Appendix D - Minnesota Toxic Emissions Inventory

BACKGROUND

The Minnesota portion of the Great Lakes regional air toxics emission inventory for mobile sources includes five subcategories: on-road sources, non-road sources, aircraft, commercial marine vessels, and locomotives. The Minnesota Pollution Control Agency (MPCA) used air toxics emissions estimations in the 1999 National Emissions Inventory (NEI) Version 3[1] for on-road and non-road sources. MPCA used state-specific data to calculate emissions estimates for both aircraft and locomotives. The U.S. Environmental Protection Agency's (U.S. EPA) emissions estimates for commercial marine vessels were modified by the MPCA to correct for apparent confusion concerning the locations of ports.

Mobile Source Emissions

On-road Mobile Sources

Minnesota's 1999 statewide air toxics emissions inventory used the U.S. EPA's estimated emissions[1] because the newest version of the U.S. EPA's MOBILE6 Vehicle Emission Modeling Software[2] was not available in time to perform state-specific calculations. MOBILE6 is believed to be a substantial improvement over the previous MOBILE5 model, and was used to generate the U.S. EPA's estimates for on-road sources.[3] MPCA added calculations for copper emissions by speciation from PM10.

County air toxics emissions estimates are the sum of the emissions estimates for twelve vehicle types and up to twelve roadway types. The twelve vehicle types included are:

- 2B Heavy Duty Diesel Vehicles (2BHDDV)
- Buses Heavy Duty Diesel Vehicles (BHDDV)
- Heavy Duty Gasoline Vehicles (HDGV)
- Heavy Heavy Duty Diesel Vehicles (HHDDV)
- Light Duty Diesel Trucks (LDDT)
- Light Duty Diesel Vehicles (LDDV)
- Light Duty Gasoline Trucks 1 (LDGT1)
- Light Duty Gasoline Trucks 2 (LDGT2)
- Light Duty Gasoline Vehicles (LDGV)
- Light Heavy Duty Diesel Vehicles (LHDDV)
- Medium Heavy Duty Diesel Vehicles (MHDDV)
- Motorcycles (MC)

The twelve roadway types included are:

- Rural Interstate
- Rural Local

- Rural Major Collector
- Rural Minor Arterial
- Rural Minor Collector
- Rural Other Principal Arterial
- Urban Collector
- Urban Interstate
- Urban Local
- Urban Minor Arterial
- Urban Other Freeways and expressway
- Urban Other Principal Arterial

<u>Non-road Mobile Sources</u>

Minnesota's 1999 statewide air toxics emissions inventory used the U.S. EPA's estimated emissions[4] because the newest version of the U.S. EPA's NONROAD model[5] has not been released. The "Lockdown (May 2002)" version of the NONROAD model was used to generate the U.S. EPA's estimates of VOC and PM for non-road sources which were speciated to calculate air toxics emissions.[6]

County air toxics emissions estimates are the sum of the emissions estimates for 163 equipment types in ten categories. The equipment categories included are:

- Agricultural Equipment
- Airport Ground Support Equipment
- Commercial Equipment
- Construction and Mining Equipment
- Industrial Equipment
- Lawn and Garden Equipment
- Logging Equipment
- Pleasure Craft
- Railroad Equipment
- Recreational Equipment

Aircraft auxiliary power units, however, were treated differently. Emissions estimates for auxiliary power units were speciated from criteria pollutant estimates generated by the Emissions and Dispersion Modeling System (EDMS) version 4.1[7] produced by the Federal Aviation Administration and commercial aircraft activity data received from the Bureau of Transportation Statistics.[8] The NEI speciation factors for commercial aircraft[9] were used for auxiliary power units.

