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# **2002 Inventory of Toxic Air Emissions For the Great Lakes Region**

May 2006

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This inventory represents the results of an ongoing initiative of the air regulatory agencies in the eight Great Lakes states and the province of Ontario.

**Submitted by:**

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**On behalf of:**

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New York Department of Environmental Conservation, Division of Air Resources  
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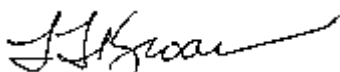
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## **Acronyms and Abbreviations**

AMS	Area and Mobile Source
BTU	British Thermal Unit
BW	Brake Wear
CAS	Chemical Abstract Service
EIIP	Emission Inventory Improvement Program
EIS	Emission Inventory System
FIRE	Factor Information Retrieval System
FPRT	Fuel Process Rate
GIS	Geographic Information Systems
GLC	Great Lakes Commission
GLEI	Great Lakes Emissions Inventory
GLIN	Great Lakes Information Network
GLPF	Great Lakes Protection Fund
HAP	Hazardous Air Pollution
HDGV	Heavy-Duty Gasoline Vehicles
HDDV	Heavy-Duty Diesel Vehicles
IDEM	Indiana Department of Environmental Management
IEPA	Illinois Environmental Protection Agency
IJC	International Joint Commission

IMS	Information Management System
INDOT	Indiana Department of Transportation
LDDV	Light-Duty Diesel Vehicles
LDDT	Light-Duty Diesel Trucks
LDGV	Light-Duty Gasoline Vehicles
LDGT1	Light-Duty Gasoline Trucks (from 0 to 6000 lbs gross vehicle weight)
LDGT2	Light-Duty Gasoline Trucks (from 6000 to 8500 lbs gross vehicle weight)
MACT	Maximum Achievable Control Technology
MC	Motorcycles
MCEI	Minnesota Criteria Pollutant Emission Inventory
MDEQ	Michigan Department of Environmental Quality
MOBILE	U.S. EPA's Vehicle Emissions Model
MPCA	Minnesota Pollution Control Agency
MSDS	Material Safety Data Sheet
NAICS	North American Industry Classification System
NATA	National Air Toxics Assessment
n.e.c.	Not Elsewhere Classified
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NO <sub>x</sub>	Nitrogen Oxides
NEI	National Emissions Inventory
NYDEC	New York Department of Environmental Conservation
OEPA	Ohio Environmental Protection Agency
OMS	Office of Mobile Standards
PAH	Polycyclic Aromatic Hydrocarbons
PDEP	Pennsylvania Department of Environmental Protection
PM	Particulate Matter
POTW	Publicly Owned Treatment Works
QA/QC	Quality Assurance/Quality Control
RAPIDS	Regional Air Pollutant Inventory Development System
RFG	Reformulated Gasoline
SAMS SIP	Air Pollutant Inventory Management System
SCC	Source Classification Code
SIC	Standard Industrial Classification
SIP	State Implementation Plan
SSD	Source Summary Database
STEPS	State Environmental Programs Systems
TOG	Total Organic Gases
TRI	Toxic Release Inventory
TW	Tire Wear
U.S. EPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
VOC	Volatile Organic Compound
WDNR	Wisconsin Department of Natural Resources

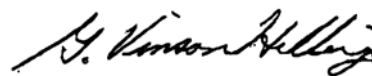
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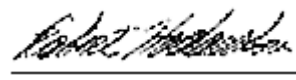


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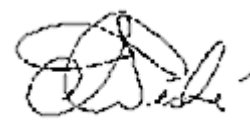
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As an unprecedented effort to compile a regional inventory of toxic air emissions, a multitude of complex issues had to be resolved to ensure that the priorities of all Great Lakes jurisdictions - federal, state, and provincial - were addressed. This unique effort has benefited from the leadership of Orlando Cabrera-Rivera, chair of the Steering Committee for the Great Lakes Regional Air Toxic Emissions Inventory Project, Kevin Yam and Jon Dettling, project managers, Great Lakes Commission, and Buzz Asselmeier and Chun Yi Wu for conducting the quality assurance and quality control checks on the inventory data. The Steering Committee, composed of emission inventory specialists from the Great Lakes states, U.S. EPA and the province of Ontario worked together closely, making the project a team effort.

