of future air pollution generating activities for traditional area source emitters (manufacturing, population-based activities), other indicators may be more appropriate for non-traditional emitters. Policy changes which may lead to increased or decreased activity in a category must also be considered. [35]

Ohio has 8 area source categories to which the Pechan growth factors (GF) are applied to the 2002 NEI data to generate the 2005 inventory. Ohio either lacks the resources to inventory these area sources or the sources lack accurate and complete data to allow for a proper inventory.

Table 2-8 shows the list of the area source categories to which Ohio applies growth factors to obtain the 2005 inventory.

Table 2-8 Area Sources with Applied Growth Factors

Area Source	SCC	GF Source
Agricultural Tilling	2801000003	Pechan GF applied to NEI 2002 Emissions
Household Waste Incineration	2461003000	Pechan GF applied to NEI 2002 Emissions
Land Clearing	2610000500	Pechan GF applied to NEI 2002 Emissions
Oil & Gas Production	2310020000	Pechan GF applied to NEI 2002 Emissions
Paved Roads	2294000000	Pechan GF applied to NEI 2002 Emissions
Unpaved Roads	2296000000	Pechan GF applied to NEI 2002 Emissions
Industrial Rubber & Plastics	2430000000	Pechan GF applied to NEI 2002 Emissions
Industrial Adhesives & Sealants	2440020000	Pechan GF applied to NEI 2002 Emissions

2.21 Miscellaneous Categories

Although the area sources discussed herein 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

The following two area sources are not inventoried for the reasons given below.

Emulsified Asphalt	Insignificant emissions in Ohio (per ODOT)
Cutback Asphalt	Not used in Ohio

2.22 References

1. Documentation For the 2002 Non-Point Source National Emission Inventory For CAPS and HAPS. U.S. Environmental Protection Agency. Emissions Factor and Inventory Group. E.H Pechan and Associates, Inc. January 2004.

2. United States Census Bureau. Population Division. **http://eire.census.gov/popest/data/counties/tables/CO-EST2002/CO-EST2002-01-39.php** (Accessed 2003)

3. United States Census Bureau. County Business Patterns. http://censtats.census.gov/cbpnaic/cbpnaic.shtml (Accessed 2003)

4. Pesticides - Agricultural and Non-Agricultural. U. S. Environmental Protection Agency. Emissions Inventory Improvement Program. Eastern Research Group, _ Volume III. Chapter 9, June 2001. http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii09_jun2001.pdf

5. Agricultural Chemical Use. U. S. Department of Agriculture. National Agricultural Statistics Service. **http://usda.mannlib.cornell.edu/reports/nassr/other/pcu-bb/agcs0503.txt** (Accessed 2003)

6. Telephone conversation with Diane Roll. Ohio Department of Agriculture, Columbus, Ohio. Percentage of active ingredients and method of application.

7. Ohio Department of Development, Office of Strategic Research. *Population Projects by Age and Sex: 2005-2030.* http://www.odod.ohio.gov/research/files/p200.htm (Accessed August 2006)

8. Environmental Protection Agency (EPA). *1999 Base Year Non-point Source National Emission Inventory for Hazardous Air Pollutants,* Research Triangle Park, NC. September 28, 2001.

9. Environmental Protection Agency (EPA). *STAPPA-ALAPCO-EPA Emission Inventory Improvement Program (EIIP).* Volume III - Area Sources Preferred and Alternative Methods. Chapter 6 - Solvent Cleaning. September 16, 1997

10. Motor Vehicle Fuel Tax. Ohio Department of Taxation. www.state.oh.us/tax (Accessed 2003)

11. Daily Vehicle Miles Traveled Reports. Ohio Department of Transportation, Office of Technical Services. http://dot.state.oh.us/techservsite/availpro/Road Infor/KDVMT/kDVMT.htm (Accessed 2003)

12. Conversation with Bill Juris. Ohio Environmental Protection Agency, Division of Air Pollution Control. Columbus, Ohio. Ohio's GDF VOC regulations and practices.

13. Environmental Protection Agency (EPA). STAPPA-ALAPCO-EPA Emission Inventory Improvement Program (EIIP). Volume III - Area Sources Preferred and Alternative Methods. November 1996.

14. Documentation for the Draft 1999 National Emissions Inventory (Version 3.0) for Criteria Air Pollutants and Ammonia. Area Sources. E. H. Pechan & Associates, Inc. March 3, 2003

15. Advancing Health in America Guide. Health Forum. American Hospital Association. 2003-2004

16. U.S. Environmental Protection Agency, STAPPA-ALAPCO-EPA Emission Inventory Improvement Program (EIIP), Volume III - Area Sources Preferred and Alternative Methods, Chapter 8. September 1997.

17. Landfills. U. S. Environmental Protection Agency. Emissions Inventory Improvement Program. Eastern Research Group Volume III: Chapter 15. January 2001.

18. Ohio EPA, Division of Solid & Infectious Waste. Columbus, Ohio.

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

20. Spreadsheet formulation provided by "Buzz" David Asselmeier, Air Quality Planning Section, Inventory Group, Springfield, Illinois.

21. California's Portable Gasoline Container Emissions Inventory. Air Resources Board Mobile Source Control Division. California Air Resource Board Inventory method (September 23, 1999). http://www.arb.ca.gov/homepage.htm. (Accessed 2003).

22. Ohio EPA Division of Surface Water. Columbus, Ohio.

23. Environmental Protection Agency (EPA). STAPPA-ALAPCO-EPA Emission Inventory Improvement Program (EIIP). Volume III - Area Sources Preferred and Alternative Methods. May 1997.

24. The Ohio Department of Transportation. Office of Technical Services. Roadway Information. Columbus, Ohio.

25. Paint and Allied Products: 2002. U.S. Census Bureau. U.S. Department of Commerce. Economics and Statistics Administration.
http://www.census.gov/industry/1/ma325f02.pdf
(Accessed 2003)

26. Highway Statistics 2002. Federal Highway Administration. U. S. Department of Transportation. http://www.fhwa.dot.gov/policy/ohim/hs02/sf2.htm
(Accessed 2003)

27. (Environmental Chemistry.com) viewed on Feb 8th, 2007.
[http://environmentalchemistry.com/yogi/environmental/200602outdoorwoodfurnaces.html]

28. (Washington State, Department of Ecology) viewed on Feb 8th, 2007
[http://www.ecy.wa.gov/programs/air/AOP_Permits/Boiler/Outdoor_Boilers_home.html]

29. U.S. Environmental Protection Agency. Reducing Pollution from Outdoor Wood-Fired Hydronic Heaters. Fact Sheet
http://www.epa.gov/owhh/pdfs/fact_sheet_1_29_07.pdf (Accessed 1/2007)

30. Industrial Sector Energy Price and Expenditure Estimates, 1970-2001, Ohio. Energy Information Administration. U. S. Department of Energy.
http://www.eia.doe.gov/emeu/states/sep_prices/ind/pr_ind_oh.html
http://www.eia.doe.gov/emeu/aer/pdf/pages/sec1_27.pdf (Accessed 2003)

31. State Fire Marshal Office. Fire Prevention Bureau, Columbus, Ohio.
http://www.com.state.oh.us/odoc/sfm/firecont.htm (Accessed 2003)

32. Documentation for the Draft 1999 National Emissions Inventory (Version 3.0) For Criteria Air Pollutants and Ammonia. Area Sources. E. H. Pechan & Associates, Inc. March 3, 2003

33. Ohio Department of Health, Vital Statistics

34. Environmental Protection Agency. STAPPA-ALAPCO-EPA Emission Inventory Improvement Program (EIIP). Volume X – Emissions Projections. December 1999.
http://www.epa.gov/ttn/chief/eiip/techreport/volume10/x01.pdf
(Accessed 2/2007)

SECTION 3

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 submitting 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. Grant Heatherington from the Wisconsin Department of Natural Resources provided the following descriptions...

The National Mobile Inventory Model (NMIM) developed by USEPA was used to estimate emissions for all other nonroad mobile categories. NMIM consolidates nonroad mobile emissions and onroad emissions modeling into a single modeling system. Only the nonroad emissions modeling portion of NMIM was used in the development of this emission's inventory. NMIM uses the USEPA's NONROAD model to calculate nonroad mobile emissions. The basic NONROAD 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.

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

b. Revised PM2.5 ratios in SCC table to correctly calculate PM2.5 diesel emissions. This error was introduced with NMIM2005 and didn't exist in NMIM2004.

c. Revised gasoline parameters using updates provided by the states and E.H. Pechan & Associates, Inc.. Gasoline parameters include Reid Vapor Pressure (RVP), oxygenate content and sulfur content.

The NMIM NEI NIF files are on the LADCO ftp site at:
ftp://ftp.airtoxics.org/inv2005/nonroad/NMIM/Base_L_ph2/2005/

Revised NMIM2005 Input Data

Emission Factor Data

All States: Pechan revised the brake specific fuel consumption (BSFC) emission factor data to include diesel tampers/rammers (2270002006). The revised NMIM file is saved as revBSFC.EMF.

Population Data

For 26000.pop, replaced default file supplied with NMIM2005 with 26000_rev_NMIM05.pop that contains revised construction data missing from 26000.pop external file provided with NMIM2005. This Michigan construction data should have been added with the other LADCO states modified construction data but was overlooked.

SCC Data

The default SCC table of NCD20060201 is replaced by a version that contains corrections to the PM25fac field that earlier NCDs contained (i.e. changed from 0.92 to 0.97 for diesel nonroad equipment) in NONROAD2004.

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. AIR revised gasoline characteristics per instructions from the states. Also, gasoline characteristic revisions for 2005 provided by states were incorporated. Additional revisions were incorporated into 2002 data for nonroad Stage 2 controls. Depending on the year being modeled, different versions of the revised tables are used. Also, the countynrfile, countyyear and datasource tables were 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 below for the appropriate versions of the tables for the selected years.

Non-LADCO States: The countynrfile, countyyear and datasource tables were revised to reference the new activity, allocation and seasonality files described above. See table below for the appropriate versions of the tables for the selected years.

Table 3-1 NMIM National County Database Tables for Specific Years and States

States	Years	
	1999 (WI only)	**2002, 05, 07, 08, 09, 12 and 18**
LADCO states	countynrfile_NMIM05_rev, countyyear_NMIM05_rev, countyyearmonth_NMIM05_w_05_12_18_rev, datasource_NMIM05_rev, gasoline_NMIM05_def SCC_NCD20060201_rev (used when NCD20060201 is used)	countynrfile_NMIM05_rev, countyyear_NMIM05_rev , countyyearmonth_NMIM05_w_05_12_18_rev, datasource_NMIM05_rev, gasoline_NMIM05_w_05_12_18_rev SCC_NCD20060201_rev (used when NCD20060201 is used)

SECTION 4

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 2005. Solid fuels have not been used by mobile sources in significant amounts since railroads retired their coal-powered steam locomotives in the 1950s.

