

Appendix D: Minnesota Toxic Emissions Inventory

INTRODUCTION

The development of the Minnesota portion of the regional air toxics emission inventory follows the instructions illustrated in the protocol document and uses the Regional Air Pollution Inventory Development System (RAPIDS) to estimate emissions. However, because Minnesota does not have air toxic emission inventory reporting requirements for industrial point sources, we have established an alternative approach for development of the Minnesota inventory that meet the protocol requirements. Using this approach, 1088 point sources were estimated to have emissions for one or more pollutants listed in the 1999 Great Lakes regional air toxics emission inventory. Also, various area sources were examined and emissions were estimated for 25 area source categories. Presented in the following sections is a detailed discussion on data acquisition, emission estimation, quality assurance and quality control plans, and uncertainties inherent in the inventory.

METHODOLOGY

Data Acquisition

The 1999 Minnesota portion of the air toxic emission inventory includes three principal source categories: point, area, and mobile sources. However, the work for mobile sources is still in process. The following sections give separate discussions on emission data acquisition for point and area sources.

Point Source Emissions

Minnesota does not have air toxic emission inventory reporting requirements for industrial point sources. However, emission data for point sources are collected for the Minnesota criteria pollutant emission inventory (MCEI). Therefore, for the purpose of the Minnesota air toxics emission inventory, point sources are identified as facilities that are required to submit their annual inventories of criteria pollutants (carbon monoxide, nitrogen oxides, particulate matter, particulate matter smaller than 10 microns, lead, sulfur dioxide, and volatile organic compounds) to the Minnesota Pollution Control Agency (MPCA). According to this definition, there were a total of 2183 point sources in Minnesota in calendar year 1999.

To estimate emissions of air toxic pollutants from Minnesota point sources, computer software, MIRROR, was developed to convert the MCEI data into the RAPIDS computing environment.

Area Source Emissions

Area sources are stationary sources that are not required to submit criteria pollutant data to the MPCA. The categories of area sources have been determined by the Great Lakes States after reviewing the 1999 Base Year Nonpoint Source National Emission Inventory for Hazardous Air Pollutants (NEI), Emission Inventory Improvement Program (EIIP) documents and other available information.^{6,8} The emission data for area sources were obtained from surveys, literature, and the submittals for the National Emission Standards for Hazardous Air Pollutants. There are 25 categories and 53 sub-categories of area sources included in Minnesota portion of the regional emission inventory. Table D-1 lists all these categories along with activity data and information sources.

EMISSION ESTIMATION

Point Sources

RAPIDS was used to compile Minnesota's air toxics inventory for point sources. The approach was to first separately identify each device/process at each facility, and then estimate emissions for each device/process. The following describes the available emission estimation methods and their prioritization for use in the emission inventory.

1. Direct reporting values

Because Minnesota does not have a rule to mandate point sources to report air toxics emissions, in August 2000, MPCA sent a letter to the top 400 emitters based on the sum of PM and VOC emissions to request that they voluntarily provide emission information. This letter was also posted on the MPCA web site along with reporting guidance. About 35% of facilities (137) responded, including refineries and other manufacturing facilities.

Also, in March 2001, a separate letter was sent to 240 facilities holding Option D air quality permits with actual VOC emissions of more than 5 tons in 1999. These facilities use paints and primers, cleaning solvents, printing solutions, and paint thinners, and are required to track monthly HAP emissions. About 98% of these facilities (236) responded to the data request. The reported information was examined and appropriate emissions were used.

In addition, lead (Pb) emissions were provided by facilities for the criteria pollutant inventory. These values were adapted to the air toxics emission inventory in order to maintain the consistency in these two MPCA inventories.

2. Emission factors

An emission factor is defined as "a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant."¹ Emission factors can be either source-specific or generic. In the current version of RAPIDS, the emission factors from the EPA Factor Information Retrieval (FIRE) Data System, version 6.23, are used as generic emission factors.² In most cases, these emission factors are derived from actual measurements of the emissions from representative

sources/processes, and are assumed to be the long-term averages for all facilities in the source category. The source-specific emission factors are derived from source-specific emission testing, mass balance, or chemical analysis. Therefore, they are preferred for estimating emissions from a source.