This report was written, compiled, and reviewed by all of the above project participants in addition to their staff. Editorial, report compilation and technical assistance was provided by Great Lakes Commission staff. Project administration and oversight was provided by Thomas R. Crane, Commission interim executive director, and Roger Gauthier, program manager.

# 1. Inventory Objectives and Methodology

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This 2002 emissions inventory, a product of the Great Lakes Regional Air Toxic Emissions Inventory Project, presents a multijurisdictional inventory of point, area and mobile sources of toxic air emissions that have the potential to impact environmental quality in the Great Lakes region. This initiative was undertaken through an intergovernmental partnership involving the eight Great Lakes states, the province of Ontario, and the U.S. Environmental Protection Agency (U.S. EPA). The objective of this ongoing initiative is to present researchers and policy makers with detailed, region-wide data on the sources and emitted amounts of air toxic contaminants.

The development of this inventory is an important step in meeting the goals outlined in:

- Sections 112(c)(6), 112(k) and 112(m) of the 1990 U.S. Clean Air Act Amendments (<http://earth1.epa.gov/oar/caa.html>);
- the 1986 Great Lakes Toxic Substances Control Agreement (signed by the Great Lakes governors and Premier of Ontario, <http://www.cglg.org/pub/toxics/index.html>); and
- Annexes 12 and 15 of the Great Lakes Water Quality Agreement (<http://www.ijc.org/rel/agree/quality.html>).

The inventory project presents a compilation of the best available data for calendar year 2002 emissions. The Great Lakes jurisdictions believe this work will provide a strong foundation upon which to build national and binational strategies to reduce toxic air emissions affecting the Great Lakes.

This inventory effort focused on the identification of point, area and mobile source categories that emit the toxic contaminants listed in Table 1-1. This list of 211 contaminants was compiled using the Great Lakes Water Quality Agreement, International Joint Commission's list of Great Lakes critical pollutants, U.S. EPA's list of targeted toxic chemicals and compounds defined in the U.S. Clean Air Act Amendments of 1990, section 112 (c)(6), and those pollutants suggested by the Great Lakes states and Province of Ontario.

The inventory strengthens decision making capabilities in the region by promoting interjurisdictional consistency in data collection and analysis, establishing standard procedures and protocols, developing and testing an automated emission estimation and inventory system, and disseminating inventory results to participants and stakeholders through the Internet.

## Inventory Objectives and Applications

The objective of the inventory is to provide a comprehensive, comparable and up-to-date accounting of the region's toxic air emissions to inform further scientific and policy efforts to assess the impacts of these emissions on human health and the environment and to support efforts to reduce such impacts. In addition to promoting broad availability to the data through the internet, the regional inventory Steering Committee has actively supported many efforts to obtain and use the inventory data for scientific research and policy development. Specific examples include the following:

- Prioritizing state air toxics compliance, enforcement and pollution prevention projects
- Providing data for analyzing impacts of air toxics to human health and environment for use in state rule making and revisions, permitting, and modification of reporting thresholds.
- Preparation of reports on environmental quality for legislature, policy makers and the general public
- Supporting efforts by the Binational Toxics Strategy B(a)P Workgroup to target reduction strategies
- Supporting state committees in developing and assessing approaches for achieving emission reductions for area and mobile sources
- Supporting the prioritization of pollutants and facilities for permitting review
- Indicating permit violations based on HAP emissions
- Providing data to neighboring states for permit evaluation
- Providing data to support the statewide assessment air toxic impacts and risks, including:
  - Wisconsin DNR's state-wide air toxics risk assessment projects
  - Minnesota PCA's evaluation of modeled and monitored air pollutant risk
  - Modeling of air toxics within New York State
- Supporting U.S. EPA activities, such as:
  - the National Emissions Inventory (NEI)
  - the National Air Toxics Assessment (NATA)
  - the Air Screening Assessment study for Cook Co. Illinois and Lake Co. Indiana, also known as the "Cumulative Risk Initiative."
  - the NEPA Environmental Impact Statement analysis for Chicago's O'Hare Airport
- Supporting the "Great Woodstove Change out" program in Minnesota
- Providing data on mercury emissions from combustion and metal production facilities for inclusion in the "2002 Estimates of Anthropogenic Mercury Air Emissions in Michigan."
- Supporting development and application of mercury modeling systems for the Great Lakes region
- Supporting regional and metropolitan efforts to assess fuel usage and emissions for diesel engines to promote pollution prevention
- Tracking the benefit of NESHAP implementation, such as for dry cleaning
- Supporting Environment Canada's preparation of issue papers addressing emissions of priority toxic substances from several classes of uncontrolled combustion in the Great Lakes basin
- Supporting state efforts to compare emissions data with the Toxics Release Inventory and over time.
- Providing assistance on determination of pollutants that would be emitted and need to be tested from certain processes
- Providing data to support community service projects and university and high school special projects
- Providing data to researchers working on environmental and children's health issues