4.1 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.

4.1.1 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: these 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:

- <u>Displacement emissions</u>. 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.

4.2 Ohio On-Highway Mobile Source Inventory

The inventory of on-highway mobile source emissions was developed in conjunction with the Ohio Department of Transportation (ODOT), Lake Michigan Air Director's Consortium (LADCO), United States Environmental Protection Agency (USEPA), and the Ohio EPA (OEPA). Estimates of the amounts of NOx and VOC are reported by county in tons per day. Emissions are reported for a typical ozone season weekday in the summer of 2002.

4.2.1 Emission Inventories Developed with MOBILE6 Model

MOBILE6 Overview:

MOBILE6 is a computer program that estimates hydrocarbon (HC), carbon monoxide (CO), oxides of nitrogen (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 EPA's MOBILE6 Web page http://www.epa.gov/otaq/models.htm.

MOBILE6 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 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.

4.2.2 MOBILE6 Defaults:

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

4.2.3 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
- Emissions factors for PM and HAP
- Output format specifications and selections

4.2.4 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 USEPA 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.

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

USEPA 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.

4.3 Ohio's Alternate Data for MOBILE6

Alternative data is state-specific data that is used in the Mobile6 runs. Using local data is preferred to using the default data in Mobile6. Efforts are made to collect as much local data as possible.

4.3.1 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 model requires estimates of a distribution of registered vehicles by age and vehicle category for current and future years. MOBILE6 default values were developed using national level vehicle registration data by age and class for July 1, 1996. 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 6 composite (gasoline and diesel) vehicle types plus motorcycles. To project future changes, 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 model requires estimates of a distribution of registered vehicles by age and vehicle category for current and future years. OEPA 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 EPA and generally is encouraged as a preferred approach over the national default approach.

4.3.2 Daily Vehicle Miles Traveled (DVMT)

Overview:

In coordination with Ohio Metropolitan Planning Organizations (MPOs), the Ohio Department of Transportation (ODOT) provided Daily Vehicle Miles Traveled (DVMT) data and travel demand model (TDM) data. TDM data will be covered in another section. Because TDM results are used by the state and MPOs to forecast traffic for a multitude of purposes, undergo rigorous calibration and validation checks, and are sensitive to roadway capacity/travel time improvements, the TDMs are considered the best tool for emissions forecasting. Therefore, the DVMT data discussed in this section is not used directly for all areas of Ohio. In counties where it is not used directly it is used for making rough emissions estimates where models do not exist or where time prohibits the use of TDMs. 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 the State of Ohio, Department of Transportation's 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 provides a very accurate estimate of statewide total DVMT for The State Highway System (Interstate, US and State Routes,). County total DVMT are consistent and considered a good source of county level DVMT for countywide emissions estimates. 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 statewide growth factors applied to account for systematic growth.

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

Table 4-1 Federal Functional Class Categories:

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

Table 4-2 DVMT County Summary:

COUNTY SUMMARY: Adjusted County kDVMT's

(kDVMT = Thousands of Daily Vehicles Miles Traveled)

2005 Data

COUNTY NAME	FC = 01 kDVMT	FC = 02 kDVMT	FC = 06 kDVMT	FC = 07 kDVMT	FC = 08 kDVMT	FC = 09 kDVMT	TOTAL RURAL kDVMT	FC = 11 kDVMT	FC = 12 kDVMT	FC = 14 kDVMT	FC = 16 kDVMT	FC = 17 kDVMT	FC = 19 kDVMT	TOTAL URBAN kDVMT	TOTAL COUNTY kDVMT
ADAMS	0.00	215.97	113.28	293.79	25.36	127.97	776.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	776.36
ALLEN	460.82	189.65	130.25	319.62	66.55	269.30	1438.19	476.73	0.00	341.68	372.75	204.05	439.03	1834.24	3272.43
ASHLAND	667.86	334.94	163.06	247.87	76.79	125.48	1616.01	0.00	0.00	170.72	26.95	35.66	21.05	254.38	1870.39
ASHTABULA	603.78	201.06	273.05	447.31	109.71	217.26	1852.17	129.74	43.84	222.24	201.60	131.20	306.78	1035.60	2887.77
ATHENS	0.00	428.66	108.93	167.84	47.67	77.28	830.37	0.00	137.96	312.50	78.93	54.58	97.68	681.55	1511.92
AUGLAIZE	261.01	239.72	11.55	280.15	49.20	132.50	974.13	81.33	41.31	5.79	107.53	112.13	47.94	396.03	1370.16
BELMONT	711.39	92.12	91.35	393.93	69.22	96.93	1454.95	399.86	189.20	115.94	206.42	48.59	77.03	1037.04	2491.98
BROWN	0.00	473.56	227.95	191.73	39.84	194.20	1127.28	0.00	0.00	29.89	0.00	4.59	1.04	35.52	1162.80
BUTLER	0.00	177.46	100.71	334.76	197.95	254.62	1065.50	1209.51	283.05	1144.03	1104.59	702.01	1246.92	5692.11	6757.61
CARROLL	0.00	0.00	306.89	126.16	47.78	107.52	588.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	588.35
CHAMPAIGN	0.00	167.72	113.43	253.64	44.37	142.95	722.11	0.00	0.00	76.51	24.96	14.78	48.24	164.49	886.60
CLARK	1115.90	208.14	22.52	411.49	37.91	368.51	2162.47	675.79	125.31	142.35	655.32	385.90	351.80	2336.47	4498.94
CLERMONT	0.00	325.08	55.85	428.85	24.80	286.74	1121.32	988.72	101.09	602.60	547.86	412.27	280.22	2932.76	4054.08
CLINTON	554.30	0.00	322.00	339.14	5.54	393.47	1614.46	0.00	0.00	140.87	21.98	23.94	8.50	195.29	1809.75
COLUMBIANA	0.00	265.05	202.55	496.66	151.69	276.59	1392.54	0.00	154.88	278.59	204.84	306.22	125.08	1069.61	2462.15
COSHOCTON	0.00	182.89	97.52	132.98	139.28	204.78	757.45	0.00	0.00	34.00	42.02	33.94	105.03	214.99	972.44
CRAWFORD	0.00	82.69	56.15	342.53	36.86	179.32	697.55	0.00	0.00	93.40	88.98	113.55	71.28	367.21	1064.76
CUYAHOGA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12614.66	875.31	4311.73	4701.74	1082.47	4747.66	28333.57	28333.57
DARKE	0.00	142.54	177.24	396.12	134.59	300.21	1150.69	0.00	30.47	55.19	41.19	29.77	12.28	168.90	1319.59
DEFIANCE	0.00	111.11	44.64	337.78	62.30	182.73	738.56	0.00	0.00	132.15	119.75	39.53	12.85	304.28	1042.83
DELAWARE	795.40	442.70	259.62	273.45	45.44	279.69	2096.30	334.11	128.15	582.08	637.20	232.29	200.90	2114.73	4211.03
ERIE	1071.00	480.23	118.29	262.88	20.74	118.62	2071.75	0.00	328.83	294.84	119.87	137.29	111.16	991.99	3063.74
FAIRFIELD	0.00	516.27	185.75	446.27	123.80	297.23	1569.33	197.46	40.15	209.44	284.47	478.16	281.63	1491.33	3060.66
FAYETTE	533.35	176.61	157.05	210.93	70.19	90.07	1238.20	0.00	40.48	44.19	61.93	21.15	15.71	183.46	1421.65
FRANKLIN	165.74	0.00	32.16	61.39	71.50	125.44	456.17	11911.77	2103.01	3770.40	5380.36	1934.86	4367.72	29468.12	29924.29
FULTON	631.92	141.88	184.44	371.01	42.48	171.36	1543.09	0.00	0.00	44.06	13.99	21.92	13.99	93.96	1637.05
GALLIA	0.00	320.98	0.00	287.90	12.22	175.71	796.81	0.00	0.00	119.41	0.00	71.16	9.65	200.22	997.03
GEAUGA	0.00	273.44	183.08	557.08	6.31	81.84	1101.76	0.00	163.39	341.11	225.16	198.19	100.89	1028.74	2130.50
GREENE	147.18	182.18	176.73	189.33	150.44	306.95	1152.80	1072.42	254.32	768.83	422.87	324.22	242.86	3085.52	4238.33

For PDF web based tables of 2005 DVMT by county see:

http://www.dot.state.oh.us/techservsite/availpro/Road_%20Infor/KDVMT/vmt2005.pdf

Disclaimer by ODOT:

The above PDF web based tables contain the State of Ohio's adjusted county DVMT's and road mileage for the years 1990 - 2005. 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.*

The Ohio Department of Transportation 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.

4.3.3 VMT From Travel Demand Models (TDM)

Overview:

Travel demand forecast modeling is performed by the Ohio Metropolitan Planning Organizations (MPOs) and ODOT for a multitude of purposes including the preparation of regional emissions estimates. The ODOT Office of Technical Services' Modeling & Forecasting Section recommends that Ohio's TDMs and ODOT'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. Therefore, ODOT provided both MPO regional TDM runs and statewide TDM runs with associated data to OEPA and LADCO. The ODOT provided model run data for years 2002, 2005, 2009, 2012, and 2018.

Data provided included loaded networks in both .csv format and GIS shape files, trip end summaries, zone boundary GIS shape files, intrazonal trip VMT estimates, and VMT summaries for each of the loaded networks. Additional post processing data was provided including but not limited to metadata describing the loaded networks, Hourly distribution by functional class, speed profiles, day of week / weekend / monthly car and truck traffic profiles, 2009 & 2018 VMT RPO data sets, statewide VMT growth rates for local traffic, and a 2005 VMT summary comparison spreadsheet. It should be noted that among other things, the loaded TDM Networks contain distance and daily volumes from which VMT is computed.

Network volumes are post processed to estimate VMT by hour of day. The hourly volumes and capacity, posted speed limit, and type of roadway for each roadway segment are then used to estimate average hourly speeds needed for MOBILE6 based emissions estimates. Modeling by segment by hour of day in this way makes emissions estimates more sensitive to the effects of roadway improvements. This allows transportation planners to evaluate the relative emissions affect of improvements to individual roadways as well as packages of improvements and the entire set of planned roadway improvement projects air quality impacts of construction programs.