<u>Aircraft</u>

Commercial Aircraft

MPCA used detailed Bureau of Transportation Statistics landing and takeoff (LTO) data[8] and the Emissions and Dispersion Modeling System (EDMS) version 4.1 software[7] to estimate hydrocarbon emissions. Hydrocarbon emissions were converted to VOC and TOG using NEI conversion factors.[9] Air toxics emissions were estimated by speciating VOC or TOG emissions with NEI speciation factors.[9]

Air Taxis and General Aviation

MPCA used two sources of activity data to calculate Air Taxis and General Aviation air toxics emissions estimates. One source of data was the Air Traffic Activity Data System (ATADS).[10] ATADS provides the actual number of aircraft operations for a limited number of airports. Since landing and taking off are both counted as aircraft operations, the number of LTOs is one half of the number of operations. MPCA also used information from the Terminal Area Forecast System (TAF).[11] TAF provides estimates of the number of aircraft operations for a large number of airports. For airports that were included in both ATADS and TAF, the ATADS data was used instead of the TAF activity estimate.

While there is some concern over using the TAF activity estimates, it is reasonable to use the TAF estimates for calculating air toxics emissions estimates for the following reasons:

- TAF is the official aviation activity forecast of the Federal Aviation Administration and is intended to be used by state authorities for planning purposes.
- TAF estimates are very similar to ATADS data for the Minnesota airports that are included in both data sets.
- Contact with airport managers in Minnesota indicated that TAF estimates are usually reasonable.
- Excluding the TAF estimates would underestimate the air taxi and general aviation activity in Minnesota because few airports are included in ATADS.

MPCA converted aircraft operations to LTOs, then applied NEI emission and speciation factors to estimate air toxics emissions for air taxis and general aviation.[12] MPCA multiplied the ratio of lead to PM10 in the U.S. EPA's estimates[4] times the PM10 in the MPCA's estimates in order to calculate lead emissions for general aviation.

Commercial Marine Vessels

Commercial marine vessel emissions are divided into *underway* and *in port* emissions. Minnesota's 1999 statewide air toxics emissions inventory modified U.S. EPA estimated emissions.[4] MPCA made two modifications to the distribution of *in port* emissions. These modifications did not affect the total emissions for the state.

The first modification involved relocating *in port* emissions from Itasca County to Cook County. The *in port* emissions were probably mistakenly assigned to Itasca county because of a misunderstanding concerning the location of a port. The port of Taconite Harbor, MN, is a major port on Lake Superior and is located in Cook County. Some publications of the U.S.

Army Corps of Engineers refer to this port as "Taconite, MN."[13] Taconite, MN, is not a major port and is located in Itasca County.

The second modification involved splitting the *in port* emissions assigned to Washington County into both Washington and Ramsey counties. The U.S. EPA air toxics emissions estimates assigned *in port* emissions to Washington County, but did not assign any *in port* emissions to Ramsey County.[4] The port of St. Paul, MN, is a major port. MPCA contacted the U.S. Army Corps of Engineers and was informed that commercial marine traffic assigned to the port of St. Paul can be in either Ramsey county or Washington county. The U.S. Army Corps of Engineers did not indicate which county received the majority of the commercial marine traffic.

MPCA used a speciation method in order to calculate emissions some pollutants that were not included in the U.S. EPA's air toxics emissions estimates.

Locomotives

MPCA requested and received a list of railroads operating in Minnesota from the Minnesota Department of Transportation. Railroads were contacted and asked to provide operational information including the number of gallons of diesel fuel consumed in line haul operation, the number of yard locomotives in use, and the counties of operation.

Line haul locomotive air toxics emissions estimation was split into three categories: Class I Railroads, Class II and Class III Railroads, and Passenger railroads. For each railroad category, MPCA distributed diesel fuel to the counties of operation using either a simple average or a weighted average for each railroad. Weighted averages were used whenever the railroad was able to provide some measure to indicate which counties had greater operations than others. The most common measure provided was the number of miles of track operated by the railroad in each county. This assumes that railroads use more fuel in counties with more track than in counties with less track. Although fuel consumption is determined by many factors, the use of weighted averages based on track length should produce more accurate distribution of air toxics emissions estimates than using simple averages. Emissions estimates were calculated using NEI emission and speciation factors[14] as well as SPECIATE 3.2[15] factors. The mercury emission factor used in calculations was 4.2e-7 lbs per gallon of diesel fuel consumed.[17]

Railroads provided the number of yard locomotives operating in each county. Diesel fuel consumption was calculated using fuel consumption factors.[16] Emissions estimates were calculated using NEI emission and speciation factors[14] as well as SPECIATE 3.2[15] factors.