## Inventory Scope

The Great Lakes Toxic Air Emissions Inventory effort began in 1989 with primary funding provided by the U.S. EPA. Development of a *Regional Air Pollutant Inventory Development System* (RAPIDS), a regional protocol for calculating emissions and an inventory for Southwest Lake Michigan launched this regional effort. To date, inventories for the years 1993, 1996, 1997, 1998, 1999, 2001 and 2002 have been released. The 1993 inventory consisted of point and area sources for 49 pollutants of concern. The 1996, 1997 and 1998 inventories include emissions information from point, area, and mobile sources for 82 toxic air pollutants. For the 1999, 2001 and 2002 inventory, the list of target compounds was increased to 211. Emissions estimates are not available for all 211 compounds on the target list. One potential reason for lack

of estimates for targeted compounds is variations in emissions reporting requirements in the states and province. Reasons for lack of estimates are described below in Section 2.

## Inventory Methodology

The 2002 iteration of the Regional Toxic Air Emissions Inventory focuses on significant sources of air emissions of 211 toxic air pollutants in the jurisdictions bordering the Great Lakes. Working cooperatively through the Great Lakes Commission, inventory work is undertaken by the air quality departments of the state and provincial governments in the region. Staff at each agency followed the *Regional Toxic Air Emissions Inventory Protocol* (online at [www.glc.org/air/protocol/protocol.html](http://www.glc.org/air/protocol/protocol.html)). The protocol provides guidelines to accomplish the regional inventory development effort so the inventory is complete, accurate, and consistent from one jurisdiction to the next. The protocol does the following:

- Assigns responsibilities and procedures to the states, province and Great Lakes Commission;
- Outlines procedures to identify and locate emission sources of target compounds;
- Guides selection of specific emission estimation techniques;
- Instructs participants on compiling and updating the regional data repository;
- Outlines quality assurance/quality control procedures for emission data and estimates; and
- Identifies the suite of automated tools available for developing the regional inventory.

Two important issues for the inventory development effort are the appropriate level of detail and the use of facility versus area approach for calculating emissions. For the inventory, the protocol defines the following level of detail as being appropriate for meeting the goals of the project:

- **Emittants included:** Include all target compounds listed in Table 1-1;
- **Spatial resolution:** By county for area and mobile sources, and to the nearest 100 meters for facility sources and associated devices;
- **Temporal resolution:** Annual emissions estimates and annual activity data; and
- **Source/device/process categorization:** By the most detailed source/device/process as identified in U.S. EPA's Source Classification Codes (SCC) and Area and Mobile Source (AMS) coding systems of process codes plus a further breakdown by North American Industrial Classification System (NAICS) or Standard Industrial Classification (SIC), as appropriate, to better categorize a given source (required to prevent the problem of inconsistent aggregation of sources/devices/processes among the participating states and province).

The protocol describes the two emission calculation approaches as follows:

- **Facility source approach:** Separately identify each device/process at each facility source and calculate its emissions (often referred to as a facility/point source approach); and
- **Area source approach:** Aggregate all similar or identical device/processes within a defined area and calculate their total emissions directly using the appropriate surrogate activity data

(the source in this case is the area in which all of the devices are found, usually an entire county).

The area source approach is generally used for sources that are small and numerous, such as gasoline stations and dry cleaning establishments. They are not included as facility sources because the effort required to gather and estimate emissions for each individual facility is beyond the resources available for inventory development efforts. Some area sources, such as consumer products, have no analog as a facility source.