4.3.4 Speed Distribution Profiles

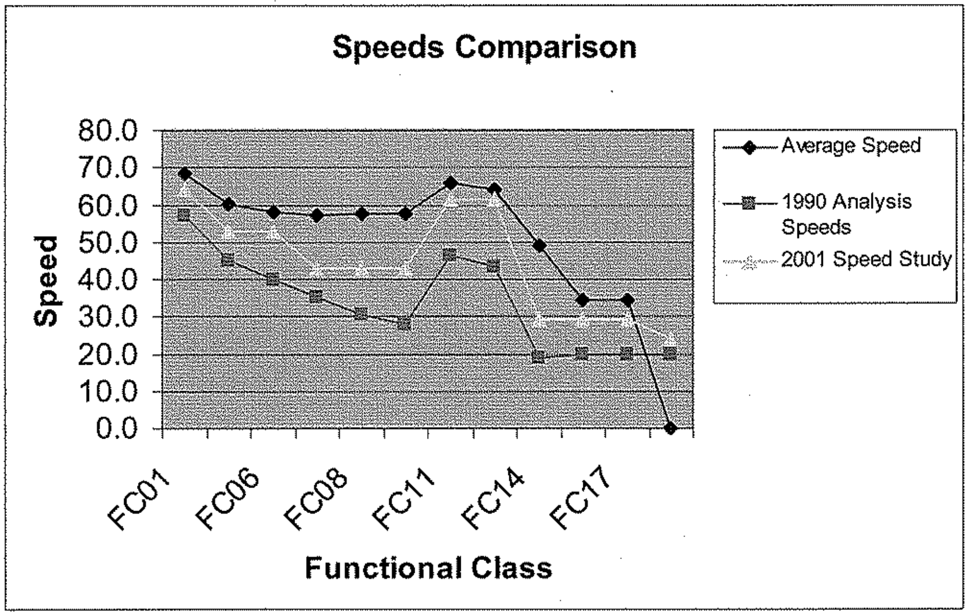
Overview:

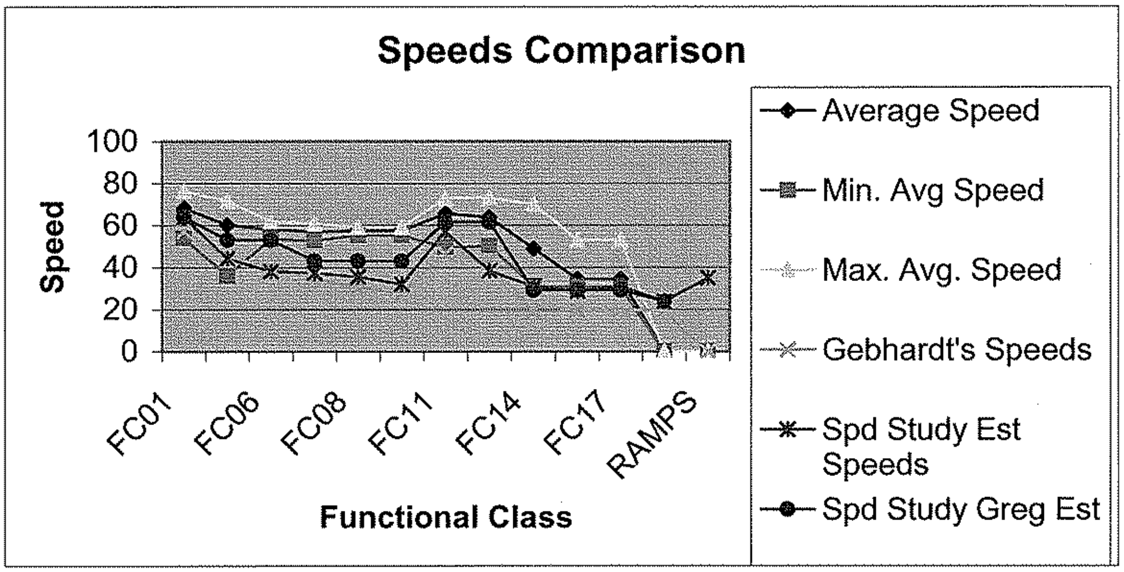
ODOT provided speed distribution profiles to LADCO. A couple of different sets of speed distribution profiles were provided to OEPA and LADCO for their use, a table of space mean speeds by functional class for use with DVMTs and link group speed curves for post processing travel demand model traffic forecasts. Both sets of speed profiles are based on the same speed study conducted by ODOT. The speed study is documented in "Statewide Travel Time Study, May 2001 by Greg Giaimo, Ohio Department of Transportation". When OEPA asked for speeds for use with MOBILE6 for development of CERR, ODOT provided a set of speeds based on that statewide travel time study. Those speeds are documented in a technical memorandum titled "Estimation of Average Speed by Functional Class for MOBILE6 Runs" dated 5/27/2004. Readers should refer to those documents for the details. Here the contents of the technical memo, Estimated Average Speed by Functional Class, are summarized.

Space Mean Speeds by Functional Class for Use With County Level DVMT, HPMS:

The memo states that the speeds which the Ohio Department of Transportation (ODOT) had been using prior to that date, 2004, for air quality analysis estimates based on County DVMT summaries, were developed by a former ODOT employee for addressing the one (1) hour standards conformity rules established due to 1990 emissions exceedances. No documentation was found in ODOT's files on the origin of these average speed values or how they were estimated. In addition, EPA has requirements for using latest planning assumptions for air quality conformity analyses. Therefore, ODOT believed that it was in the state's best interest to use the most recent available data to provide a new set of estimated average speeds consistent with those used for urban area travel demand models which were under development at that time. The memo contains comparisons of 2002 speed data obtained from traffic count equipment, automatic traffic recorders (ATRs) which collect data continuously throughout the year. It also contains comparisons of the new speeds with those used to address the one hour standard Gebhart's. The graphs shown in figure 1, taken from the memo, illustrate the comparisons. The first graph compares time mean speeds from the ATRs with space mean speeds from ODOTs travel time study done in 2001and with the speeds used for addressing the one hour standard.

Figure 1 - Speed Comparison Graphs





The following caution statement was taken from the_Estimation of Average Speed by Functional Class memo.

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 of Cambridge Systematics Inc. is referenced by EPA's documented procedures for emission inventory preparation. This document suggests post processing travel demand model traffic assignment results to estimate average speeds.

Final space mean speeds that ODOT provided are summarized in the Table 1 below:

Table 4-3 Speed by Federal Functional Class

Functional Class	1990 Analysis Speeds	2001 Speed Study Speeds
FC01	57.3	64.0
FC02	45.3	53.0
FC06	39.9	53.0
FC07	35.1	43.1
FC08	30.5	43.1
FC09	28.0	43.1
FC11	46.3	61.6
FC12	43.3	61.6
FC14	18.9	29.3
FC16	19.6	29.3
FC17	19.6	29.2
FC19	19.6	23.8

It was decided by mutual agreement among individuals within the ODOT Office of Technical Services that these new space mean speed based average speed estimates were reproducible and defensible since they are well documented and should therefore be the speeds used with HPMS** VMT if any year 2002 emissions budget work is done using only the county level VMT summaries discussed in section 5.3.2 Daily Vehicle Miles Traveled (DVMT).

** Note that HPMS VMT is a statewide VMT estimate and the county level DVMT summaries are consistent with the HPMS VMT so the county level DVMT summaries are loosely referred to as HPMS VMTs even though in fact they are not.

4.3.5 Link Group Speed Curves:

The ODOT Modeling & Forecasting Section recommends that Ohio's travel demand forecasting models and ODOT's conformity analysis methods be used to establish the roadway mobile source portion of Ohio's SIP budget for reasons already mentioned in 5.3.2 and to assure consistent methods are used for transportation conformity demonstration analyses and budgets. Therefore, ODOT provided travel demand model runs and the speed curves by link group that ODOT uses for the speed estimates within the post processing of travel demand model runs for estimating regional emissions. Table 2 shows these link group curves.

Table 4-4 Link Group Codes & Associated BPR Curves

Link Group	Facility Type	Free Flow Speed	Areatype	a	b
1	Freeway	75	Any	0.39	6.3
2	Freeway	70	Any	0.32	7.0
3	Freeway	65	Any	0.25	9.0
4	Freeway	60	Any	0.18	8.5
5	Freeway	55	Any	0.10	10.0
6	Multi-Lane	60	Rural	0.09	6.0
7	Multi-Lane	55	Rural	0.08	6.0
8	Multi-Lane	50	Rural	0.07	6.0
9	Multi-Lane	45	Rural	0.07	6.0
10	2 Lane	Any	Rural	0.34	4.0
10	Urban Street	50	Suburban	0.34	4.0
11	Urban Street	50	Urban	0.74	5.0
12	Urban Street	50	CBD	1.16	6.0
13	Urban Street	40	Suburban	0.38	5.0
14	Urban Street	40	Urban	0.70	5.0
15	Urban Street	40	CBD	1.00	5.0
16	Urban Street	35	Suburban	0.96	5.0
17	Urban Street	35	Urban	1.00	5.0
18	Urban Street	35	CBD	1.40	5.0
19	Urban Street	30	Suburban	1.11	5.0
20	Urban Street	30	Urban	1.20	5.0
21	Urban Street	30	CBD	1.50	5.0

Note: a and b are the BPR curve parameters for the equation

$$T = T_0\{1 + a * (V/C)^b]$$

More complete details about emissions modeling process employed by ODOT may be found in ODOT documentations. The document titled "Congestion Management & Air Quality Analysis (CMAQ) Program Documentation" dated December 2005 may be obtained from the ODOT web site at www.dot.state.oh.us/urban/data/cmaq.doc (Microsoft Word document)

4.4 Mobile6 Inputs:

The following table contains the inputs supplied to LADCO to process our mobile inventory.

4.4.1 Ohio's 2005 MOBILE6 Inputs

The following tables are the result of a joint meeting between Ohio EPA, ODOT, and MPOs from around the state. At that meeting Mobile6 inputs were discussed and efforts were made to verify the sources of data inputs for Moble6. Dialogue has continued between the parties.

For historical reference:

>>> Dave Moore <Dave.Moore1@dot.state.oh.us> 4/10/2006 2:13 PM >>>

All,

An air quality coordination meeting has been scheduled for April 27, 2006 at 10:00 AM at ODOT Central Office conference room GA. The primary purpose of this meeting is to discuss development of 2002 mobile source inventories for use in developing the Ohio 2007 8-Hour Ozone SIP Attainment Demonstrations. See meeting agenda below. OEPA is working toward a June 15, 2006 schedule for submitting the 2002 inventories to US EPA.