The MPCA has focused on developing source-specific emission factors. Some source-specific emission factors were developed based on the information in facility permit applications and stack testing reports. Metal Mining/Iron Ores Process and Electric Services/Coal Burning facilities were selected for this special effort. These two industrial sectors are not covered by the Toxics Release Inventory (TRI) report but contributed almost 50% of PM emissions from point sources in 1999. A detailed discussion on the development of emission factors and the emission inventory for these two industrial sectors was presented in two papers.^{3,4}

In addition, we also developed source-specific emission factors for municipal solid waste incinerators, chromium electroplating facilities, some paper mills, and some facilities manufacturing wood products.

We have noticed that a number of measurements from stack tests or chemical analyses are lower than detection limits. In these situations, the detection limits were used in place of the measurements.

3. TRI data

The TRI is compiled by the Minnesota Department of Public Safety for manufacturing point sources with certain reporting thresholds. The emission data are facility-based and of unknown accuracy. For many facilities reporting to the TRI, the emission estimates appear to be incomplete in terms of the number of pollutants included. However, when the source-specific or generic emission factors were not available, TRI emissions were used for some facilities. For the MN inventory, we incorporated TRI emissions for 162 facilities.

Area Source Emissions

Source-specific emission factors and speciation profiles were developed for each area source category. Then, the county-level activity data were imported to RAPIDS and emission estimates were calculated by using the emission factor method and speciation method. In the speciation method, emissions of particulate matter (PM) or total organic gases (TOG) were speciated to individual air toxic compounds using speciation profiles.

Activity Data Pre-Treatment

There are different levels of source activity data available for different categories of area sources. Source activities are any parameters associated with the source that are surrogates for emissions, for example, fuel throughput, solvent usage, or population. Some source categories, such as Dry Cleaning, Chromium Electroplating, Halogenated Solvent Cleaners, need to comply with NESHAPs and the source-level or process-level activity data are available from the initial notification forms. In this case, spreadsheets were used to aggregate emission data for all similar or identical device/processes within each county. For example, for dry cleaners, county total tetrachloroethylene consumption values were calculated for all

dry-to-dry machines with control, all dry-to-dry machines without control, all transfer machines with control, and all transfer machines without control, using tetrachloroethylene consumption data from each individual dry cleaner within the county.

However, for some area sources direct activity data are not available at the county level. In these cases, statewide activity data were apportioned to each county based on appropriate activity indicators. For example, fuel consumption data for Residential Fuel Combustion were calculated from the state fuel consumption by using population data. If state-level activity data were not available, appropriate surrogate activity data were used. For example, county-based population data were used as the most appropriate or applicable activity data for commercial and consumer solvent products and architectural surface coating.

Source-Specific Emission Factors and Speciation Profiles

Since FIRE version 6.23 and SPECIATE version 3.0 contain few emission factors and speciation profiles for area sources, source-specific emission factors and speciation profiles were developed for the area sources included in the Minnesota portion of the regional emission inventory.^{2,5} These emission factors and speciation profiles were compiled from a review of available literature. Given first preference were EPA publications or studies, such as the 1999 NEI documents and Emission Inventory Improvement Program (EIIP) documents.^{6,8} Information from the California Air Resource Board and other resources were also incorporated. If information was not available for a source category, emission factors for similar processes or sources were used as surrogates such as the use of emission factors for commercial/institution combustion to estimate emissions from residential fuel combustion.

The resulting approaches and methodologies have been documented in the emission estimation protocols for Minnesota area sources.⁷

QUALITY ASSURANCE AND QUALITY CONTROL

To develop a reasonable and comprehensive air toxic emission inventory, procedures have been developed to provide quality assurance/quality control (QA/QC) of the data throughout the entire process of emission inventory development. Quality assurance is a planned set of external activities that are conducted by personnel not directly involved in the development of the inventory to evaluate data quality. On the other hand, quality control is a planned set of internal activities conducted by inventory development personnel to ensure data accuracy and completeness.

Quality Control

The QC procedures in the inventory development include technical reviews, accuracy checks, and use of approved standardized procedures for emission calculations. The QC activities have been performed and will be performed in the following three aspects.