RESULTS AND DISCUSSION

The following results represent emissions from all point, area, and mobile sources in the State of Minnesota for calendar year 1999. The emissions are from 289 distinct source categories and 557 distinct source classification codes (SCC).

The 1999 emissions were estimated for 213 target compounds, however, data were only available to obtain emissions for 144 air toxics, including 16 polycyclic aromatic hydrocarbons (PAHs), 13 metal compounds, and 115 non-metal compounds. Table D-1 shows pollutant names and estimated emissions from point and area sources.

Point sources emitted 139 out of 144 pollutants while area sources emitted 117 pollutants. Pollutant emissions from onroad and nonroad mobile sources numbered 36 and 38, respectively.

Area sources contributed about more than 50% of the total emissions for 14 PAHs and 40 non-metal compounds. Point sources were responsible for more than 55% of total emissions for 10 metal compounds. About 90% of cadmium emissions were from area sources, mainly Prescribed Burning. Point sources contributed more than 50% of total emissions for 1 PAH, and 64 non-metal compounds. Onroad and nonroad mobile sources together emitted a significant portion (more than 64%) of state total emissions for acetaldehyde, benzene, 1,3-butadiene, ethylbenzene, methyl tert butyl ether, propionaldehyde, toluene, 2,2,4-trimethylpentane, and xylenes. Mobile sources also contributed more than 50% emissions of 1 PAH, formaldehyde, copper, and lead. Mobile source copper emissions were basically from vehicles' brake wear. Almost all lead emissions of mobile sources were from Aircraft: General Aviation that used lead-contained aviation gasoline.

Among the 197 pollutants, toluene was estimated to have the highest emissions at 55,782,458 pounds, while 2,3,7,8-tetrachlorodibenzo-p-dioxin emissions were the lowest recorded at about 0.009 pounds.

Table D-2 shows a breakdown of mobile source emissions to sub-categories. Overall, each of two sub-categories, onroad vehicles and nonroad equipment, contributed about half of the total mobile source emissions. Emissions from aircraft, locomotives, and commercial marine vessels accounted for only 1.3% of total mobile source emissions.

MERCURY

A special effort in the development of the 1999 inventory was on more complete and accurate mercury emissions. Besides mercury emissions estimated from onroad vehicles and nonroad equipment in previous emission inventories, emissions from locomotive and commercial marine vessels were also calculated. The improved emission factors and speciation factors provided more mercury emissions in 1999 than in previous inventoried years. Table D-3 shows a comparison of mercury emissions between the 1999 and 1998 inventories for mobile sources. Mercury emissions in 1999 were about 3 times over that of 1998.

The exhaust of vehicles contributed about two thirds of mobile source mercury emissions while the other one third was mainly from exhaust of nonroad equipment.

INFORMATION

For more information about Minnesota's air toxics inventory, please contact:

Ms. Chun Yi Wu
Environmental Outcomes Division
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194
(P) 651-282-5855
(F) 651-297-7709
(E) chun.yi.wu@pca.state.mn.us

Mr. Nicholas Salkowski
Environmental Outcomes Division
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194
(P) 651-296-8709
(F) 651-297-7709
(E) nicholas.salkowski@pca.state.mn.us