A key component of the meeting will be to review and confirm the MOBILE6.2 input parameters, by Ohio a/q area, for use in developing the 2002 mobile inventories. See draft template below. The Ohio MPO travel demand models will be used to generate the 2002 VMT inputs to MOBILE. Thanks, DM
DM

IMPORTANT NOTICE: The following tables are not to be used for inventory purposes as the data is subject to change. For the current input table, contact Ohio EPA, Division of Air Pollution Control.

Table 4-5 Mobile Inputs

Cleveland-Akron 2005 Ozone M6.2 Inputs

Includes the following counties:
Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Medina, Portage, Summit

State Programs	Input
Stage II Refueling	93/3/86/86
Anti-tampering Programs	96/78/50/22222/21111111/1/12/098./12111112
I/M Programs	Yes
Exclude Ashtabula County - No I/M program	
Program	1 2004 2050 2 T/O OBD I/M
Model Years	1 1996 2050
Vehicles	1 22222 21111111 1
Stringency	1 30.0
Compliance	1 98.0
Waiver Rates	1 1.0 1.0
Cutpoints	
Exemption Age	1 25
Grace Period	1 4
NO TTC Credits	
Effectiveness	
DESC file	
Program	2 2004 2050 2 T/O EVAP OBD & GC
Model Years	2 1996 2050
Vehicles	2 22222 11111111 1
Stringency	
Compliance	2 98.0
Waiver Rates	2 1.0 1.0
Cutpoints	
Exemption Age	2 25
Grace Period	2 4
NO TTC Credits	
Effectiveness	
DESC file	
Program	3 2001 2003 2 T/O ASM 2525 PHASE-IN

Model Years	3 1996 2003
Vehicles	3 22222 21111111 1
Stringency	3 30.0
Compliance	3 98.0
Waiver Rates	3 3.0 1.0
Cutpoints	
Exemption Age	3 25
Grace Period	3 2
NO TTC Credits	
Effectiveness	
DESC file	

Program	4 2001 2050 2 T/O ASM 2525 PHASE-IN
Model Years	4 1975 1995
Vehicles	4 22222 21111111 1
Stringency	4 30.0
Compliance	4 98.0
Waiver Rates	4 3.0 1.0
Cutpoints	
Exemption Age	4 25
Grace Period	4 4
NO TTC Credits	
Effectiveness	
DESC file	

Program	5 1998 2000 2 T/O LOADED/IDLE
Model Years	5 1975 2000
Vehicles	5 22222 21111111 1
Stringency	5 30.0
Compliance	5 98.0
Waiver Rates	5 3.0 1.0
Cutpoints	
Exemption Age	5 25
Grace Period	5 2
NO TTC Credits	
Effectiveness	
DESC file	

Program	6 1996 1997 2 T/O IM240
Model Years	6 1975 1997
Vehicles	6 22222 21111111 1
Stringency	6 30.0
Compliance	6 98.0
Waiver Rates	6 3.0 1.0
Cutpoints	6 CUTPOINT.D
Exemption Age	6 25
Grace Period	6 2
NO TTC Credits	
Effectiveness	
DESC file	

Program	7 1996 2050 2 T/O GC
Model Years	7 1975 1995
Vehicles	7 22222 21111111 1
Stringency	
Compliance	7 98.0
Waiver Rates	7 3.0 1.0
Cutpoints	
Exemption Age	7 25
Grace Period	7 2
NO TTC Credits	
Effectiveness	
DESC file	

Fuel Commands

Fuel Program	1
Oxygenated Fuels	0.00 0.42 0.00 0.036 2
Fuel RVP	9

Alternative Emission Regulations and Control Measures

Rebuild Effects	0.1

External Conditions Commands

Calendar Year	2005
Evaluation Month	7
Min/Max Temperature	National Climatic Data Center

Vehicle Fleet Characteristic Commands

Registration Distribution	Variable

Cincinnati-Dayton-Springfield 2005 Ozone M6.2 Inputs

Includes the following counties:
Ohio: Butler, Clark, Clermont, Clinton, Greene, Hamilton, Miami, Montgomery, Warren
Indiana: Lawrenceburg Twp., Dearborn County
Kentucky: Boone, Campbell and Kenton counties

State Programs	Input
Note: Indiana and Kentucky inputs may not coincide with Ohio inputs	
Stage II Refueling	93/3/86/86
Anti-tampering Programs	96/78/05/22222/21111111/1/12/098./12111112
I/M Programs	Yes
Excludes Clinton Co. and Miami Co., OH, Dearborn County, IN - No I/M program	
Note: I/M inputs for Kentucky counties are not included	
Program	1 2004 2050 2 T/O OBD I/M
Model Years	1 1996 2050
Vehicles	1 22222 21111111 1
Stringency	1 30.0
Compliance	1 98.0
Waiver Rates	1 1.0 1.0
Cutpoints	
Exemption Age	1 25
Grace Period	1 2
NO TTC Credits	
Effectiveness	
DESC file	
Program	2 2004 2050 2 T/O EVAP OBD & GC
Model Years	2 1996 2050
Vehicles	2 22222 11111111 1
Stringency	
Compliance	2 98.0
Waiver Rates	2 1.0 1.0
Cutpoints	
Exemption Age	2 25
Grace Period	2 2
NO TTC Credits	
Effectiveness	
DESC file	
Program	3 2001 2003 2 T/O ASM 2525 PHASE-IN
Model Years	3 1996 2003
Vehicles	3 22222 21111111 1
Stringency	3 30.0
Compliance	3 98.0

Waiver Rates	3 3.0 1.0
Cutpoints	
Exemption Age	3 25
Grace Period	3 2
NO TTC Credits	
Effectiveness	
DESC file	
Program	4 2001 2050 2 T/O ASM 2525 PHASE-IN
Model Years	4 1975 1995
Vehicles	4 22222 21111111 1
Stringency	4 30.0
Compliance	4 98.0
Waiver Rates	4 3.0 1.0
Cutpoints	
Exemption Age	4 25
Grace Period	4 4
NO TTC Credits	
Effectiveness	
DESC file	
Program	5 1998 2000 2 T/O LOADED/IDLE
Model Years	5 1975 2000
Vehicles	5 22222 21111111 1
Stringency	5 30.0
Compliance	5 98.0
Waiver Rates	5 3.0 1.0
Cutpoints	
Exemption Age	5 25
Grace Period	5 2
NO TTC Credits	
Effectiveness	
DESC file	
Program	6 1996 1997 2 T/O IM240
Model Years	6 1975 1997
Vehicles	6 22222 21111111 1
Stringency	6 30.0
Compliance	6 98.0
Waiver Rates	6 3.0 1.0
Cutpoints	6 CUTPOINT.D
Exemption Age	6 25
Grace Period	6 2
NO TTC Credits	
Effectiveness	
DESC file	
Program	7 1996 2050 2 T/O GC
Model Years	7 1975 1995
Vehicles	7 22222 21111111 1

Stringency	
Compliance	7 98.0
Waiver Rates	7 3.0 1.0
Cutpoints	
Exemption Age	7 25
Grace Period	7 2
NO TTC Credits	
Effectiveness	
DESC file	

Fuel Commands

Fuel Program	1
Oxygenated Fuels	0.00 0.42 0.00 0.036 2
Fuel RVP	9

Alternative Emission Regulations and Control Measures

Rebuild Effects	0.1

External Conditions Commands

Calendar Year	2005
Evaluation Month	7
Min/Max Temperature	National Climatic Data Center

Vehicle Fleet Characteristic Commands

Registration Distribution	Variable

Other Areas (excluding NOACA/AMATS and OKI/MVRPC) Ozone M6.2 Inputs

Includes the following counties:
Ohio: Belmont, Columbiana, Delaware, Fairfield, Franklin, Jefferson, Knox, Licking, Lucas,Madison, Mahoning, Pickaway, Trumball, Wood

Fuel Commands	Input
Fuel Program	1
Oxygenated Fuels	0.00 0.42 0.00 0.036 2
Fuel RVP	9

Alternative Emission Regulations and Control Measures	
Rebuild Effects	0.1 (0.30 for 2018)

External Conditions Commands	
Calendar Year	All
Evaluation Month	7
Min/Max Temperature	National Climatic Data Center

Vehicle Fleet Characteristic Commands	
Registration Distribution	Variable

4.5 Ohio's Mobile Emission Data Processed by LADCO (Lake Michigan Air Director's Consortium):

2005 TDM and Mobile6 input data were provided to LADCO for processing. The data was processed by LADCO with T3 to prepare it as an input into the ConCEPT model. T3 and ConCEPT are described as follows.

4.5.1 T3--Development of Link-Level Mobile Source Emission Inventories:

Highly resolved emission inventories for on-road mobile sources are needed for air quality modeling to develop the necessary technical support for new State Implementation Plans (SIPs) for regional haze, fine particles, and ozone. Emissions for on-road motor vehicles are estimated using vehicle miles traveled, trip starts and ends, speed, and other activity data developed by State Agencies and Metropolitan Planning Organizations (MPOs) using transportation demand models (TDMs), and emission factors from EPA's MOBILE6 model. To support this modeling in the upper Midwest, ENVIRON, working with LADCO, State DOTs, and local MPOs, has developed a software tool (the TDM Transformation Tool, or "T3") that takes TDM output from approximately twenty transportation networks using a variety of models, applies appropriate data transformations, and outputs link- and county-level activity data in a uniform format for input to the CONCEPT emissions processing model (a new emissions processing model also developed with funding from LADCO). In a parallel effort, analyses of extensive automatic traffic recorder (ATR) data collected by State DOTs were conducted to develop temporal profiles (hour of day, day of week, and month of year) of vehicle counts and vehicle mix by roadway type for developing the detailed on-road emission inventories.

T3 provides a conduit from the projections of traffic demand modelers regarding vehicle types, road networks, and vehicle activity to the activity data required by emissions modelers. The primary goals of T3 are to provide an easy mechanism for incorporating TDM model outputs in as "raw" a format as possible, while simultaneously providing a great degree of flexibility in representing the TDM projections in terms acceptable to most air quality models. These goals have been achieved through the use of a dimensional transformation approach, where the dimensions of the various transformations are user-defined - hence the name of the tool.

