

Appendix C: Michigan Toxic Emissions Inventory

INTRODUCTION

The State of Michigan conducted its 2002 portion of the Great Lakes Region air toxic emissions inventory by collecting new point source throughput and emissions data for the 2002 inventory year. The Michigan Toxics Emission Inventory covers all measured point sources from the 2002 calendar year Michigan Air Emissions Reporting System (MAERS). Michigan followed the *Air Toxic Emissions Inventory Protocol for the Great Lakes Commission* in developing its inventory. The Factor Information Retrieval System (FIRE) reference tables from the Regional Air Pollutant Inventory Development System (RAPIDS), emission factors specific to the State of Michigan, and individual stack tests were used as sources of emission factors and constants. MAERS and RAPIDS software along with some spreadsheets were used to estimate emissions.

The area source emissions data were estimated by use of the methodologies compiled by the Great Lakes Commission. Emissions data from 17 area source categories was created for 2002. The categories are: agricultural pesticides, architectural surface coatings, auto body refinishing, consumer commercial solvents, dry cleaning, gasoline marketing, graphic arts, halogenated solvent degreasing, hospital sterilizers, human cremation, industrial surface coatings, lamp breakage, lamp recycling, residential fuel combustion, residential wood burning, structure fires, and traffic markings. Landfills are included in the point source inventory.

Onroad and nonroad mobile source air toxic emissions were obtained from the United States Environmental Protection Agency's (EPA's) 2002 draft NEI created via the Nonroad Mobile Inventory Model (NMIM).

POINT EMISSIONS DATA SOURCES

Data for point source emissions were collected by the Michigan Department of Environmental Quality (DEQ), Air Quality Division (AQD) as part of its annual air emissions inventory process. A facility air emissions report is required by the administrative rules of the MDEQ, under authority of Act 348, P.A. 1965, and by Section 182 (a) (3) (B) of the Clean Air Act. Data was collected from 1,962 facilities under these reporting requirements. The data collected contains little reported toxic pollutant emission information. Operator-supplied criteria pollutant data was used in MAERS to estimate toxic emissions for the processes within each facility; however, facility reported toxic emission estimates were used where available.

POINT SOURCE EMISSIONS

The 2002 Michigan point source data was collected from each facility, quality audits were performed, and the data was imported into MAERS. MAERS was then used to make emission estimates for the toxic air pollutants of interest to the Regional Inventory. A calculation was made for every SCC code identified process, which had state-specific or generic FIRE toxic pollutant emission factors, a proper corresponding throughput material and amount. These calculations produced annual emission estimates for 147 different point source toxic air pollutants. The calculated results were exported in NEI format for analysis. A second quality assurance audit was performed, which found several data manipulation and emission factor

discrepancies. Once corrected, the inventory was compared to the Michigan 2001 point source inventory.

A Word of Caution to Trend Analyzers

Because of the program developments, additions, corrections, table reconstructions, and emission estimating algorithms that took place in MAERS, the data that has been generated and becomes the 2002 Michigan Air Toxics Emissions Inventory should not be compared to earlier inventory years for the purpose of trend analysis. Instead, this 2002 point source air toxics emissions inventory should be considered as the base year for future toxic emissions comparisons.

AREA SOURCE EMISSIONS

Agricultural Pesticides

This category was estimated consistent with the Regional Protocol.

Architectural Surface Coating

This category was estimated consistent with the Regional Protocol.

Auto Body Refinishing

The Regional Protocol, alternate method two, was followed. National emissions for the category were allocated to the county level based on census estimates.

Consumer and Commercial Solvent Use

Michigan used the per capita method from the Regional Protocol for this area source category.

Dry Cleaning

Michigan followed the Regional Protocol recommended Emission Inventory Improvement (EIIP) guidance, alternative method two.

Employment data at the six digit NAICS code level for dry cleaning was only available for 11 counties. Therefore, employment numbers were obtained for the numerous counties where three-digit employment data was available, and a ratio of three-digit to six-digit employment values was developed. This ratio was applied to all counties lacking full six-digit employment values. Adjustments were made for point sources, and for those counties not having any perchlorethylene dry cleaners as identified by Michigan's dry cleaning program.

Fluorescent Lamp Breakage

To estimate emissions of MERCURY from fluorescent lamp breakage, Michigan utilized the methodology from the *1999 Base Year Nonpoint Source National Emission Inventory for Hazardous Air Pollutants*, Appendix A, A-52.

Fluorescent Lamp Recycling

To estimate emissions of MERCURY from fluorescent lamp recycling, Michigan utilized the methodology set forth in the *1999 Base Year Nonpoint Source National Emission Inventory for Hazardous Air Pollutants*, Appendix A, A-30.