REFERENCES

[1] *Hazardous Air Pollutants Data - Review Draft 1999 NEI Version 3*; U.S. Environmental Protection Agency, October 2002.
ftp://ftp.epa.gov/EmisInventory/draftnei99ver3/haps/datafiles/onroad/statefiles/MNHAPONRD1002.zip
[2] *MOBILE6.2 Vehicle Emission Modeling Software*; U.S. Environmental Protection Agency, Research Triangle Park, NC, October 2002.
http://www.epa.gov/otaq/m6.htm
[3] *Documentation for the 1999 National Emissions Inventory Version 2.0 for Criteria Air Pollutants and Draft Version 3.0 for HAPS On-Road Sources*; E.H. Pechan & Associates, Inc., Springfield, VA, October 2002; pp13-17.
ftp://ftp.epa.gov/EmisInventory/draftnei99ver3/haps/documentation/onroad/or_doc99v2_oct02.pdf
[4] *Hazardous Air Pollutants Data - Review Draft 1999 NEI Version 3*; U.S. Environmental Protection Agency, September 2002.
ftp://ftp.epa.gov/EmisInventory/draftnei99ver3/haps/datafiles/nonroad/statefiles/mnhapacr0902.zip
[5] *NONROAD Model*; U.S. Environmental Protection Agency.
http://www.epa.gov/otaq/nonrdmdl.htm
[6] *Documentation for Aircraft, Commercial Marine Vessel, Locomotive, and Other Nonroad Components of the National Emissions Inventory Volume I - Methodology*; Eastern Research Group, Inc.: Morrisville, NC, November 11, 2002; p D1.
ftp://ftp.epa.gov/EmisInventory/finalnei99ver2/criteria/documentation/nonroad/nonroad_voli_nov2002.pdf
[7] *Emissions and Dispersion Modeling System*; Federal Aviation Administration, Washington, DC, October 2002.
http://www.aee.faa.gov/emissions/edms/EDMShome.htm
[8] U.S. Department of Transportation, Bureau of Transportation Statistics, Office of Airline Information. Communication with Don Bright, February 2001.
[9] *Documentation for Aircraft, Commercial Marine Vessel, Locomotive, and Other Nonroad Components of the National Emissions Inventory Volume I - Methodology*; Eastern Research Group, Inc.: Morrisville, NC, November 11, 2002; pp A1-A6.
ftp://ftp.epa.gov/EmisInventory/finalnei99ver2/criteria/documentation/nonroad/nonroad_voli_nov2002.pdf
[10] *Air Traffic Activity Data System (ATADS)*; Federal Aviation Administration.
http://www.apo.data.faa.gov/faaatadsall.HTM
[11] *Terminal Area Forecast System (TAF)*; Federal Aviation Administration.
http://www.apo.data.faa.gov/faatafall.HTM
[12] *Documentation for Aircraft, Commercial Marine Vessel, Locomotive, and Other Nonroad Components of the National Emissions Inventory Volume I - Methodology*; Eastern Research Group, Inc.: Morrisville, NC, November 11, 2002; pp A6-A18.
ftp://ftp.epa.gov/EmisInventory/finalnei99ver2/criteria/documentation/nonroad/nonroad_voli_nov2002.pdf
[13] *Waterborne Commerce of the United States Calendar Year 1999 Part 5 National Summaries*; U.S. Army Corps of Engineers; p 5-5.

http://www.iwr.usace.army.mil/ndc/wcsc/pdf/wcusnatl99.pdf

[14] *Documentation for Aircraft, Commercial Marine Vessel, Locomotive, and Other Nonroad Components of the National Emissions Inventory Volume I - Methodology*; Eastern Research Group, Inc.: Morrisville, NC, November 11, 2002; pp C1-C8.
ftp://ftp.epa.gov/EmisInventory/finalnei99ver2/criteria/documentation/nonroad/nonroad_voli_nov2002.pdf

[15] *SPECIATE 3.2*; U.S. Environmental Protection Agency, Research Triangle Park, NC, November 1, 2002.
http://www.epa.gov/ttn/chief/software/speciate/index.html

[16] *Procedures for Emission Inventory Preparation Volume IV: Mobile Sources*; U.S. Environmental Protection Agency, December 1992; p 207.
http://www.epa.gov/otaq/invntory/r92009.pdf

[17] *Documentation for Aircraft, Commercial Marine Vessel, Locomotive, and Other Nonroad Components of the National Emissions Inventory Volume I - Methodology*; Eastern Research Group, Inc.: Morrisville, NC, November 11, 2002; p C-3.
ftp://ftp.epa.gov/EmisInventory/finalnei99ver2/criteria/documentation/nonroad/nonroad_voli_nov2002.pdf

Table D-1. Summary of the 1999 air toxics emissions from the State of Minnesota.