## **Quality Assurance/Quality Control**

Quality Assurance/Quality Control (QA/QC) of the inventory was performed. The RAPIDS software used to compile the inventory provides feedback on missing data during emission calculation and “out of range” errors when importing or entering data via the input screens. Regional checks included items such as:

- Comparing emissions of the states/province to each other
  - State/province emissions by pollutant;
  - State/province emissions by pollutant and source category (point, area, etc.);
- Comparing emissions of a state or province to its emissions from previous inventories, and other sources of data;
- Ranking emissions by county for each pollutant and looking for outliers;
- Identifying the individual source types for area, mobile and non-road sources that were not inventoried by a state or province;
- For each SCC, identified which pollutants each state and province inventoried and indicated which pollutants were missing or extra.

These checks, and other minor ones, ensured that this report provided an accurate, consistent and useful summary of toxic air emissions at the regional level.

## **On-line Data Access**

The Steering Committee, working with Pangaea Technologies, Ltd., has completed the development of a spatial, online interface to the regional inventory data, the Centralized Air emissions Repository On-Line (CAROL). CAROL represents a vast improvement in the communication and outreach capacity of the regional inventory program. This tool allows users to view and download source-level emissions inventory data in a user-specific format, including online mapping applications. This powerful tool promotes the broader use of the emissions inventory data in modeling and impact assessment activities throughout the basin. The expected benefits include better-informed decision making and identification of additional inventory needs, among others. The CAROL tool can be accessed at <http://mds.glc.org/carol/>.

This report represents a summary of the data at the date of publication. Updates and corrections to the regional emissions data may be made and will be disseminated online through the CAROL system.

## Next Steps

The project will prepare its next inventory representing the calendar year 2005. In the interim, the group will continue to improve emission estimates for PBTs, with particular focus on benzo(a)pyrene and other pollutants of concern to the region. The group will work to improve the level of detail of the inventory information to better satisfy policy, modeling, and research needs. Moreover, we will continue to work on improving the state and provincial capacity to compile inventories, and in coordinating our project with other regional and national initiatives dealing with emission inventories and the assessment of toxic air emissions.