Gasoline Marketing (Stage I and II)

The Regional Protocol and the EIIP guidance were followed. County gasoline sales data was used to apportion state total gasoline sales to the county level. Emission factors from the regional protocol were then applied. All gasoline marketing (stage I and stage II) emissions are included in this inventory.

Graphic Arts

The Regional Protocol recommending the use of the EIIP guidance was followed. Alternative method two, the per capita emission factor, was the method selected. Speciation factors provided in the Regional Protocol were applied.

Halogenated Solvent Degreasing

Michigan calculated emissions from this category by using employment-based emission factors, per the Regional Protocol.

Hospital Sterilizers

Emissions estimates for this category were prepared by following the Regional Protocol. The second method, which includes emission factors based on hospital size (per number of beds) was utilized.

Human Cremation

Michigan followed the recommendations of the Regional Protocol. The number of human cremations per county for 2002 was obtained from the Michigan Department of Community Health. Emission factors from the NEI were then applied.

Industrial Surface Coating

In accordance with the Regional Protocol, Michigan used alternative method one of the EIIP guidance. Where six-digit NAICS employment data was not available for counties, employment was estimated with the use of ratios based on four- and five-digit NAICS employment data.

Landfills

This area source category was covered as a point source in Michigan's inventory.

Residential Fuels Combustion

The Regional Protocol was followed. Year 2000 Census data on household heating and statewide fuel consumption was obtained, and the emission factors from the protocol were applied.

Residential Wood Burning

Michigan followed the methodology in the Regional Protocol using state energy data reports. However, to convert wood use from cords to tons, Michigan used the method proposed in the EIIP guidance.

Structure Fires

Guidance from EIIP Volume III, Chapter 18: *Structure Fires*, was followed. The first alternative method for estimating emissions was used.

Traffic Markings

A survey was utilized to obtain paint consumption data from Michigan county highway departments. County traffic paint consumption was estimated, and the equation provided in the Regional Protocol was utilized.

ON-ROAD AND NON-ROAD MOBILE EMISSIONS

Onroad and nonroad mobile source air toxic emissions were obtained from the EPA's 2002 NEI Draft Onroad and Nonroad Inventory. The onroad and nonroad mobile emissions were estimated by EPA's NMIM, which develops MOBILE6.2 and NONROAD model input files.

Commercial, Air Taxis, General Aviation, and Military

For aircraft, HAP emission estimates were developed by the EPA using the Federal Aviation Administration's (FAA) Emission and Dispersion Modeling System.

Other Categories Estimated

The commercial marine vessel (CMV) source category includes all boats and ships used either directly or indirectly in the conduct of commerce or military activity. The CMV emission estimates in this inventory were developed by the EPA, and are the same estimates that were developed for the 1999 NEI. The locomotive emission estimates in this inventory were developed by the EPA for the draft 2002 NEI. Spatial allocations were based on the 1999 GIS dataset.

RESULTS

The toxic emissions for Michigan are listed in the table below. The values are expressed in total pounds per year of pollutant by inventory type. As indicated in the text, point source emissions were calculated at the process level, but have been aggregated to and are only reported at the state or county level. An electronic database of toxic emissions, NEI format, for the State of Michigan, is available at the process level upon request. For additional information, contact the MDEQ-AQD, Emissions Reporting and Assessment Unit, P.O. Box 30260, Lansing, Michigan 48909. Telephone: (517)-373-7023.

Michigan - Statewide Emissions (lb/yr)