Activity Data

For point source, the Minnesota emission inventory data for criteria pollutants were used. Using the MCEI data minimized errors in the activity data because these data are the bases for emission fees. For this reason, facilities pay close attention to the quality of these data.

For area sources, the activity data were compared with other states data. Special attention was paid to point and area source reconciliation to eliminate double counting of emissions. This is because a given category of emissions can be comprised of both point and area sources. For example, some of the halogenated solvent cleaners are point sources and their emissions are included with the point source emissions.

Emission Factors

There are many multiple generic emission factors found in FIRE 6.23. To select the appropriate emission factors, each state reviewed a section of FIRE 6.23. The generic criteria for emission factor selection were established after the review process. These selections were then reviewed and subsequently approved by the other states.

The source-specific emission factors for point sources that were developed in Minnesota were based on stack testing data, mass balance, chemical analysis results, available literature, and engineering calculations. These emission factors were reviewed by both the MPCA and the individual facilities. Most of these emission factors were derived from facility air quality permit applications.

Emission Results

To assess the reasonableness of estimated emission results for point sources, the process-based emissions for each pollutant were examined. The extraordinary emission values were re-calculated. The activity data and emission factors, which led to the extraordinary emissions, were verified. For area sources, the emissions were calculated using the RAPIDS software and spreadsheets. The results from these two approaches were compared and evaluated until a perfect match was reached.

Quality Assurance

The QA plan included the following activities:

- Release of the process-level emission inventories to selected facilities. Requested their voluntary validation of the emission data and estimates. The selected facilities were those having source-specific emission factors such as Metal Mining/Iron Ores Process and Electric Services/Coal Burning facilities. The information and comments in the facility responses were also incorporated into the emission inventory.
- Requested technical review at Great Lakes regional level. Minnesota emission estimates were compared with estimates from other Great Lakes States. Extraordinary values, missing pollutants, and extra pollutants were examined.

RESULTS AND DISCUSSIONS

Emissions were estimated for the 213 target compounds in the Great Lakes regional air toxics emission inventory project. However, data were only available to obtain emissions for 144 out of the 213 air toxics. Point sources emit 139 pollutants, while area sources emit 117 pollutants. The summary table (Table D-2) shows the name and the emissions of these 144 pollutants totaled by principal source category.

It was estimated that 1088 out of 2183 point sources emitted one or more pollutants listed in the summary table. We incorporated source-specific emission information from 145 large emitters, 236 facilities with Option D permits, and 165 TRI facilities. Point source emissions are from 246 distinct standard industrial classification (SIC) codes and 200 distinct source classification codes (SCC). Emissions from area sources were calculated for the 25 categories and 53 sub-categories, mentioned in the previous section, and 44 distinct SCCs.

Hydrochloric acid was estimated to have the highest emissions at 25,876,892.81 pounds, while TCDD,2378 emissions are the lowest recorded at 0.0091 pounds.

Mercury

A special effort in the development of the 1999 inventory was on more complete and accurate mercury emissions.

First, area sources categories were expanded to include those associated with mercury emissions, such as fluorescent lamp breakage and fluorescent lamp recycling.

Second, we identified source categories and processes from which mercury emissions were likely, but emission factors were not available in FIRE 6.23. Six SCCs for coal, oil, and natural gas combustion were identified: 10200204, 10200217, 10300209, 10300401, 20100201, 20300202. We didn't estimate mercury emissions for these processes in the 1999 inventory but will use emission factors for similar processes in future inventories if EPA does not update FIRE emission factors for these SCCs.

Third, through regional QA/QC activities, we identified sources and processes associated with available mercury emission factors, from which mercury emissions were not estimated. Five SCCs for combustion, manufacture, and waste dispersal were identified: 10300222, 30400301, 30400403, 30600106, and 50300501. The problems were mainly due to a lack of appropriate activity data. Consequent investigation and correction were made to these sources and processes.

Fourth, we worked collaboratively with MPCA staff who compiled an updated inventory of 1990 releases of mercury in Minnesota required under *Minnesota Statutes*. This updated inventory used an approach at a different level of details from the emission inventory compiled in this project.⁹ We used the same methodology for certain area source categories, such as fluorescent lamp breakage and recycling, and municipal solid waste landfills. A comparison of total mercury

emissions was made between the 2000 updated mercury inventory and the results presented in this report. The difference is less than 5%. However, there are discrepancies on the coverage of source categories between these two emission inventories.