By Stella Shepard, Alison K. Pollack, John Haasbeek, ENVIRON International

Corporation, 101 Rowland Way, Suite 220, Novato, CA. 94945
& Mark Janssen, Lake Michigan Air Directors Consortium (LADCO), 2250 E. Devon Avenue # 250, Des Plaines, IL 60018, janssen@ladco.org

4.5.2 ConCEPT--Consolidated Community Emissions Processing Tool an Open-Source Tool for the Emissions Modeling Community:

The new CONCEPT (CONsolidated Community Emissions Processing Tool) Emissions Processor is now available for use by the emissions modeling community. Developed as joint project between Alpine Geophysics, LLC and ENVIRON Corporation, with Midwest RPO and joint RPO funding, the CONCEPT model combines the best attributes of current emissions modeling systems into an open source model highlighting the following features:

- Open Source. Written primarily in PostgreSQL, the software required for running

CONCEPT is in the public domain. The model itself is GNU Public License (GPL) compliant and users are encouraged to make additions and enhancements to the modeling system.

- Transparent. The database structure of the model makes the system easy to understand, and the modeling codes themselves are extremely well documented to encourage user participation in the customizing the system for specific modeling requirements.

- Quality Control. The CONCEPT model structure and implementation allows for multiple levels of QA analysis during every step of the emissions calculation process. Using the database structures, an emissions modeler can easily trace a process or facility and review the calculation procedures and assumptions for any emissions value.

The CONCEPT model includes modules for the major emissions source categories: area source, point source, on-road motor vehicles, non-road motor vehicles and biogenic emissions, as well as a number of supporting modules, including spatial allocation factor development, speciation profile development, growth and control for point and area sources, and CEM point source emissions handling. The emissions modeling community has already begun development of additional CONCEPT support modules including CEM preprocessing software, graphical QA tools, and an interface to the traffic demand models for on-road motor vehicle emissions estimation.

By Cyndi Loomis, James G. Wilkinson, Alpine Geophysics, LLC, & John Haasbeek, Alison Pollack, ENVIRON Corporation. & Mark Janssen, Lake Michigan Air Directors Consortium (LADCO), 2250 E. Devon Avenue # 250, Des Plaines, IL 60018, janssen@ladco.org

4.5.3 LADCO Ohio Data Outputs for 2005:

The following LADCO outputs and documents can be found at: www.ladco.org/tech/emis/net05/index.html

Table 4-6 LADCO Data Output

State	Network	T3 Description DOC	M6 Inputs	VMT vs HPMS Excel	Average Day VMT (this should match conformity inventory)	County Emissions Report	All Pollutants After Speciation	Dropped VMT	M6 Run Summary	Pollutant Totals (Short)	Raw Summary (pol,veh, etype)	Hourly Temporal Summary	Hourly Veh Mix Summary	Hourly Speed Summary (with volume/ capacity)
OH	AKRON	AKRON	OH	OH	AKRON	1	1	1	1	1	1	1	1	1

OH	CANTON	CANTON	OH	OH	CANTON	1	1	1	1	1	1	1	1	1
OH	CINCI	CINCI	OH	OH	CINCI	1	1	1	1	1	1	1	1	1
OH	CLEVE	CLEVE	OH	OH	CLEVE	1	1	1	1	1	1	1	1	1
OH	COLUMBUS	COLUMBUS	OH	OH	COLUMBUS	1	1	1	1	1	1	1	1	1
OH	SPRINGFLD	SPRINGFLD	OH	OH	SPRINGFLD	1	1	1	1	1	1	1	1	1
OH	TOLEDO	TOLEDO	OH	OH	TOLEDO	1	1	1	1	1	1	1	1	1
OH	YNGSTOWN	YNGSTOWN	OH	OH	YNGSTOWN	1	1	1	1	1	1	1	1	1
OH	STATEWD	STATEWD	OH	OH	STATEWD	1	1	1	1	1	1	1	1	1

Additional Documents on LADCO Web Page:

"Comparison to EPA's Default Model NMIM"

"How we Build the 2005 Vmt/Networks"

"Spreadsheet/Graphics on Vehicle Mix"

"Background on the T3 Tool "

4.6 MPO Contact Table

Table 4-7 County Summary Table of MPOs by County

FIPS	County	Model Network	MPO	Contact Person
39001	Adams	Statewide		
39003	Allen	Statewide	Lima Allen County Regional Planning Commission	Tom Mazur
39005	Ashland	Statewide		
39007	Ashtabula	Statewide		
39009	Athens	Statewide		
39011	Auglaize	Statewide		
39013	Belmont	Statewide	Bel-O-Mar Regional Council and Interstate Planning Commission	Rakesh Sharma
39015	Brown	Statewide		
39017	Butler	Cincinnat/Dayton	Ohio-Kentucky-Indiana Regional Council of Governments	Andy Reser
39019	Carroll	Statewide		
39021	Champaign	Statewide		
39023	Clark	Springfield	Coordinating Committee of the Clark County-Springfield	Eric Ottoson

			Transportation Study	
39025	Clermont	Cincinnat/Dayton	Ohio-Kentucky-Indiana Regional Council of Governments	Andy Reser
39027	Clinton	Statewide		
39029	Columbiana	Statewide		
39031	Coshocton	Statewide		
39033	Crawford	Statewide		
39035	Cuyahoga	Cleveland	Northeast Ohio Areawide Coordinating Agency	Bill Davis
39037	Darke	Statewide		
39039	Defiance	Statewide		
39041	Delaware	Columbus	Mid-Ohio Regional Planning Commission	Nick Gill
39043	Erie	Statewide		
39045	Fairfield	Statewide		
39047	Fayette	Statewide		
39049	Franklin	Columbus	Mid-Ohio Regional Planning Commission	Nick Gill
39051	Fulton	Statewide		
39053	Gallia	Statewide		
39055	Geauga	Cleveland	Northeast Ohio Areawide Coordinating Agency	Bill Davis
39057	Greene	Cincinnat/Dayton	Miami Valley Regional Planning Commission	Ana Ramirez
39059	Guernsey	Statewide		
39061	Hamilton	Cincinnat/Dayton	Ohio-Kentucky-Indiana Regional Council of Governments	Andy Reser
39063	Hancock	Statewide		
39065	Hardin	Statewide		
39067	Harrison	Statewide		
39069	Henry	Statewide		
39071	Highland	Statewide		
39073	Hocking	Statewide		
39075	Holmes	Statewide		
39077	Huron	Statewide		
39079	Jackson	Statewide		
39081	Jefferson	Statewide	Brooke-Hancock-Jefferson Transportation Study Policy Committee	Mike Proprocki
39083	Knox	Statewide		
39085	Lake	Cleveland	Northeast Ohio Areawide Coordinating Agency	Bill Davis
39087	Lawrence	Statewide	KYOVA Interstate Planning Commission	
39089	Licking	Columbus	Licking County Area Transportation Study	Matthew Hill
39091	Logan	Statewide		
39093	Lorain	Cleveland	Northeast Ohio Areawide	Bill Davis

			Coordinating Agency	
39095	Lucas	Toledo	Toledo Metropolitan Area Council of Governments	Sujatha Mohanakrishnan
39097	Madison	Statewide		
39099	Mahoning	Youngstown	Eastgate Regional Council of Governments	R.P. Samulka
39101	Marion	Statewide		
39103	Medina	Cleveland	Northeast Ohio Areawide Coordinating Agency	Bill Davis
39105	Meigs	Statewide		
39107	Mercer	Statewide		
39109	Miami	Cincinnat/Dayton	Miami Valley Regional Planning Commission	Ana Ramirez
39111	Monroe	Statewide		
39113	Montgomery	Cincinnat/Dayton	Miami Valley Regional Planning Commission	Ana Ramirez
39115	Morgan	Statewide		
39117	Morrow	Statewide		
39119	Muskingum	Statewide		
39121	Noble	Statewide		
39123	Ottawa	Statewide		
39125	Paulding	Statewide		
39127	Perry	Statewide		
39129	Pickaway	Statewide		
39131	Pike	Statewide		
39133	Portage	Akron	Akron Metropolitan Area Transportation Study	Jason Segedy
39135	Preble	Statewide		
39137	Putnam	Statewide		
39139	Richland	Statewide	Richland County Regional Planning Commission	John Adams
39141	Ross	Statewide		
39143	Sandusky	Statewide		
39145	Scioto	Statewide		
39147	Seneca	Statewide		
39149	Shelby	Statewide		
39151	Stark	Canton	Stark County Regional Planning Commission	Dan Slicker
39153	Summit	Akron	Akron Metropolitan Area Transportation Study	Jason Segedy
39155	Trumbull	Youngstown (partial county model coverage)	Eastgate Regional Council of Governments	R.P. Samulka
39157	Tuscarawas	Statewide		
39159	Union	Statewide		
39161	Van Wert	Statewide		
39163	Vinton	Statewide		
39165	Warren	Cincinnat/Dayton	Ohio-Kentucky-Indiana Regional Council of Governments	Andy Reser, OKI +

			+ Miami Valley Regional Planning Commission	Ana Ramirez, MVRPC
39167	Washington	Statewide	Wood-Washington-Wirt Interstate Planning Commission	
39169	Wayne	Statewide		
39171	Williams	Statewide		
39173	Wood	Toledo	Toledo Metropolitan Area Council of Governments	Sujatha Mohanakrishnan
39175	Wyandot	Statewide		

NOTE: Complete MPO information can be found at, www.dot.state.oh.us/urban/mpomap.htm and at www.dot.state.oh.us/urban/mpolist.htm#Cleveland .

SECTION 5

MARINE, AIRCRAFT and RAIL (MAR) SOURCES

MAR sources are 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 Ohio EPA.

5.1 Marine Vessel Sources

The approach to commercial marine emission estimates needed to be flexible because the activity data was available in many formats. Emission estimates were determined either by multiplying engine power, load factor, hours per year of operation, or on the basis of the number of gallons of fuel consumed.

Emissions were determined for ten subclasses of vessel types: Deep draft vessels (DDV) at port, DDV mid-late, push boats (rivers/lakes), tugs, ferries, other special (excursion) vessels, support vessels, dredges, commercial fishing, and military vessels (Coast Guard). These were linked to various Ohio lakes and rivers.

Because of the large variety of methodologies employed, inventory tables for the ten subcategories are detailed in the complete inventory prepared and published by ENVIRON International Corporation: **LADCO 2005 COMMERCIAL MARINE EMISSIONS**, by Christian E. Lindhjem, March, 2007.

Emission totals produced by ENVIRON were provided to LADCO to submit to EPA for Ohio's State Implementation Plan (SIP).

5.2 Rail Sources

The primary activity unit used to determine emissions is gallons of fuel consumed. Emission rates were derived from EPA documents provided as support documentation for the 1997 locomotive emission standards (EPA, 1997). Gallons of fuel consumed were based on rail activity.