	Emissions (lb)					Percent (%)			
Pollutant Code	**Point**	**Area**	**Onroad**	**Nonroad**	**Total**	**Point**	**Area**	**Onroad**	**Nonroad**
ACENAPHTHEN	73,759.29	5,186.54	952.28	1,791.58	81,689.69	90.29	6.35	1.17	2.19
ACENAPHTHYL	295.66	109,094.91	4,911.19	4,265.93	118,567.69	0.25	92.01	4.14	3.60
ANTHRACENE	276.37	15,688.71	1,161.52	990.49	18,117.09	1.53	86.60	6.41	5.47
BENZ(A)ANTHR	117.86	20,443.56	328.56	327.03	21,217.01	0.56	96.35	1.55	1.54
BENZ(GHI)PE	1.46	10,396.54	336.52	712.14	11,446.66	0.01	90.83	2.94	6.22
BENZO(A)PYRE	16.89	4,466.45	184.14	220.34	4,887.82	0.35	91.38	3.77	4.51
BENZO(B)FLUO	15.33	3,131.09	198.24	171.09	3,515.75	0.44	89.06	5.64	4.87
BENZO(K)FLUO	1.72	5,297.17	198.24	156.53	5,653.67	0.03	93.69	3.51	2.77
CHRYSENE	14.57	16,386.61	153.21	211.92	16,766.31	0.09	97.74	0.91	1.26
DIBENZAHAN	0.66	0.29	0.03	4.99	5.97	11.00	4.86	0.50	83.64
FLUORANTHENE	393.53	21,821.82	1,190.52	2,145.47	25,551.34	1.54	85.40	4.66	8.40
FLUORENE	201.68	12,663.02	1,994.37	3,562.70	18,421.77	1.09	68.74	10.83	19.34
INDN(123CDPY	0.80	5,617.35	89.79	216.55	5,924.50	0.01	94.82	1.52	3.66
NAPHTHALENE	110,102.28	654,231.68	130,796.73	63,364.65	958,495.35	11.49	68.26	13.65	6.61
PHENANTHRENE	792.66	49,557.46	3,252.86	6,939.61	60,542.59	1.31	81.86	5.37	11.46
PYRENE	461.62	27,977.89	1,671.27	2,451.53	32,562.31	1.42	85.92	5.13	7.53
PAH Total	**186,452.38**	**961,961.10**	**147,419.47**	**87,532.56**	**1,383,365.51**	**13.48**	**69.54**	**10.66**	**6.33**
Metal Compounds									
ANTIMONY	2,427.36	413.71			2,841.07	85.44	14.56		
ARSENIC	16,878.98	72.93	812.46	546.55	18,310.92	92.18	0.40	4.44	2.98
BERYLLIUM	356.41	34.99		45.83	437.23	81.52	8.00		10.48
CADMIUM	2,030.53	17,561.50		52.44	19,644.46	10.34	89.40		0.27
CHROMIUM	27,561.31	1,340.68	311.53	49.28	29,262.81	94.19	4.58	1.06	0.17
CHROMIUM VI	315.23	21.66	207.00	25.39	569.28	55.37	3.80	36.36	4.46
COBALT	4,817.61	485.46			5,303.07	90.85	9.15		
COPPER	29,508.92	1,614.66	32,074.21		63,197.78	46.69	2.55	50.75	
LEAD	79,083.61	7,513.19		103,942.40	190,539.20	41.51	3.94		54.55
MANGANESE	206,486.34	6,431.88	176.17	109.06	213,203.46	96.85	3.02	0.08	0.05
MERCURY	3,561.00	274.42	914.84	491.15	5,241.40	67.94	5.24	17.45	9.37
NICKEL	35,890.92	1,445.05	394.14	1,629.72	39,359.83	91.19	3.67	1.00	4.14