Pollutant Name (CAS)	Area Source Emissions	Non-road Emissions	On-road Emissions	Point Source Emissions	Total Emissions
Acenaphthene (83-32-9)	2885	1840	2242	79.57	7046
Acenaphthylene (208-96-8)	61,220	6288	12,010	1627	81,150
Acetaldehyde (75-07-0)	421	1,182,000	1,976,000	85,720	3,244,000
Acetamide (60-35-5)	1,216				1,216
Acetonitrile (75-05-8)	2.13			461.2	463.3
Acetophenone (98-86-2)	85.73			624.2	709.9
Acrolein (107-02-8)	82,870	146,400	266,200	24,600	520,100
Acrylic acid (79-10-7)	55.75			14.7	70.45
Acrylonitrile (107-13-1)				3183	3183
Anthracene (120-12-7)	4034	1660	2679	52.36	8425
Antimony (7440-36-0)	0.036			753.7	753.8
Arsenic (7440-38-2)	160.6		11.6	7753	7926
Benz(a)anthracene (56-55-3)	5754	512.1	587.1	147.2	7000
Benzo(g,h,i)perylene (191-24-2)	1152	1305	795.4	3083	6336
Benzene (71-43-2)	1,844,000	5,949,000	14,330,000	352,500	22,470,000
Benzo(a)pyrene (50-32-8)	1152	391.5	390.7	7228	9163
Benzo(b)fluoranthene (205-99-2)	1733	300.6	437	3,897	2474
Benzo(k)fluoranthene (207-08-9)	577.9	280.4	437	2,992	1298
Benzyl chloride (100-44-7)				18,580	18,580
Beryllium (7440-41-7)	44.77	11.48		420.9	477.2
Biphenyl (92-52-4)				338.9	338.9
Bromoform (75-25-2)				4516	4516
Methyl bromide (74-83-9)	2,231,000			4692	2,236,000
1,3-Butadiene (106-99-0)		791,900	1,628,000	79,310	2,500,000
Cadmium (7440-43-9)	471.4	19.89		1521	2013
Captan (133-06-2)	141,500				141,500
Carbaryl (63-25-2)	93,360				93,360
Carbon disulfide (75-15-0)				11,130	11,130
Carbon tetrachloride (56-23-5)	724.7			172.7	897.4
Carbonyl sulfide (463-58-1)				96,980	96,980
Chlorine (7782-50-5)			2051	33,900	35,950
Chlorobenzene (108-90-7)	719,800			1395	721,200
Chloroethane (75-00-3)	91,230			1263	92,490

Pollutant Name (CAS)	Area Source Emissions	Non-road Emissions	On-road Emissions	Point Source Emissions	Total Emissions
Chloroform (67-66-3)	9928			1930	11,860
2-Chloro-1,3-butadiene (126-99-8)				3.84	3.84
Chromium (7440-47-3)	579	68.61	2010	14,330	16,980
Chromium VI (18540-29-9)		36.45	402.1	2212	2650
Chrysene (218-01-9)	3455	334.1	349.7	44.88	4184
2-Chloroacetophenone (532-27-4)				185.8	185.8
Cobalt (7440-48-4)	33.25			351.9	385.1
Coke oven emissions				432,000	432,000
Copper (7440-50-8)			683.3		683.3
Cumene (98-82-8)	25,460			1884	27,350
Cyanide (57-12-5)				66,580	66,580
2,4-D (2,4-Dichlorophenoxyacetic acid) (94-75-7)	163,900				163,900
Dibenz(a,h)anthracene (53-70-3)	806.2	9.667	0.3393	6.951	823.1
Dibenzofuran (132-64-9)	0.000304			1520	1520
1,2-Dibromoethane (106-93-4)	242.1			128.9	371.1
Di-N-butyl phthalate (84-74-2)	8.54			1552	1560
1,2-Dichloroethane (107-06-2)	2525			1376	3902
1,4-Dichlorobenzene (106-46-7)	353,800			22.74	353,800
1,1-Dichloroethane (75-34-3)				1599	1599
1,3-Dichloropropene (542-75-6)				57.9	57.9
Diethanolamine (111-42-2)	100.4			1418	1518
Dimethyl phthalate (131-11-3)	63.85				63.85
Dimethyl sulfate (77-78-1)				1274	1274
N,N-Dimethylformamide (68-12-2)	86,220			4	86,230
4,6-Dinitro-O-cresol (534-52-1)				7237	7237
2,4-Dinitrophenol (51-28-5)				4,281	4,281
2,4-Dinitrotoluene (121-14-2)				7,432	7,432
1,4-Dioxane (123-91-1)				0.0463	0.0463
Epichlorohydrin (106-89-8)				255.5	255.5
Ethyl acrylate (140-88-5)	13.01				13.01
Ethyl benzene (100-41-4)	792,700	4,264,000	5,218,000	32,850	10,310,000
Ethylene glycol (107-21-1)	913,900			711	914,700
Ethylene oxide (75-21-8)	49,600			1661	51,260