The total mercury emissions in Minnesota were 3,835.41 pounds in 1999. About 92.85% of mercury emissions were from point sources. Point source mercury emissions were from 183 SIC codes and 75 distinct SCCs. Area source mercury emissions were from 4 categories including 8 sub-categories.

A summary of mercury emissions in Minnesota by source categories is shown in Table D-3. Among all source categories, electric services contributed the most, with emissions of 1524.32 pounds (approximately 40% of the total).

UNCERTAINTIES

Although QA/QC plans were established to ensure optimum results, there are uncertainties in the Minnesota portion of the Great Lakes regional air toxics emission inventory. Some uncertainties are common for all air toxics emission inventories. For example, not all pollutants are included in the inventory and some emission factors are missing or are of poor quality, resulting in unrepresentative emission estimates. These uncertainties are not discussed here. The following discussions focus on three uncertainties specifically for Minnesota.

Source Classification Code Assignment

Since Minnesota does not have air toxic emission inventory reporting requirements, the emission data in MCEI were used for point sources. These emission data, including facility identification, device identification, process identification, and process activities, were submitted by the individual facilities. However, the quality of a key component, source classification codes (SCC), is in question because these codes have never been reviewed by facilities in the MCEI reporting system. SCC codes are very important for estimating air toxics emissions because all emission factors are directly tied to SCC codes. It is interesting to note that the relationship of emissions and SCC codes for criteria pollutants is not as sensitive as for air toxics. An incorrect SCC assignment may still give correct emission values for criteria pollutants but lead to significant over-estimation or under-estimation of air toxics emissions.

Small Point Sources

There are 466 and 785 facilities in the MCEI with registration permit Options B and D, respectively. These facilities do not report process level throughput data and have no SCC assigned to them. Without the information, RAPIDS cannot estimate air toxics emissions for these facilities. Relying on the MCEI to convert point source emissions data to the RAPIDS computing environment caused the air toxics emission inventory to be incomplete. These sources are relative small sources, include auto body shops, small painting shops, wood furniture shops,

asphalt plants, grain elevators, seed elevators, feed mills, mechanical garages, and others. Although we collected data from 236 Option D facilities and some other facilities may report to the TRI, most of these small point sources had to be treated as area sources. Since chemical species use varied from one facility to the other, our solution was to collect material usage and composition data from these facilities. There is a plan to collect more source-specific data in the future.

Control Efficiencies

Most control efficiencies used in the MCEI are default values and may not reflect the operating conditions in facilities. Therefore, uncertainties are introduced for criteria pollutant emission estimates. Due to scarce information on control efficiencies for air toxics, control efficiencies for particulate matter (PM) and volatile organic compounds (VOC) were used for all air toxics in PM format and VOC format, respectively. It is recognized that the control efficiencies for individual air toxics can deviate greatly from the control efficiencies for PM or VOC. However, PM and VOC control efficiencies have to be used until better information is obtained for each individual air toxic. Therefore, it is unlikely there will be a reduction in this uncertainty for some time.

Detection Limits

A number of source-specific emission factors as well as generic emission factors were developed by using detection limits when the measurements were lower than detection limits. This approach provides conservative results but tends to over-estimate emissions.

REFERENCES

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INFORMATION

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Table D-1: Area source categories and information sources for their activity data.