Rail activity was broken down into four Source Category Codes (SCC). Class I, line-haul rail: Large interstate railroad companies like Union Pacific and Norfolk Southern. Class I,II, III, switching rail: Yard operations. Class II, III line haul: Regional and local railroads. And Passenger rail: AMTRAK.

Class I, line-haul represents 84.3% of fuel used and the largest emission's category. The complete emission's inventory was prepared and published by ENVIRON International Corporation: **LADCO 2005 LOCOMOTIVE EMISSIONS**, by Christian E. Lindhjem, February, 2007.

Emission totals produced by ENVIRON were provided to LADCO to submit to EPA for Ohio's State Implementation Plan (SIP).

EPA. 1997: "Locomotive Emission Standards." Regulatory Support Document, United States Environmental Protection Agency, Office of Mobile Sources, April. And EPA 1997, Emission Factors for Locomotives," Environmental Protection Agency, EPA420-F-97-051, December.

5.3 Aircraft Sources

INTRODUCTION:

The aircraft emission's inventory is derived by taking the number of Landings and Take Offs (LTOs) per year and multiplying by an emission factor. In the Ohio inventory when specific aircraft models and engine type emission factors are known they were used. For the rest of the inventory the emission factors came from USEPA's fleet average emissions data. Those results are then compiled as tons per year per pollutant by county. The following describes the components, methodology, and concludes with a description of an Access based aircraft emission calculator.

COMPONENTS:

I. Ohio Airports:

A list of both towered and non-towered airports in Ohio was obtained from the Ohio Department of transportation. See: www.dot.state.oh.us/aviation/ In conversation with ODOT two individuals stated that the 164 airports listed covered over 90% of the airports in Ohio. See Table 1.

II. Number of Operations/LTOs by Airport/County:

The ODOT list contained the number of operations a year per airport. An operation is either a landing or take off. A Landing and Take Off (LTO) is required for FAA EDMS calculations. LTOs were derived simply by dividing the number of operations by two. These were totaled by county.

Table 5-1. Number of operations and LTOs for 2005.

County	Airport Name	ID	Total Operations	LTOs/Year
Adams	Alexander Salamon	AMT	5210	2605
Allen	Allen County	AOH	32500	16250
Ashland	Ashland County	3G4	49240	24620
Ashtabula	Ashtabula County	HZY	16886	8443
Ashtabula	Germack	7D9	840	420
Athens	Ohio University	UNI	51600	25800
Auglaize	Neil Armstrong	AXV	29456	14728
Belmont	Barnesville-Bradfield	6G5	10150	5075
Belmont	Alderman	2P7	6150	3075
Brown	Brown County	GEO	5157	2578.5
Butler	Butler County Regional	HAO	61687	30843.5
Butler	Hook Field Municipal	MWO	40050	20025
Butler	Miami University	OXD	16708	8354
Carroll	Carroll County -Tolson	TSO	34950	17475
Carroll	Parsons	5D6	2674	1337
Champaign	Grimes Field	I74	23480	11740
Champaign	Weller	38I	300	150
Clark	Springfield-Beckley Municipal	SGH	64033	32016.5
Clark	Mad River	I54	15350	7675
Clermont	Clermont County	I69	35741	17870.5
Clinton	Airborne Airpark	ILN	52000	26000
Clinton	Clinton Field	I66	29360	14680
Clinton	Hollister Field	2B6	161	80.5
Columbiana	Columbiana County	Ø2G	31146	15573
Columbiana	Koons	8G8	2546	1273
Coshocton	Richard Downing	I4Ø	19550	9775
Coshocton	Tri-City	8ØG	8085	4042.5
Crawford	Port Bucyrus	17G	24871	12435.5
Crawford	Galion Municipal	GQQ	5216	2608
Cuyahoga	Burke Lakefront	BKL	97100	48550
Cuyahoga	Cleveland-Hopkins International	CLE	234356	117178
Cuyahoga	Cuyahoga County	CGF	79774	39887
Darke	Darke County	VES	9238	4619
Defiance	Defiance Memorial	DFI	9130	4565
Delaware	Delaware Municipal	DLZ	39300	19650
Delaware	Packer	5E9	3181	1590.5
Erie	Hinde	88D	1350	675
Erie	Kelleys Island	89D	25495	12747.5
Erie	Griffing-Sandusky	SKY	112100	56050
Erie	Wakeman	I64	17324	8662
Fairfield	Miller's Farm	7B4	360	180

Fairfield	Fairfield County	LHQ	**43066**	21533
Fayette	Fayette County	I23	**29405**	14702.5
Franklin	Ohio State University	OSU	**134459**	67229.5
Franklin	Port Columbus International	CMH	**218438**	109219
Franklin	Rickenbacker International	LCK	**96200**	48100
Franklin	Bolton Field	TZR	**69149**	34574.5
Franklin	Columbus Southwest	Ø4I	**11833**	5916.5
Franklin	Darby Dan	6I6	**11260**	5630
Fulton	Fulton County	USE	**21123**	10561.5
Gallia	Gallia-Meigs Regional	GAS	**12200**	6100
Geauga	Gates	7D8	**4200**	2100
Geauga	Geauga County	7G8	**5350**	2675
Greene	Greene County - Lewis A. Jackson	I19	**37400**	18700
Greene	Bloom	14I	**100**	50
Guernsey	Cambridge Municipal	CDI	**6040**	3020
Hamilton	Lunken	LUK	**129430**	64715
Hamilton	Blue Ash	ISZ	**35000**	17500
Hamilton	Cincinnati West	I67	**30197**	15098.5
Hancock	Bluffton	5G7	**71980**	35990
Hancock	Findlay	FDY	**19800**	9900
Hancock	Priebe	7D5	**3850**	1925
Hardin	Ada	ØD7	**331**	165.5
Hardin	Hardin County	I95	**6562**	3281
Hardin	Elliott's Landing	O74	**1560**	780
Harrison	Harrison County	8G6	**11900**	5950
Henry	Henry County	7W5	**15637**	7818.5
Highland	Highland County	HOC	**18325**	9162.5
Holmes	Holmes County	1ØG	**21400**	10700
Huron	Huron County	5A1	**10100**	5050
Huron	Willard	8G1	**2715**	1357.5
Jackson	James A. Rhodes	I43	**6053**	3026.5
Jefferson	Jefferson County Airpark	2G2	**15969**	7984.5
Jefferson	Eddie Dew Memorial	1G8	**3540**	1770
Knox	Knox County	4I3	**20150**	10075
Knox	Wynkoop	6G4	**4691**	2345.5
Lake	Concord Airpark	2G1	**4510**	2255
Lake	Willoughby Lost Nation Municipal	LNN	**45085**	22542.5
Lawrence	Lawrence County Airpark	HTW	**41910**	20955
Licking	Newark-Heath	VTA	**12457**	6228.5
Logan	Bellefontaine Regional	EDJ	**8325**	4162.5
Lorain	Columbia	4G8	**5150**	2575
Lorain	Elyria	1G1	**14300**	7150
Lorain	Lagrange	92D	**1155**	577.5
Lorain	Lorain County Regional	LPR	**62000**	31000
Lorain	Reader-Botsford Airfield	67D	**18700**	9350
Lucas	Toledo Express	TOL	**94600**	47300
Madison	Madison County	UYF	**41410**	20705
Mahoning	Salem Airpark	38D	**16920**	8460

Mahoning	Tri-City	3G6	**10555**	5277.5
Mahoning	Elser Metro	4G4	**49232**	24616
Mahoning	Lansdowne	Ø4G	**750**	375
Marion	Marion Municipal	MNN	**42650**	21325
Medina	Medina Municipal	1G5	**79685**	39842.5
Medina	Wadsworth Municipal	3G3	**41025**	20512.5
Medina	Weltzien Skypark	15G	**79130**	39565
Mercer	Lakefield	CQA	**16212**	8106
Miami	Hartzell Field	I17	**10200**	5100
Miami	Troy Skypark	37I	**4264**	2132
Miami	Waco Field	1WF	**0**	0
Monroe	Monroe County	4G5	**3324**	1662
Montgomery	Brookville Air-Park	I62	**29359**	14679.5
Montgomery	James M. Cox Dayton Intl	DAY	**134524**	67262
Montgomery	Dayton Wright Brothers	MGY	**89045**	44522.5
Montgomery	Moraine Airpark	I73	**12938**	6469
Montgomery	Dahio Trotwood	I44	**1853**	926.5
Montgomery	Phillipsburg	3I7	**68000**	34000
Morgan	Morgan County	I71	**5725**	2862.5
Morrow	Morrow County	4I9	**19108**	9554
Muskingum	Zanesville Municipal	ZZV	**33312**	16656
Muskingum	Parr	42I	**16150**	8075
Noble	Noble County - Mike Brienza Field	I1Ø	**5950**	2975
Ottawa	Middle Bass-East Point	3W9	**1300**	650
Ottawa	Middle Bass Island	3T7	**6500**	3250
Ottawa	North Bass Island	3X5	**1000**	500
Ottawa	Carl R. Keller Field	PCW	**20890**	10445
Ottawa	Put-In-Bay	3W2	**15140**	7570
Paulding	Paulding	2H8	**2100**	1050
Perry	Crooksville	I84	**400**	200
Perry	Perry County	I86	**4550**	2275
Pickaway	Pickaway County	CYO	**35450**	17725
Pickaway	Clarks Dream Strip	Ø3I	**2770**	1385
Pike	Pike County	EOP	**2012**	1006
Portage	Freedom Air Field	7D6	**1623**	811.5
Portage	Farview	86D	**3353**	1676.5
Portage	Mills	7E3	**1050**	525
Portage	Portage County	29G	**9621**	4810.5
Putnam	Ruhe's	R47	**13250**	6625
Putnam	Putnam County	OWX	**11910**	5955
Putnam	Ohio Dusting Co.	6C2	**2995**	1497.5
Richland	Mansfield Lahm Regional	MFD	**57518**	28759
Richland	Shelby Community	12G	**2012**	1006
Ross	Ross County	RZT	**50150**	25075
Sandusky	Fremont	14G	**37450**	18725
Sandusky	Sandusky County Regional	S24	**6148**	3074
Scioto	Greater Portsmouth Regional	PMH	**45830**	22915
Seneca	Bandit Field	5D9	**140**	70

Seneca	Fostoria Metropolitan	FZI	**7900**	3950
Seneca	Weiker	82D	**320**	160
Seneca	Seneca County	16G	**60165**	30082.5
Shelby	Sidney Municipal	I12	**20500**	10250
Stark	Barber	2D1	**13750**	6875
Stark	Miller Airport	4G3	**8000**	4000
Stark	Beach City	2D7	**6112**	3056
Summit	Akron Fulton International	AKR	**26000**	13000
Summit	Akron-Canton Regional	CAK	**120441**	60220.5
Summit	Mayfield	1D4	**450**	225
Summit	Kent State University	1G3	**72500**	36250
Trumbull	Braceville	41N	**425**	212.5
Trumbull	Warren	62D	**14738**	7369
Trumbull	Youngstown-Warren Regional	YNG	**98298**	49149
Tuscarawas	Harry Clever Field	PHD	**54880**	27440
Union	Union County	MRT	**31886**	15943
Van Wert	Van Wert County	VNW	**20516**	10258
Vinton	Vinton County	22I	**5225**	2612.5
Warren	Warren County	I68	**24951**	12475.5
Warren	Red Stewart Airfield	4ØI	**16800**	8400
Wayne	Wayne County	BJJ	**96520**	48260
Williams	Williams County	ØG6	**10010**	5005
Wood	Wood County	1GØ	**27405**	13702.5
Wood	Bordner	3D8	**2200**	1100
Wood	Deshler Municipal	6D7	**2000**	1000
Wood	Metcalf	TDZ	**90700**	45350
Wyandot	Wyandot County	56D	**7410**	3705

III. Aircraft Models and Number of LTO/yr:

Specific aircraft models by airport (generally the larger airports) was obtained from "Table 7" provided by the United States Department of Transportation, Office of Airline Information. This provided the number of LTO's for each aircraft model per year per airport.