**Table 1-1: List of 211 targeted toxic air pollutants or groups.**

Pollutant Grouping	Substance Name	CAS #	RAPIDS Code
1,1,1-Trichloroethane	1,1,1-Trichloroethane	71-55-6	TCE,111
1,1,2,2-Tetrachloroethane	1,1,2,2-Tetrachloroethane	79-34-5	TETCLET,1122
1,1,2-Trichloroethane	1,1,2-Trichloroethane	79-00-5	TRICLETH,112
1,1-Dichloroethane	1,1-Dichloroethane	75-34-3	DICLETH,11-
1,1-Dimethylhydrazine	1,1-Dimethyl hydrazine	57-14-7	DIMETH HY,11
1,2,4-Trichlorobenzene	1,2,4-Trichlorobenzene	120-82-1	TRICLBZ,124
1,2-Dibromo-3-chloropropane	1,2-Dibromo-3-chloropropane	96-12-8	DIBROMO3,12
1,2-Dibromoethane	1,2-Dibromoethane	106-93-4	DIBROMOET,12
1,2-Dichloroethane	1,2-Dichloroethane	107-06-2	DICHLORETH12
1,2-Diphenylhydrazine	1,2-Diphenylhydrazine	122-66-7	DIPHENHYD,12
1,2-Epoxybutane	1,2-Epoxybutane	106-88-7	EPOXYBUT,12
1,2-Propylenimine	1,2-Propylenimine	75-55-8	PROP IM, 12
1,3-Butadiene	1,3-Butadiene	106-99-0	BUTADIENE,13
1,3-Dichloropropene	1,3-Dichloropropene	542-75-6	DICLPROPE,13
1,3-Propane sultone	1,3-Propane sultone	1120-71-4	PROPANESU,13
1,4-Dichlorobenzene	1,4-Dichlorobenzene	106-46-7	DICLBENZ,14
1,4-Dioxane	1,4-Dioxane	123-91-1	DIOXANE
2,2,4-Trimethylpentane	2,2,4-Trimethylpentane	540-84-1	TRIME-PENTAN
2,3,7,8-Tetrachlorodibenzofuran	2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	TCDF,2378
2,3,7,8-Tetrachlorodibenzo-p-dioxin	2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	TCDD,2378
2,4,5-Trichlorophenol	2,4,5-Trichlorophenol	95-95-4	TRICLPHN,245
2,4,6-Trichlorophenol	2,4,6-Trichlorophenol	88-06-2	TRICLPHN,246
2,4-D (2,4-Dichlorophenoxyacetic acid)	2,4-D, salts and esters	94-75-7	D,2,4
2,4-Diaminotoluene	2,4-Diaminotoluene	95-80-7	TOL DIAMIN24
2,4-Dinitrophenol	2,4-Dinitrophenol	51-28-5	DINITROPH,24
2,4-Dinitrotoluene	2,4-Dinitrotoluene	121-14-2	DINITRTOL,24
2-Acetylaminofluorene	2-Acetylaminofluorene	53-96-3	ACETYLAMIN,2
2-Chloro-1,3-butadiene	Chloroprene	126-99-8	CHLOROPRENE
2-Chloroacetophenone	2-Chloroacetophenone	532-27-4	CLACETOPHE,2
2-Nitropropane	2-Nitropropane	79-46-9	NITROPROPA,2
3,3'-Dichlorobenzidine	3,3-Dichlorobenzidine	91-94-1	DICLBENZD,33
3,3'-Dimethoxybenzidine	3,3-Dimethoxybenzidine	119-90-4	DIMETHOXY,33
3,3'-Dimethylbenzidine	3,3-Dimethylbenzidine	119-93-7	DIMETHBNZ,33
4,4'-Methylene bis(2-chloroaniline)	4,4-Methylene bis(2-chloroaniline)	101-14-4	METEN BIS,44
4,4'-Methylenedianiline	4,4-Methylene dianiline	101-77-9	METHENE DIAN
4,4'-Methylenediphenyl diisocyanate	4,4-Methylenediphenyl diisocyanate	101-68-8	METHENE(B)4-