Category Name	Sub-Category Name	Emission Estimation Method	Activity Data Information Source
Architectural Surface Coating	Water-based Paint	Apply speciation profiles to VOC. VOC emissions are obtained from population-based estimation method.	Census data
	Solvent-based Paint	Same as above	Same as above
Asphalt Paving	Asphalt Paving	Use state-specific activity data and emission factors.	Survey of asphalt suppliers
Autobody Refinishing	Autobody Refinishing	Use per capita emission factor for VOC and apply speciation profiles to VOC emissions.	Census data
Chromium Electroplating	Chromic Anodizing	Use both source-specific and generic emission factors. Activity data are source-specific.	NESHAP submittals and survey
	Decorative Hexavalent plating	Same as above	Same as above
	Hard Chrome Plating	Same as above	Same as above
Commercial/Consumer Solvent Products	Commercial/Consumer Solvent Products	Use national per capita emission factors	Census data
Dry Cleaners	Transfer Machines with Control	Use emission factor based on solvent usage and machine type.	NESHAP submittals and survey letters
	Transfer Machines Uncontrolled	Same as above	Same as above
	Dry-Dry Machine with Control	Same as above	Same as above
	Dry-Dry Machine Uncontrolled	Same as above	Same as above
Fluorecent Lamp Breakage	Fluorecent Lamp Breakage	Apportion national numbers of discarded lamp to county values based on the population census data. Use state-specific fractions for recycling and generic emission factors.	Census data
Fluorecent Lamp Recycling	Fluorecent Lamp Recycling	Same as above	Same as above
Forest Fires	Forest Fires	Use the acreage of forest fires at a county level and emission factors.	MD of Natural Resources
Gasoline Service Stations	Stage I: Splash Filling of Gasoline Storage Tanks	Use EPA emission factor for VOC and some air toxics. County activity data are allocated from state fuel consumption based on population. Applied speciation profiles to VOC emissions for air toxics without emission factors.	MD of Revenue
	Stage I: Submerged Filling w/o Control of Underground Tanks	Same as above	Same as above
	Stage I: Gasoline Underground Tank Breathing	Same as above	Same as above
	Stage II: Vapor Loss from Vehicle Refueling	Same as above	Same as above
	Stage II: Spilling Loss w/o controls from vehicle refueling	Same as above	Same as above

Category Name	Sub-Category Name	Emission Estimation Method	Activity Data Information Source
	Stage I: Total, Aviation Gasoline	Same as above	Same as above
Gasoline Trucks in Transit	Gasoline Trucks in Transit	Use EPA emission factor for VOC. County activity data are allocated from state fuel consumption based on population. Apply speciation profiles to VOC emissions for air toxics.	MD of Revenue
Grain Elevators	Grain Elevators	Apportion state pesticide usage to a county-level based on the amount of grain harvested. Calculate with an emission factor method.	MD of Agricultural, U.S. Department of Agriculture
Graphic Arts	Graphic Arts	Apply state-specific speciation profiles to VOC. VOC emissions are obtained from population-based estimation method.	Census data
Hospital Sterilization	Hospital Sterilization	Use the 1996 NEI emission factors based on the number of beds in a hospital.	American Hospital Association, MD of Health
Human Cremation	Human Cremation	Emission factors from the 1999 NEI based on tons cremated. Assume 150 LB per body.	MD of Health
Industrial Surface Coating	General Surface Coatings	Use employee-based emission factors for VOC and apply speciation profiles to VOC emissions.	Census data
	High Performance Coatings, Solvent Based Coatings	Use per capita emission factor for VOC and apply speciation profiles to VOC emissions.	Census data
	High Performance Coatings, Water Based Coatings	Same as above	Same as above
Municipal Solid Waste Landfills	Non-flaring MSW Landfills	Create a model based on AP-42, Section 2.4. Most concentrations of air toxics are obtained from MPCA landfill gas study.	MPCA
	Flaring MSW Landfill gas	Use generic emission factors.	MPCA
POTW facilities	Evap. emissions assoc. with treatment	Survey to gather annual influent flowrate and chlorine consumption. Treat big facilities based on actual processes. Assume a typical plant then use emission factors for small facilities.	MPCA Water Quality Division, WWTIR
	Evap. emissions assoc. with chlorination	Same as above	Same as above
Pesticides - Agricultural	Herbicides, Corn	Use vapor pressure of the active ingredients to determine per acre emission factors. Consider pesticide application and formulation type. Apportion state pesticide usage to a county-level based on crop acreage.	MD of Agricultural, U.S. Department of Agriculture
	Insecticides, Corn	Same as above	Same as above
	Herbicides, Soy Beans	Same as above	Same as above