Table 2. Sample from "Table 7." This is the all community total of aircraft models for the Akron/Canton area. "All Service" departures were used as the number of LTOs per year for that model. Listed in the original table are aircraft model by airport and number of services/LTOs.

TOTAL DEPARTURES PERFORMD

Aircraft Model	Scheduled Service	Non-Sched Service	All Service
A-318	1		1
A319	384		384
BOEING 717-200	3850		3850
BOEING 727-100		1	1
BOEING 727-200		5	5
BOEING 737-100/200		74	74
BOEING 737-200C	3	3	6
BOEING 737-300		2	2
BOEING 737-700/LR	212		212
BOEING 737-800		5	5
BOEING 757-200		4	4
BOEING 767-300/ER		4	4
CANADAIR RJ-100/ER	542	3	545
CANADAIR RJ-700	2881		2881
CONVAIR CV-580		3	3
DASSAULT FALCON		7	7
DHC8-100 DASH 8	2		2
DOUGLAS DC-9-15F		13	13
DOUGLAS DC-9-30		6	6
EMBRAER-145	144		144
RJ-200ER/RJ-440	5519		5519
SAAB-FAIRCHD 340/B	1804		1804
ALL TYPES	15342	130	15472

IV. Emission factors:

Where there was specific aircraft model data the emission factors were derived using the FAA's Emission Dispersion Modeling System (EDMS). EDMS is a combined emissions and dispersion model for assessing air quality at civilian airports and military air bases. The model was developed by the Federal Aviation Administration (FAA) in cooperation with the United States Air Force (USAF). The model is used to produce an inventory of emissions generated by sources on and around the airport or air base, and to calculate pollutant concentrations in these environments.

Table 5-2 EDMS Aircraft Emissions

Emissions provided by Michigan Department of Environmental Quality. (The few aircraft in Ohio not included in the table had emissions derived by EDMS 5.0 in-house.)

EDMS Aircraft Emissions/LTO by Aircraft Type

EDMS 4.5 Emissions Inventory Report of 2005 Aircraft Inventory Emissions Factors

Year 2005	Lbs Emitted Per LTO						
Aircraft Type	CO	NOx	HC	VOC	SO2	PM2.5	PM10
A- 318	19.8	18.7	4.0	4.4	1.5	0.0	0.0
A-300-600/R/CF/RCF	27.1	56.4	2.0	2.2	4.0	0.2	0.2
A-300B/C/F-100/200	30.2	52.5	3.5	3.7	3.3	0.2	0.2
A-310-200C/F	32.6	52.5	7.3	7.9	3.3	0.2	0.2
A-319	19.8	18.7	4.0	4.4	1.5	0.0	0.0
A320-100/200	13.7	19.8	1.3	1.3	1.8	0.2	0.2
A-321	16.8	36.8	3.1	3.3	2.2	0.0	0.0
A-330-200	29.8	61.5	0.4	0.4	4.4	0.2	0.2
AVROLINER RJ85	24.7	9.5	2.9	3.3	1.3	0.2	0.2
BAE-146-300	24.7	9.0	3.1	3.3	1.3	0.2	0.2
BEECH 1900 A/B/C	11.0	1.1	3.3	3.5	0.2	0.0	0.0
BEECH KINGAIR C-90	1.8	0.9	0.2	0.2	0.2	0.0	0.0
717-200	11.7	23.4	0.0	0.0	1.5	0.0	0.0
727-100	21.4	23.1	4.6	5.1	2.9	0.4	0.4
727-100C/QC	44.5	19.8	4.6	5.1	2.4	1.1	1.1
727-200	19.6	27.3	2.9	3.1	3.3	1.1	1.1
737-100/200	14.1	16.1	2.2	2.4	2.0	0.7	0.7
737-200C	13.9	17.4	6.8	7.5	2.0	0.9	0.9
737-300	28.7	15.9	1.8	2.0	1.8	0.0	0.0
737-400	26.5	18.5	1.5	1.5	1.8	0.0	0.0
737-500	24.7	21.2	1.3	1.3	2.0	0.0	0.0
737-700/LR	17.6	20.1	2.0	2.0	1.8	0.4	0.4
737-800	15.7	27.1	1.5	1.8	2.0	0.7	0.7
737-900	15.7	27.1	1.5	1.8	2.0	0.7	0.7
747-100	252.6	108.5	106.7	116.8	7.1	0.4	0.4
747-200/300	60.6	104.7	7.1	7.7	6.8	0.7	0.7
747-400	67.0	105.6	5.7	6.4	7.3	0.7	0.7
757-200	24.7	35.7	2.0	2.2	2.6	0.4	0.4
757-300	27.1	33.1	0.4	0.4	3.1	0.2	0.2
767-200/ER	32.6	52.5	7.3	7.9	3.3	0.2	0.2
767-300/ER	32.0	62.2	2.6	2.9	4.0	0.4	0.4
777	32.8	85.1	5.1	5.7	4.4	0.4	0.4
CANADAIR RJ-100/ER	16.3	4.9	1.5	1.8	0.7	0.0	0.0
CANADAIR RJ-700	12.6	9.3	0.0	0.0	1.1	0.0	0.0
CESSNA 208	1.1	0.4	0.0	0.0	0.0	0.0	0.0
CONVAIR CV-580	36.2	0.9	8.8	9.5	0.7	0.0	0.0
DASSAULT FALCON	13.7	2.6	2.4	2.6	0.2	0.0	0.0
DHC8-100 DASH 8	5.1	3.1	0.0	0.0	0.4	0.0	0.0
DORNIER 328 JET	1.3	6.6	11.9	12.6	0.7	0.0	0.0
DOUGLAS DC-10-10	102.5	76.7	38.6	42.1	4.2	0.0	0.0
DOUGLAS DC-10-30	45.4	78.7	5.3	5.7	5.1	0.4	0.4

DOUGLAS DC-10-40	131.8	81.8	30.2	33.1	6.0	0.7	0.7
DOUGLAS DC-8-63	263.5	25.6	219.1	239.9	4.2	5.1	5.1
DOUGLAS DC-8-71	53.6	34.6	3.1	3.3	3.7	0.0	0.0
DOUGLAS DC-8-73	53.6	34.6	3.1	3.3	3.7	0.0	0.0
DOUGLAS DC-9-10	14.1	14.6	3.7	4.0	1.8	0.2	0.2
DOUGLAS DC-9-15F	14.1	14.6	3.7	4.0	1.8	0.2	0.2
DOUGLAS DC-9-30	14.1	14.6	3.7	4.0	1.8	0.2	0.2
DOUGLAS DC-9-40	39.7	16.5	10.8	11.9	2.0	1.3	1.3
DOUGLAS DC-9-50	12.6	20.1	1.8	1.8	2.2	0.9	0.9
EMBRAER-135	12.8	5.5	1.1	1.3	0.7	0.0	0.0
EMBRAER-140	13.7	6.0	1.3	1.3	0.7	0.0	0.0
EMBRAER-145	6.4	6.8	1.1	1.1	0.7	0.0	0.0
EMBRAER-170	9.0	9.7	0.0	0.0	1.1	0.0	0.0
F28-4000/6000	76.7	10.4	77.2	84.4	1.5	0.0	0.0
JETSTREAM 41	4.6	2.0	0.4	0.7	0.2	0.0	0.0
L-101101/100/200	33.3	112.0	6.2	6.8	5.7	1.3	1.3
LEAR-25	75.2	0.7	7.9	8.4	0.2	0.0	0.0
LOCKHEED L100-30	48.7	9.9	19.6	21.4	1.8	0.0	0.0
MD-11	47.8	93.3	4.0	4.4	6.0	0.7	0.7
MD-80, 1, 2, 3, 7, 8	16.3	20.3	0.0	0.0	2.2	0.2	0.2
MD-90	12.1	23.8	0.2	0.2	2.0	0.2	0.2
RJ-200ER/RJ-440	16.3	4.9	1.5	1.8	0.7	0.0	0.0
SAAB-FAIRCHD 340/B	4.2	1.5	1.5	1.5	0.2	0.0	0.0

NOTE: Where specific aircraft model data was not available fleet emissions were used. EPA default fleet average emission factors were taken from "Documentation for Aircraft, Commercial Marine Vessel, ,Locomotive, and Other Nonroad Components of the National Emissions Inventory. 2005, see Appendix A, Aircraft Emission Estimation Methodology." Specific model LTOs were subtracted from county LTO totals to eliminate double counting those LTOs.

Table 5-3 Fleet Emission Factor Categories

Fleet emission factors were broken down into three categories. Itinerant General, Local General, and Military.

Table 5-3a Fleet Average Emission Factors for Itinerant General Aircraft.

(Taken from : Table A-5)

Pollutant	Emission Factors (lbs/LTO)
HC	1.234
NOx	0.158
CO	28.13
SOx	0.015
PM10	0.60333

Note: *Air taxi HC emissions * VOC/HC (*0.9914) *conversion factor = air taxi VOC estimate*

Table 5-3b. Fleet Average Emission Factors for Local General Aircraft.