Pollutant Grouping	Substance Name	CAS #	RAPIDS Code
4,6-Dinitro-O-cresol	4,6-Dinitro-o-cresol (including salts)	534-52-1	DINITRO-O-CR
4-Aminobiphenyl	4-Aminobiphenyl	92-67-1	AMINOBIPEHE,4
4-Nitrobiphenyl	4-Nitrobiphenyl	92-93-3	NITRBIPHEN,4
4-Nitrophenol	4-Nitrophenol	100-02-7	NITROPHENL,4
Acenaphthene	Acenaphthene	83-32-9	ACENAPHTHEN
Acenaphthylene	Acenaphthylene	208-96-8	ACENAPHTHYL
Acetaldehyde	Acetaldehyde	75-07-0	ACETALDEHYDE
Acetamide	Acetamide	60-35-5	ACETAMIDE
Acetonitrile	Acetonitrile	75-05-8	ACETONITRILE
Acetophenone	Acetophenone	98-86-2	ACETOPHENONE
Acrolein	Acrolein	107-02-8	ACROLEIN
Acrylamide	Acrylamide	79-06-1	ACRYLAMIDE
Acrylic acid	Acrylic acid	79-10-7	ACRYLIC ACID
Acrylonitrile	Acrylonitrile	107-13-1	ACRYLONITRIL
Alkylated lead	Alkylated lead compounds Tetraethyl lead	78-00-2	LEAD,ALK TETETH LEAD
Allyl chloride	Allyl chloride	107-05-1	ALLYL CHLORI
Aniline	Aniline	62-53-3	ANILINE
Anthracene	Anthracene	120-12-7	ANTHRACENE
Antimony	Antimony Antimony compounds Antimony oxide Antimony pentafluoride Antimony trichloride Antimony trioxide	7440-36-0 1327-33-9 7783-70-2 10025-91-9 1309-64-4	ANTIMONY ANTIMONY CMP ANTIMONY OXI ANTIMPENTAFL ANTIM TRICL ANTIMONY O3
Arsenic	Arsenic Arsenic acid Arsenic compounds Arsenic pentoxide Arsenic trioxide Arsine	7440-38-2 1327-52-2 1303-28-2 1327-53-3 7784-42-1	ARSENIC ARSENIC ACID ARSENIC CMP ARSEN PENTOX ARSENIC O3 ARSINE
Asbestos	Asbestos	1332-21-4	ASBESTOS
Atrazine	Atrazine	1912-24-9	ATRAZINE
Benz(a)anthracene	Benz(a)anthracene	56-55-3	BENZ(A)ANTHR
Benzene	Benzene	71-43-2	BENZENE
Benzdine	Benzdine	92-87-5	BENZIDINE
Benzo(a)pyrene	Benzo(a)pyrene	50-32-8	BENZO(A)PYRE
Benzo(b)fluoranthene	Benzo(b)fluoranthene	205-99-2	BENZO(B)FLUO
Benzo(g,h,i)perylene	Benzo(g,h,i)perylene	191-24-2	BENZ(GHI)PE
Benzo(k)fluoranthene	Benzo(k)fluoranthene	207-08-9	BENZO(K)FLUO
Benzoic trichloride	Benzoic trichloride	98-07-7	BENZOTRICHLO
Benzyl chloride	Benzyl chloride	100-44-7	BENZYL CHLOR
Beryllium	Beryllium Beryllium compounds Beryllium fluoride Beryllium oxide Beryllium sulfate	7440-41-7 7787-49-7 1304-56-9 13510-49-1	BERYLLIUM BERYLLIU CMP BERYLL FLUOR BERYLL OXIDE BERYLL SULF
Beta-propiolactone	Beta-propiolactone	57-57-8	BETA-PROPRIO
Biphenyl	Biphenyl	92-52-4	BIPHENYL
Bis(2-chloroethyl)ether	Bis (2-chloroethyl) ether	111-44-4	BIS(2-CLETH)
Bis(chloromethyl)ether	Bis(chloromethyl)ether	542-88-1	BIS(CLMETH)
Bromoform	Bromoform	75-25-2	BROMOFORM