Category Name	Sub-Category Name	Emission Estimation Method	Activity Data Information Source
Prescribed Burning	Prescribed Burning	Apportion 'region' (6 regions in the state) level data on the acreage of prescribed burns to the county level using the proportion of forested land by county. Calculate with an emission factor method.	MD of Natural Resources
Residential Fossil Fuel Combustion	Combustion of Natural Gas	Use population-based fuel consumption and both state -specific and generic emission factors.	
	Combustion of Bituminous/Subbituminous Coal	Same as above	Same as above
	Combustion of Distillate Oil	Same as above	Same as above
	Combustion of Liquid Petroleum Gas (LPG)	Same as above	Same as above
Residential Wood Burning	Certified, Catalytic Woodstoves	Use population-based fuel consumption and emission factors.	MD of Public Service, MN energy data book
	Certified, Non-Catalytic Woodstoves	Same as above	Same as above
	Conventional Woodstoves	Same as above	Same as above
	Fireplace, Cordwood	Same as above	Same as above
	Fireplace, Firelog	Same as above	Same as above
Solvent Cleaning	Open Top Vapor Degreasing, Trichloroethylene (Misc Control)	Use emission factors and facility-specific data on type of degreasing and solvent consumption.	NESHAP submittals and survey
	Open Top Vapor Degreasing, Trichloroethylene (Uncontrol)	Use emission factors and facility-specific data on type of degreasing and solvent consumption.	NESHAP submittals and survey
	Cold, Vapor, and In-Line Cleaning	Use employee-based emission factors for VOC and apply sepciation profiles to VOC emissions.	Census data
	Solvent Cleanup	Use employee-based emission factors for VOC and apply sepciation profiles to VOC emissions.	Census data
Structure Fires	Residential Structure Fires	Use emission factors recommended by the EIIP document based on tons of material burned. Assume the average total material burned in each fire is 1.15 ton.	MD of Public Safety
Traffic Markings	Water-based paints	Use emission factor based on pain usage. Apply Minnesota specific information from the MSDS for estimating VOC and air toxics.	MD of Transportation and venders
	Epoxy	Same as above	Same as above
Total 25	Total 53		

DC = Department of Climatology, University of Minnesota. It provided heating degree days for adjusting the wood consumption.
DNR = Minnesota Department of Natural Resources
MD = Minnesota Department
NESHAP = National Emission Standards for Hazardous Air Pollutants
WWTIR = Wastewater Treatment Facilities Inventory Report

Table D-2: Minnesota - Statewide Emissions (lb/yr)