Pollutant Name (CAS)	Area Source Emissions	Non-road Emissions	On-road Emissions	Point Source Emissions	Total Emissions
Fluoranthene (206-44-0)	5756	3565	2820	386.4	12,530
Fluorene (86-73-7)	6915	4889	4677	4302	20,780
Formaldehyde (50-00-0)	532,200	3,032,000	5,172,000	527,400	9,264,000
Glycol ethers	423,200			71,560	494,700
Hydrochloric acid (7647-01-0)	288,200			35,540,000	35,830,000
Hexamethylene-1,6-diisocyanate (822-06-0)	0.89				0.89
Hexane (110-54-3)	4,946,000	3,014,000	4,256,000	219,000	12,430,000
Hydrogen fluoride (7664-39-3)	0.783			4,184,000	4,184,000
Hydroquinone (123-31-9)	12,660				12,660
Indeno(1,2,3-c,d)pyrene (193-39-5)	0.1835	394.2	227.2	3.756	625.4
Isophorone (78-59-1)	1108			15,400	16,500
Lead (7439-92-1)	345.6	9035	141	79,220	88,740
Manganese (7439-96-5)	336.8	120.6	2368	41,340	44,160
Mercury (7439-97-6)	213.2			4225	4439
Methyl ethyl ketone (78-93-3)	3,565,000			57,790	3,623,000
Methyl hydrazine (60-34-4)				4512	4512
Methyl iodide (74-88-4)				12.46	12.46
Methyl isobutyl ketone (108-10-1)	1,125,000			6069	1,131,000
Methyl methacrylate (80-62-6)	2328			912.9	3241
Methyl tert-butyl ether (1634-04-4)	216.1		205,400	1799	207,500
Methanol (67-56-1)	461,200			69,580	530,800
4,4'-Methylenediphenyl diisocyanate (101-68-8)				738	738
Methoxychlor (72-43-5)				199	199
Methyl chloride (74-87-3)	76,020			20,690	96,710
Methylene chloride (dichloromethane) (75-09-2)	2,736,000			150,400	2,886,000
Naphthalene (91-20-3)	760,900	111,400	300,500	59,430	1,232,000
Nickel (7440-02-0)	114.1	2047	1555	13,580	17,290
4-Nitrophenol (100-02-7)	0.00102			7243	7243
Polychlorinated biphenyls (PCBs) (1336-36-3)				2.985	2.985
Polychlorinated dibenzodioxins, total		0.04655	0.137	7.293	7.476
Polychlorinated dibenzofurans, total		0.003219	0.00956	36.95	36.96
Tetrachloroethylene (Perc) (127-18-4)	5,810,000			32,310	5,842,000
Phenanthrene (85-01-8)	22,470	7733	7740	4871	42,820
Phenol (108-95-2)	0.032	1741		259,500	261,200

Pollutant Name (CAS)	Area Source Emissions	Non-road Emissions	On-road Emissions	Point Source Emissions	Total Emissions
Phosphorus (7723-14-0)				1513	1513
Phthalic anhydride (85-44-9)				4	4
Propionaldehyde (123-38-6)		302,200	298,400	11,460	612,000
Propylene dichloride (78-87-5)				189	189
Propylene oxide (75-56-9)	5264			4274	9538
Pyrene (129-00-0)	6919	4287	3909	142.2	15,260
Quinone (106-51-4)				1820	1820
Selenium (7782-49-2)	179.9	15.85	33.57	2268	2498
Styrene (100-42-5)	330,300	327,200	1,081,000	357,600	2,096,000
Styrene oxide (96-09-3)				2773	2773
2,3,7,8-Tetrachlorodibenzo-p-dioxin (1746-01-6)		0.00008466	0.0001	0.0005553	0.0007399
2,3,7,8-Tetrachlorodibenzofuran (51207-31-9)		0.0002135	0.00046	0.06963	0.0703
1,1,1-Trichloroethane (71-55-6)	11,450,000			2995	11,460,000
1,1,2,2-Tetrachloroethane (79-34-5)				1816	1816
Toluene (108-88-3)	14,690,000	34,610,000	35,580,000	476,600	85,360,000
Toluene-2,4-diisocyanate (584-84-9)	186.2			1157	1343
Trichloroethylene (79-01-6)	8,237,000			208,100	8,445,000
1,2,4-Trichlorobenzene (120-82-1)				1811	1811
1,1,2-Trichloroethane (79-00-5)				71.13	71.13
Triethylamine (121-44-8)	5287			17,820	23,110
Trifluralin (1582-09-8)	29,450				29,450
2,2,4-Trimethylpentane (540-84-1)	559,400	13,260,000	12,390,000	1039	26,210,000
Vinylidene chloride (75-35-4)				428.2	428.2
Vinyl acetate (108-05-4)	37,480			21,130	58,620
Vinyl chloride (75-01-4)	30.91			3306	3337
M-Xylene (108-38-3)	89,810			1977	91,790
O-Xylene (95-47-6)	160,100			441.5	160,500
P-Xylene (106-42-3)	89,810			257.1	90,070
Xylene (mixed isomers) (1330-20-7)	9,529,000	18,020,000	20,020,000	93,910	47,670,000