<b>Pollutant Grouping</b>	<b>Substance Name</b>	<b>CAS #</b>	<b>RAPIDS Code</b>
<b>Cadmium</b>	<b>Cadmium</b>	<b>7440-43-9</b>	<b>CADMIUM</b>
	Cadmium chloride	10108-64-2	CADMIUM CL
	Cadmium compounds		CADMIUM CMP
	Cadmium iodide	7790-80-9	CADMIUM IOD
	Cadmium nitrate	10325-94-7	CADMIUM NIT
	Cadmium oxide	1306-19-0	CADMIUM OXI
	Cadmium sulfate	10124-36-4	CAD SULFATE
	Cadmium sulfide	1306-23-6	CAD SULFIDE
<b>Calcium cyanamide</b>	<b>Calcium cyanamide</b>	<b>156-62-7</b>	<b>CALCIUM CYAN</b>
<b>Captan</b>	<b>Captan</b>	<b>133-06-2</b>	<b>CAPTAN</b>
<b>Carbaryl</b>	<b>Carbaryl</b>	<b>63-25-2</b>	<b>CARBARYL</b>
<b>Carbon disulfide</b>	<b>Carbon disulfide</b>	<b>75-15-0</b>	<b>CARBON DISUL</b>
<b>Carbon tetrachloride</b>	<b>Carbon tetrachloride</b>	<b>56-23-5</b>	<b>CARBON TETRA</b>
<b>Carbonyl sulfide</b>	<b>Carbonyl sulfide</b>	<b>463-58-1</b>	<b>CARBONYL SUL</b>
<b>Catechol</b>	<b>Catechol</b>	<b>120-80-9</b>	<b>CATECHOL</b>
<b>Chloramben</b>	<b>Chloramben</b>	<b>133-90-4</b>	<b>CHLORAMBEN</b>
<b>Chlordane</b>	<b>Chlordane</b>	<b>57-74-9</b>	<b>CHLORDANE</b>
<b>Chlorine</b>	<b>Chlorine</b>	<b>7782-50-5</b>	<b>CHLORINE</b>
<b>Chloroacetic acid</b>	<b>Chloroacetic acid</b>	<b>79-11-8</b>	<b>CHLOROACETIC</b>
<b>Chlorobenzene</b>	<b>Chlorobenzene</b>	<b>108-90-7</b>	<b>CHLOROBENZ</b>
<b>Chlorobenzilate</b>	<b>Chlorobenzilate</b>	<b>510-15-6</b>	<b>CLBENZILATE</b>
<b>Chloroethane</b>	<b>Chloroethane</b>	<b>75-00-3</b>	<b>CHLOROETHANE</b>
<b>Chloroform</b>	<b>Chloroform</b>	<b>67-66-3</b>	<b>CHLOROFORM</b>
<b>Chloromethyl methyl ether</b>	<b>Chloromethyl methyl ether</b>	<b>107-30-2</b>	<b>CLMETH METH</b>
<b>Chromium</b>	<b>Chromium</b>	<b>7440-47-3</b>	<b>CHROMIUM</b>
	Chromic acid	11115-74-5	CHROMIC ACID
	Chromic sulfate	10101-53-8	CHROMIC SULF
	Chromic sulfuric acid	13530-68-2	CHR SULFACID
	Chromic trioxide	1333-82-0	CHROMIC O3
	Chromium (iii)	16065-83-1	CHROMIUM III
	Chromium (iii) oxide	1308-38-9	CHROM(III)OX
	Chromium (vi) oxide (1:3)	1333-82-0	CHRO(VI)OXID
	Chromium chloride	10060-12-5	CHROMIUM CL
	Chromium compounds		CHROMIUM CMP
	Chromium dioxide	12018-01-8	CHROMIUM O2
	Chromium hydroxide	1308-14-1	CHROM HYDROX
	Chromium zinc oxide	12018-19-8	CHROM ZN OX
	Strontium chromate	7789-06-2	STRON CHROM
	Zinc chromate	13530-65-9	ZINC CHROMATE
Zinc chromite	50922-29-7	ZINC CHROMITE	
<b>Chromium VI</b>	<b>Chromium (vi)</b> Chromium (6) compounds	<b>18540-29-9</b>	<b>CHROMIUM VI</b> CHROM6 CMP
<b>Chrysene</b>	<b>Chrysene</b>	<b>218-01-9</b>	<b>CHRYSENE</b>
<b>Cobalt</b>	<b>Cobalt</b>	<b>7440-48-4</b>	<b>COBALT</b>
	Cobalt 2-ethylhexanoate	13586-82-8	COBALT2ETHEX
	Cobalt 2-ethylhexanoate (known stoichiometry)	136-52-7	COBALT2E(STO
	Cobalt aluminate	1345-16-0	COBALT ALUM
	Cobalt carbonate	7542-09-8	COBALT CARB
	Cobalt compounds		COBALT CMP
	Cobalt hydrocarbonyl	16842-03-8	COBALT HYDR
	Cobalt naphtha	61789-51-3	COBALT NAPH
	Cobalt oxide	1307-96-6	COBALT OXIDE
	Cobalt sulfate	10124-43-3	COBALT SULFA