SELENIUM	3,884.99	175.80		12.45	4,073.24	95.38	4.32		0.31
Metal Total	**412,803.22**	**37,385.93**	**34,890.35**	**106,904.26**	**591,983.76**	**69.73**	**6.32**	**5.89**	**18.06**
Non-Metal Compounds (Excluding PAHs)									
ACETALDEHYDE	161,318.98	1,397,090.65	1,884,013.59	1,207,185.28	4,649,608.49	3.47	30.05	40.52	25.96
ACETAMIDE		0.58			0.58		100.00		
ACETONITRILE	12,220.86	0.72			12,221.58	99.99	0.01		
ACETOPHENONE	334.93	1,220.82			1,555.74	21.53	78.47		
ACROLEIN	18,033.75	716,127.92	143,475.58	148,447.77	1,026,085.02	1.76	69.79	13.98	14.47
ACRYLAMIDE	235.00				235.00	100.00			
ACRYLIC ACID	13,708.31	18.65			13,726.96	99.86	0.14		
ACRYLONITRIL	2,004.23	3,320.88			5,325.11	37.64	62.36		
ALLYL CHLORI	7.00				7.00	100.00			
ANILINE	1.10				1.10	100.00			
ATRAZINE		179,347.95			179,347.95		100.00		
BENZENE	158,740.08	3,852,128.35	6,432,980.32	3,647,594.73	14,091,443.48	1.13	27.34	45.65	25.89
BENZYL CHLOR	12,084.88	3.04			12,087.92	99.97	0.03		
BIPHENYL	1,472.51	812.07			2,284.58	64.45	35.55		
BROMOFORM	724.88	0.17			725.05	99.98	0.02		
BROMOMETH	14,008.08	1,060,163.46			1,074,171.54	1.30	98.70		
BUTADIENE,13	1,714.20	667,115.14	783,898.88	451,090.35	1,903,818.57	0.09	35.04	41.18	23.69
CARBON DISUL	2,293.73	437.15			2,730.88	83.99	16.01		
CARBON TETRA	750.77	858.38			1,609.14	46.66	53.34		
CARBONYL SUL	211,113.40	1,170.65			212,284.05	99.45	0.55		
CATECHOL	636.00				636.00	100.00			
CHLORINE	17,824.09	503,638.82			521,462.91	3.42	96.58		
CHLOROACETIC	0.22				0.22	100.00			
CHLOROBENZ	593.55	342,674.25			343,267.80	0.17	99.83		
CHLOROETHANE	11,940.08	42,200.48			54,140.57	22.05	77.95		
CHLOROFORM	43,863.66	10,793.32			54,656.98	80.25	19.75		
CHLOROPRENE	1.00				1.00	100.00			
CLACETOPHE,2	130.11	0.03			130.14	99.98	0.02		
CRESOL MX IS	51,112.97				51,112.97	100.00			
CRESOL,O	21.26				21.26	100.00			