Pollutant	Point Sources	Area Sources	Total
ACENAPHTHEN	73,759.29	5,186.54	78,945.83
ACENAPHTHYL	295.66	109,094.91	109,390.56
ACETALDEHYDE	161,318.98	1,397,090.65	1,558,409.62
ACETAMIDE	0.00	0.58	0.58
ACETONITRILE	12,220.86	0.72	12,221.58
ACETOPHENONE	334.93	1,220.82	1,555.74
ACROLEIN	18,033.75	716,127.92	734,161.67
ACRYLAMIDE	235.00	0.00	235.00
ACRYLIC ACID	13,708.31	18.65	13,726.96
ACRYLONITRIL	2,004.23	3,320.88	5,325.11
ALLYL CHLORI	7.00	0.00	7.00
ANILINE	1.10	0.00	1.10
ANTHRACENE	276.37	15,688.71	15,965.08
ANTIMONY	2,427.36	413.71	2,841.07
ARSENIC	16,878.98	72.93	16,951.91
ATRAZINE	0.00	179,347.95	179,347.95
BENZ (A) ANTHR	117.86	20,443.56	20,561.42
BENZ (GHI) PE	1.46	10,396.54	10,398.00
BENZENE	158,740.08	3,852,128.35	4,010,868.43
BENZO (A) PYRE	16.89	4,466.45	4,483.34
BENZO (B) FLUO	15.33	3,131.09	3,146.42
BENZO (K) FLUO	1.72	5,297.17	5,298.89
BENZYL CHLOR	12,084.88	3.04	12,087.92
BERYLLIUM	356.41	34.99	391.40
BIPHENYL	1,472.51	812.07	2,284.58
BROMOFORM	724.88	0.17	725.05
BROMOMETH	14,008.08	1,060,163.46	1,074,171.54
BUTADIENE, 13	1,714.20	667,115.14	668,829.34
CADMIUM	2,030.53	17,561.50	19,592.03
CARBON DISUL	2,293.73	437.15	2,730.88
CARBON TETRA	750.77	858.38	1,609.14
CARBONYL SUL	211,113.40	1,170.65	212,284.05
CATECHOL	636.00	0.00	636.00
CHLORINE	17,824.09	503,638.82	521,462.91
CHLOROACETIC	0.22	0.00	0.22
CHLOROBENZ	593.55	342,674.25	343,267.80
CHLOROETHANE	11,940.08	42,200.48	54,140.57
CHLOROFORM	43,863.66	10,793.32	54,656.98
CHLOROPRENE	1.00	0.00	1.00
CHROMIUM	27,561.31	1,340.68	28,901.99
CHROMIUM VI	315.23	21.66	336.89
CHRYSENE	14.57	16,386.61	16,401.18
CLACETOPHE, 2	130.11	0.03	130.14
COBALT	4,817.61	485.46	5,303.07
COPPER	29,508.92	1,614.66	31,123.58
CRESOL MX IS	51,112.97	0.00	51,112.97
CRESOL, O	21.26	0.00	21.26
CRESOL, P	1.19	0.00	1.19
CUMENE	33,590.99	13,297.58	46,888.57
CYANIDE	48,479.92	10.87	48,490.79
D, 2, 4	0.00	168,350.00	168,350.00
DIBENZAHAN	0.66	0.29	0.95
DIBENZOFURAN	3.97	35.34	39.31
DIBROMOET, 12	560.57	4.63	565.21
DIBUTYL PHTH	2,376.57	165.20	2,541.76
DICHLORETH12	1,588.14	1,048.46	2,636.60
DICLBENZ, 14	409.82	372,012.08	372,421.89
DICLETH, 11-	15.23	965.82	981.05
DICLPROPE, 13	46.56	764,081.28	764,127.84
DIETH SULFAT	6.22	0.00	6.22
DIETHANOLAMI	150.93	33.53	184.46
DIMETH PHTHA	3,590.75	21.29	3,612.04
DIMETH SULFA	892.16	0.21	892.37
DIMETHFORMAM	10,061.34	47,000.31	57,061.65
DINITROPH, 24	145.26	0.00	145.26
DINITRTOL, 24	5.20	0.00	5.21
DIOCTYL PHTH	9,778.00	24.64	9,802.64
DIOXANE	12,324.18	74.42	12,398.60
ETH ACRYLATE	4,647.03	4.34	4,651.38
ETHYLBENZENE	251,287.12	95,003.55	346,290.67
ETHYLENE GLY	46,128.98	155,147.11	201,276.08