(Taken From: Table A-11)

Pollutant	**Emission Factors (lbs/LTO)**
HC	0.394
NOx	0.065
CO	12.014
SOx	0.01
PM10	0.2367

Note: *GA HC emissions * VOC/HC(*0.9708) *conversion factor = GA VOC estimate*

Table 5-3c. Fleet Average Emission Factors for Military Aircraft.

(Taken from: Table A-17)

Pollutant	**Emission Factors (lbs/LTO**
HC	1.234
NOx	0.158
CO	28.13
SOx	0.015
PM10	0.60333

Note: *Military HC emissions * VOC/HC(*1.1046) *conversion factor = Military VOC estimate*

METHODOLOGY

Introduction

The following information was considered in the development of emission estimates:

1. Commercial scheduled and non-scheduled aircraft air carrier activity and commercial air freight activity by aircraft model types,

2. General aviation and air taxi annual local and itinerant operations for year 2005,

3. Military annual local and itinerant operations for year 2005.

Due to the need to have aircraft operations information expressed as landing/take off (LTO) cycles, the following assumptions were made:

1. For commercial aircraft and commercial air freight activity, the number of annual aircraft annual LTO cycles was assumed to be equal to the number of departures. The daily LTO cycle frequency was then obtained by dividing the yearly LTO cycles by 365.

2. For general aircraft annual local and itinerant airport operations, each respective operations total was divided by 2 to obtain the corresponding year local and itinerant LTO cycles. The expected daily local and itinerant LTO cycles then were obtained by dividing these annual totals by 365.

3. For military annual local and itinerant operations, each respective operations total was divided by 2 to obtain the corresponding year local and itinerant LTO cycles. The expected military daily local and itinerant LTO cycles then were obtained by dividing these annual totals by 365.

Airport LTO cycles were further categorized into commercial aircraft by plane and engine type, general aviation itinerant aircraft of unknown aircraft type, general aviation local aircraft of unknown aircraft type, and military aircraft. This was necessary in order to utilize the U.S. Department of Transportation, Federal Aviation Administration EDMS Emissions and Dispersion Modeling System. Commercial and air freight aircraft emission factors per LTO cycle were determined using EDMS for each commercial aircraft type models where possible were used at each towered airport. Default commercial aircraft engine type, and Environmental Protection Agency (EPA) default time in mode values for takeoff, approach, and landing roll times were used in the EDMS model simulations.

For those aircraft types that could not be determined using the EDMS emissions model, aircraft emission factors based upon EPA alternative fleet average procedures were then used to estimate their emissions. These included general aviation and air taxi itinerant aircraft of unknown aircraft type, general aviation local aircraft of unknown aircraft type, and military aircraft. Conversion from total hydrocarbons to volatile organic compounds was performed and based upon the EPA guidance.

APPROACH

1. A list of more than 90% of the airports was obtained from the Ohio Department of Transportation. These were classed by airport, county, aircraft flight classification, and the total number of operations per year.

2. The number of operations (a landing or a take off) were then divided by two giving the number of LTOs per year per airport. These airports were combined by county for the total number of LTOs per year, per county.

3. In dialog with ODOT it was determined that the following Ohio flight groups of aircraft be combined to match the three categories used by the USEPA in calculating emissions.

Itinerant (General, air carrier, commuter, air taxi, general aviation itinerant)

Local (General aviation local)

Military (Military)

4. LTOs for specific models of aircraft per airport were taken from the FAA Table 7. See **Table 2** above. These were then combined to give the number of LTOs per aircraft model per county. Specific model LTOs were subtracted from county totals to avoid double counting those LTOs.

5. Emission factors were determined from the FAA's EDMS program for specific aircraft model and engine type. See **IV. Emission factors** above. The aircraft emission table provided by Michigan had the emission factors for most of the aircraft flown in Ohio. . Where specific aircraft model data was not available USEPA average fleet emissions were used.

6. Emission factors times LTOs by county yielded tons per year per county.

Table 5-4 Pollutant by County (Sample)

County	POLLUTANT	ACTIVITY(LTOS/YEAR)	ACTIVITY(LTOS/DAY)	EMISSIONS(TON/YEAR)
ADAMS	CO	2605	7.136986	24.552325
ADAMS	HC	2605	7.136986	0.977285
ADAMS	NOX	2605	7.136986	0.136045
ADAMS	PM10-PRI	2605	7.136986	0.513114825
ADAMS	PM25-PRI	2605	7.136986	0
ADAMS	SOX	2605	7.136986	0.0157875
ADAMS	VOC	2605	7.136986	0.96314234
ALLEN	CO	16250	44.52055	147.945065
ALLEN	HC	16250	44.52055	5.841097
ALLEN	NOX	16250	44.52055	0.827189
ALLEN	PM10-PRI	16250	44.52055	3.081191265
ALLEN	PM25-PRI	16250	44.52055	0
ALLEN	SOX	16250	44.52055	0.0984575
ALLEN	VOC	16250	44.52055	5.769568254
ASHLAND	CO	24620	67.45205	173.67794
ASHLAND	HC	24620	67.45205	6.19414
ASHLAND	NOX	24620	67.45205	0.94895
ASHLAND	PM10-PRI	24620	67.45205	3.532515
ASHLAND	PM25-PRI	24620	67.45205	0
ASHLAND	SOX	24620	67.45205	0.1311

ASHLAND	VOC	24620	67.45205	6.07175247
ASHTABULA	CO	8863	24.28219	78.115087
ASHTABULA	HC	8863	24.28219	3.042551
ASHTABULA	NOX	8863	24.28219	0.431593
ASHTABULA	PM10-PRI	8863	24.28219	1.623493455
ASHTABULA	PM25-PRI	8863	24.28219	0
ASHTABULA	SOX	8863	24.28219	0.0520325
ASHTABULA	VOC	8863	24.28219	2.99420213
ATHENS	CO	25800	70.68493	196.874985
ATHENS	HC	25800	70.68493	7.267183
ATHENS	NOX	25800	70.68493	1.081521
ATHENS	PM10-PRI	25800	70.68493	4.037266335
ATHENS	PM25-PRI	25800	70.68493	0
ATHENS	SOX	25800	70.68493	0.1420925
ATHENS	VOC	25800	70.68493	7.128180006

7. Emissions were then summed by pollutants in each county by SCC aircraft category type so data could be provided to LADCO in the EPA prescribed NEI – NIF format.

DATA ERROR

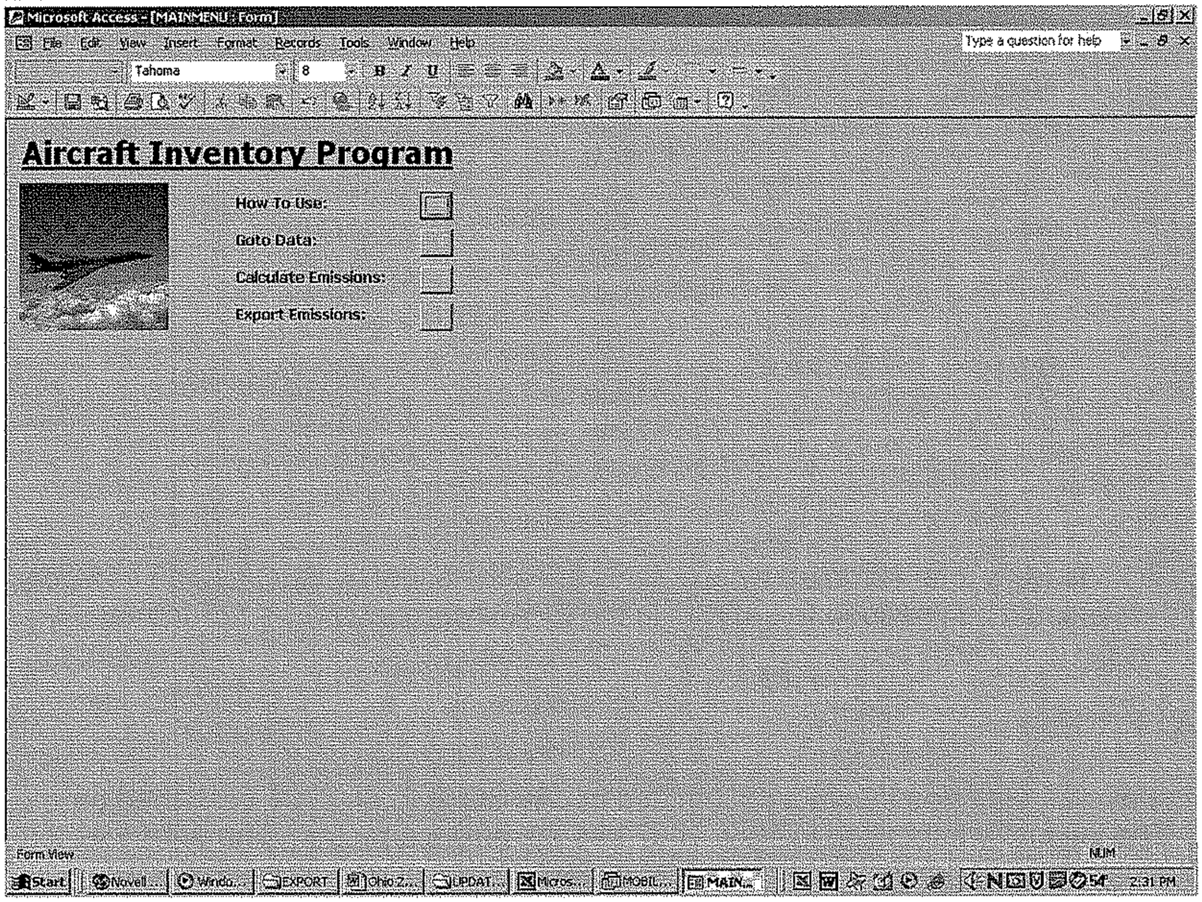
The first aircraft emission inventory submitted to LADCO in April, 2007 contained an error. The inventory submitted in May, 2007 has the error corrected. The error was the result of a carry over function in Access that picked up the number of operations as instead of LTOs….which made the inventory exactly twice as large as what it really was.

ACCESS CALCULATOR

Introduction:

Our database programmer set up Access application to calculate Ohio's aircraft emission inventory, and export those results to Excel. His utility allows for easy modification of the aircraft data to match future data scenarios. Output to Excel also allows for additional data manipulation and importation.

Interface:



Through this interface the following sets of data can be edited/updated: Airport activity, emission factors, specific airport emissions, state/county FIPS, detailed aircraft information, airport information, and aircraft SCCs. Once the final emissions have been calculated and summed, then the data can be export via the export function on the Main Menu.