CRESOL,P	1.19				1.19	100.00			
CUMENE	33,590.99	13,297.58			46,888.57	71.64	28.36		
CYANIDE	48,479.92	10.87			48,490.79	99.98	0.02		
D,2,4		168,350.00			168,350.00		100.00		
DIBENZOFURAN	3.97	35.34			39.31	10.09	89.91		
DIBROMOET,12	560.57	4.63			565.21	99.18	0.82		
DIBUTYL PHTH	2,376.57	165.20			2,541.76	93.50	6.50		
DICHLORETH12	1,588.14	1,048.46			2,636.60	60.23	39.77		
DICLBENZ,14	409.82	372,012.08			372,421.89	0.11	99.89		
DICLETH,11-	15.23	965.82			981.05	1.55	98.45		
DICLPROPE,13	46.56	764,081.28			764,127.84	0.01	99.99		
DIETH SULFAT	6.22				6.22	100.00			
DIETHANOLAMI	150.93	33.53			184.46	81.82	18.18		
DIMETH PHTHA	3,590.75	21.29			3,612.04	99.41	0.59		
DIMETH SULFA	892.16	0.21			892.37	99.98	0.02		
DIMETHFORMAM	10,061.34	47,000.31			57,061.65	17.63	82.37		
DINITROPH,24	145.26				145.26	100.00			
DINITRTOL,24	5.20	0.00			5.21	99.98	0.02		
DIOCTYL PHTH	9,778.00	24.64			9,802.64	99.75	0.25		
DIOXANE	12,324.18	74.42			12,398.60	99.40	0.60		
ETH ACRYLATE	4,647.03	4.34			4,651.38	99.91	0.09		
ETHYLBENZENE	251,287.12	95,003.55	2,746,200.54	2,415,876.76	5,508,367.97	4.56	1.72	49.86	43.86
ETHYLENE GLY	46,128.98	155,147.11			201,276.08	22.92	77.08		
ETHYLENE OXI	11,080.30	103,782.31			114,862.61	9.65	90.35		
FORMALDEHYDE	797,707.72	5,104,578.85	3,016,415.59	3,008,306.92	11,927,009.08	6.69	42.80	25.29	25.22
GLYCOL ETHRS	907,612.05	2,246,115.08			3,153,727.13	28.78	71.22		
HCL	25,809,355.02	67,537.78			25,876,892.81	99.74	0.26		
HEXAMETHYL16	3,647.52	0.32			3,647.84	99.99	0.01		
HEXANE	2,390,911.01	3,410,659.90	2,401,854.85	1,733,422.54	9,936,848.30	24.06	34.32	24.17	17.44
HF	2,728,924.70	720.95			2,729,645.64	99.97	0.03		
HYDRAZINE	1.00				1.00	100.00			
HYDROGEN CYA	464.00	142,561.55			143,025.55	0.32	99.68		
HYDROQUINONE	2,340.74	4,232.53			6,573.28	35.61	64.39		
ISOPHORONE	10,996.04	15,318.56			26,314.60	41.79	58.21		
LINDANE ISO	3.00				3.00	100.00			

MALEIC ANHYD	641.70				641.70	100.00			
METH ETH KET	1,191,263.49	3,543,610.64			4,734,874.12	25.16	74.84		
METH HYDRAZI	3,159.73	0.74			3,160.47	99.98	0.02		
METH IODIDE	5.08				5.08	100.00			
METH ISOBUT	354,199.42	1,793,342.83			2,147,542.25	16.49	83.51		
METH METHACR	81,054.43	16.45			81,070.89	99.98	0.02		
METH TERT BU	4,529.80	102.83	12,564.98		17,197.60	26.34	0.60	73.06	
METHANOL	1,550,404.52	3,475,184.94			5,025,589.46	30.85	69.15		
METHENE DIAN	151.00				151.00	100.00			
METHENE(B)4-	63,263.15	554.89			63,818.04	99.13	0.87		
METHYL CHLOR	99,066.45	246,332.26			345,398.72	28.68	71.32		
METHYLENE CL	182,814.89	574,467.69			757,282.58	24.14	75.86		
NITROBENZ	480.13				480.13	100.00			
NITROPHENL,4	427.32				427.32	100.00			
NITROPROPA,2		9.26			9.26		100.00		
PCBS	1.14	0.11			1.25	90.92	9.08		
PCDD	0.03	0.00			0.03	99.09	0.91		
PCDF	0.05	0.00			0.05	98.28	1.72		
PCP	0.01				0.01	100.00			
PERC	76,037.94	328,340.18			404,378.12	18.80	81.20		
PHENOL	215,471.05	31.49			215,502.54	99.99	0.01		
PHENYLENED,P	99.00				99.00	100.00			
PHOSPHINE	439.70	419.70			859.40	51.16	48.84		
PHOSPHORUS	42,491.85	34,347.56			76,839.41	55.30	44.70		
PHTHALIC ANH	758.21				758.21	100.00			
PROPIONALDEH	9,440.89	1.65	159,883.84	276,887.71	446,214.09	2.12	0.00	35.83	62.05
PRPLENE DICH	6.74	201.07			207.81	3.24	96.76		
PRPLENE OXID	644.83				644.83	100.00			
QUINOLINE	0.22				0.22	100.00			
QUINONE	1,868.25				1,868.25	100.00			
STYRENE	2,057,136.33	1,176.02	556,695.28	225,030.16	2,840,037.79	72.43	0.04	19.60	7.92
TCDD,2378	0.00	0.01			0.01	26.85	73.15		
TCDF,2378	0.03	0.40			0.42	6.17	93.83		
TCE,111	5,640.16	1,727,228.68			1,732,868.84	0.33	99.67		
TETCLET,1122	72.09	1,063.79			1,135.88	6.35	93.65		