Pollutant	Point Sources	Area Sources	Total
ETHYLENE OXI	11,080.30	103,782.31	114,862.61
FLUORANTHENE	393.53	21,821.82	22,215.35
FLUORENE	201.68	12,663.02	12,864.71
FORMALDEHYDE	797,707.72	5,104,578.85	5,902,286.57
GLYCOL ETHRS	907,612.05	2,246,115.08	3,153,727.13
HCL	25,809,355.02	67,537.78	25,876,892.81
HEXAMETHYL16	3,647.52	0.32	3,647.84
HEXANE	2,390,911.01	3,410,659.90	5,801,570.91
HF	2,728,924.70	720.95	2,729,645.64
HYDRAZINE	1.00	0.00	1.00
HYDROGEN CYA	464.00	142,561.55	143,025.55
HYDROQUINONE	2,340.74	4,232.53	6,573.28
INDN(123CDPY	0.80	5,617.35	5,618.15
ISOPHORONE	10,996.04	15,318.56	26,314.60
LEAD	79,083.61	7,513.19	86,596.80
LINDANE ISO	3.00	0.00	3.00
MALEIC ANHYD	641.70	0.00	641.70
MANGANESE	206,486.34	6,431.88	212,918.23
MERCURY	3,561.00	274.42	3,835.41
METH ETH KET	1,191,263.49	3,543,610.64	4,734,874.12
METH HYDRAZI	3,159.73	0.74	3,160.47
METH IODIDE	5.08	0.00	5.08
METH ISOBUT	354,199.42	1,793,342.83	2,147,542.25
METH METHACR	81,054.43	16.45	81,070.89
METH TERT BU	4,529.80	102.83	4,632.62
METHANOL	1,550,404.52	3,475,184.94	5,025,589.46
METHENE DIAN	151.00	0.00	151.00
METHENE(B)4-	63,263.15	554.89	63,818.04
METHYL CHLOR	99,066.45	246,332.26	345,398.72
METHYLENE CL	182,814.89	574,467.69	757,282.58
NAPHTHALENE	110,102.28	654,231.68	764,333.97
NICKEL	35,890.92	1,445.05	37,335.96
NITROBENZ	480.13	0.00	480.13
NITROPHENL,4	427.32	0.00	427.32
NITROPROPA,2	0.00	9.26	9.26
PCBS	1.14	0.11	1.25
PCDD	0.0300	0.0003	0.0303
PCDF	0.0525	0.0009	0.0534
PCP	0.0100	0.0000	0.0100
PERC	76,037.94	328,340.18	404,378.12
PHENANTHRENE	792.66	49,557.46	50,350.12
PHENOL	215,471.05	31.49	215,502.54
PHENYLENED,P	99.00	0.00	99.00
PHOSPHINE	439.70	419.70	859.40
PHOSPHORUS	42,491.85	34,347.56	76,839.41
PTHALIC ANH	758.21	0.00	758.21
PROPIONALDEH	9,440.89	1.65	9,442.54
PRPLENE DICH	6.74	201.07	207.81
PRPLENE OXID	644.83	0.00	644.83
PYRENE	461.62	27,977.89	28,439.51
QUINOLINE	0.22	0.00	0.22
QUINONE	1,868.25	0.00	1,868.25
SELENIUM	3,884.99	175.80	4,060.79
STYRENE	2,057,136.33	1,176.02	2,058,312.35
TCDD,2378	0.00	0.01	0.01
TCDF,2378	0.03	0.40	0.42
TCE,111	5,640.16	1,727,228.68	1,732,868.84
TETCLET,1122	72.09	1,063.79	1,135.88
TOLUENE	2,278,625.92	10,333,742.33	12,612,368.25
TOLUENE24DII	4,887.55	62.37	4,949.92
TRICHLORETHY	396,772.86	29,304.02	426,076.88
TRICLBNZ,124	7,315.20	0.00	7,315.20
TRICLETH,112	97.70	0.00	97.70
TRIETHAMINE	590.18	4,006.65	4,596.83
TRIFLURALIN	0.00	84,240.00	84,240.00
TRIME-PENTAN	6,687.80	408,291.84	414,979.64
VINLIDENE CL	213.75	2,249.99	2,463.74
VINYL ACETAT	28,861.75	12,500.65	41,362.40
VINYL CHLOR	824.09	12,543.97	13,368.06
XYLENE,M	305.98	3,095.40	3,401.38
XYLENE,O	7,520.76	199,701.31	207,222.06
XYLENE,P	132.74	0.00	132.74
XYLENES ISO	2,054,780.69	7,069,664.92	9,124,445.61

Table D-3: Minnesota - Statewide Summary of Mercury Emissions

SIC Code	Description	Emissions (lb)	Percent (%)
4911	Electric services	1,524.32	39.74
1011	Metal mining, iron ores	859.56	22.41
4952	Sewerage systems	379.29	9.89
4953	Refuse systems	261.77	6.83
3312	Blast furnaces and steel mills	176.21	4.59
MSW Landfills	Municipal solid waste landfills	175.10	4.57
3341	Secondary nonferrous metals	96.62	2.52
2911	Petroleum refining	103.26	2.69
Residential Fossil Fuel Combustion	Residential fossil fuel combustion	68.01	1.77
2063	Beet sugar	33.88	0.88
4922	Natural gas transmission	33.37	0.87
2621	Paper mills	29.51	0.77
Fluorescent Lamp Breakage and Recycling	Fluorescent Lamp Breakage and Recycling	26.94	0.70
2611	Pulp mills	23.91	0.62
4931	Electric and other services combined	7.02	0.18
2075	Soybean oil mills	6.37	0.17
2759	Commercial printing	5.64	0.15
Human Cremation	Human Cremation	4.37	0.11
8062	General medical & surgical hospitals	4.17	0.11
8221	Colleges and universities	2.56	0.07
4961	Steam and air-conditioning supply	1.18	0.03
Other	Other	12.34	0.32
Total	Total	3,835.41	