TOLUENE	2,278,625.92	10,333,742.33	18,620,142.76	24,549,946.51	55,782,457.51	4.08	18.53	33.38	44.01
TOLUENE24DII	4,887.55	62.37			4,949.92	98.74	1.26		
TRICHLORETHY	396,772.86	29,304.02			426,076.88	93.12	6.88		
TRICLBNZ,124	7,315.20				7,315.20	100.00			
TRICLETH,112	97.70				97.70	100.00			
TRIETHAMINE	590.18	4,006.65			4,596.83	12.84	87.16		
TRIFLURALIN		84,240.00			84,240.00		100.00		
TRIME-PENTAN	6,687.80	408,291.84	6,432,286.76	9,785,967.77	16,633,234.17	0.04	2.45	38.67	58.83
VINLIDENE CL	213.75	2,249.99			2,463.74	8.68	91.32		
VINYL ACETAT	28,861.75	12,500.65			41,362.40	69.78	30.22		
VINYL CHLOR	824.09	12,543.97			13,368.06	6.16	93.84		
XYLENE,M	305.98	3,095.40			3,401.38	9.00	91.00		
XYLENE,O	7,520.76	199,701.31			207,222.06	3.63	96.37		
XYLENE,P	132.74				132.74	100.00			
XYLENES ISO	2,054,780.69	7,069,664.92	10,469,753.86	10,026,089.08	29,620,288.55	6.94	23.87	35.35	33.85
Non-Metal Total	**44,555,209.48**	**51,377,748.62**	**53,660,166.82**	**57,475,845.57**	**207,068,970.49**	**21.52**	**24.81**	**25.91**	**27.76**
Grand Total	**45,154,465.08**	**52,377,095.65**	**53,842,476.64**	**57,670,282.39**	**209,044,319.75**	**21.60**	**25.06**	**25.76**	**27.59**

Table D-2. Summary of the 1999 air toxics emissions from mobile sources in the State of Minnesota.

Sub-Source Category	Emissions (lb)	Percentage (%)
Onroad Vehicles	53,842,477	48.28
Nonraod Equipment	56,250,067	50.44
Aircraft	674,431	0.60
Locomotives	245,780	0.22
Commercial Marine Vessels	500,004	0.45
Total Mobile Sources	111,512,759	100.00

Table D-3. Summary of the 1999 mercury emissions from mobile sources in the State of Minnesota.

Sub-Source Category	1999 Emissions (lb)	1998 Emissions (lb)
Onroad Vehicles	914.84	115.70
Nonraod Equipment	408.32	318.02
Aircraft		
Locomotives	45.32	
Commercial Marine Vessels	37.50	
Total Mobile Sources	1,405.99	433.72