Pollutant Grouping	Substance Name	CAS #	RAPIDS Code
	Cobalt sulfide	1317-42-6	COBALT SULFI
<b>Coke oven emissions</b>	<b>Coke oven emissions</b>		<b>COKE OVEN GS</b>
<b>Copper</b>	<b>Copper</b> Copper compounds	<b>7440-50-8</b>	<b>COPPER</b> COPPER CMP
<b>Cresol (mixed isomers)</b>	<b>Cresol- mixed isomers</b>	<b>1319-77-3</b>	<b>CRESOL MX IS</b>
<b>Cumene</b>	<b>Cumene</b>	<b>98-82-8</b>	<b>CUMENE</b>
<b>Cyanide</b>	<b>Cyanide</b> Cyanide compounds Copper cyanide	<b>57-12-5</b> 544-92-3	<b>CYANIDE</b> CYANIDE CMP CU CYANIDE
<b>Diazomethane</b>	<b>Diazomethane</b>	<b>334-88-3</b>	<b>DIAZOMETHANE</b>
<b>Dibenz(a,h)anthracene</b>	<b>Dibenzo(a,h)anthracene</b>	<b>53-70-3</b>	<b>DIBENZAHAH</b>
<b>Dibenzofuran</b>	<b>Dibenzofuran</b>	<b>132-64-9</b>	<b>DIBENZOFURAN</b>
<b>Dichlorvos (DDVP)</b>	<b>Dichlorvos</b>	<b>62-73-7</b>	<b>DICHLORVOS</b>
<b>Diethanolamine</b>	<b>Diethanolamine</b>	<b>111-42-2</b>	<b>DIETHANOLAMI</b>
<b>Diethylhexyl phthalate</b>	<b>Diethylhexyl phthalate</b>	<b>117-81-7</b>	<b>DIETHYLHEX PHT</b> and <b>DIOCTYL PHTH</b>
<b>Diethyl sulfate</b>	<b>Diethyl sulfate</b>	<b>64-67-5</b>	<b>DIETH SULFAT</b>
<b>Dimethyl aminoazobenzene</b>	<b>Dimethyl aminoazobenzene</b>	<b>60-11-7</b>	<b>DIMETH AMINO</b>
<b>Dimethyl phthalate</b>	<b>Dimethyl phthalate</b>	<b>131-11-3</b>	<b>DIMETH PHTHA</b>
<b>Dimethyl sulfate</b>	<b>Dimethyl sulfate</b>	<b>77-78-1</b>	<b>DIMETH SULFA</b>
<b>Dimethylaniline</b>	<b>Dimethylaniline(n,n-dimethylaniline)</b>	<b>121-69-7</b>	<b>DIMETHYLANIL</b>
<b>Di-N-butyl phthalate</b>	<b>Dibutyl phthalate</b>	<b>84-74-2</b>	<b>DIBUTYL PHTH</b>
<b>Di-N-octyl phthalate</b>	<b>Di-n-octylphthalate</b>	<b>117-84-0</b>	<b>DIOCTYLPHT,N</b>
<b>Epichlorohydrin</b>	<b>Epichlorohydrin</b>	<b>106-89-8</b>	<b>EPICLHYDRIN</b>
<b>Ethyl acrylate</b>	<b>Ethyl acrylate</b>	<b>140-88-5</b>	<b>ETH ACRYLATE</b>
<b>Ethyl benzene</b>	<b>Ethylbenzene</b>	<b>100-41-4</b>	<b>ETHYLBENZENE</b>
<b>Ethyl carbamate</b>	<b>Ethyl carbamate</b>	<b>51-79-6</b>	<b>ETHYL CARBAM</b>
<b>Ethylene glycol</b>	<b>Ethylene glycol</b>	<b>107-21-1</b>	<b>ETHYLENE GLY</b>
<b>Ethylene oxide</b>	<b>Ethylene oxide</b>	<b>75-21-8</b>	<b>ETHYLENE OXI</b>
<b>Ethylenethiourea</b>	<b>Ethylene thiourea</b>	<b>96-45-7</b>	<b>ETHYLENE THI</b>
<b>Ethylenimine</b>	<b>Ethylene imine</b>	<b>151-56-4</b>	<b>ETHYLENE IMI</b>
<b>Fine mineral fibers</b>	<b>Fine mineral fibers</b>		<b>FINE MNRLFIB</b>
<b>Fluoranthene</b>	<b>Fluoranthene</b>	<b>206-44-0</b>	<b>FLUORANTHENE</b>
<b>Fluorene</b>	<b>Fluorene</b>	<b>86-73-7</b>	<b>FLUORENE</b>
<b>Formaldehyde</b>	<b>Formaldehyde</b>	<b>50-00-0</b>	<b>FORMALDEHYDE</b>
<b>Glycol ethers</b>	<b>Glycol ethers (misc.)</b> 2-(2-Butoxyethoxy)-ethanol 2-(Hexyloxy)ethanol 2-Butoxyethyl acetate Butyl cellosolve Carbitol Carbitol acetate Cellosolve Cellosolve acetate Diethylene glycol butyl ether Methyl carbitol Methyl cellosolve N-hexyl carbitol Phenyl cellosolve Propyl cellosolve	 112-34-5 112-25-4 112-07-2 111-76-2 111-90-0 112-15-2 110-80-5 111-15-9  111-77-3 109-86-4 112-59-4 122-99-6 2807-30-9	<b>GLYCOL ETHRS</b> BUT CARBITOL HEXYETHANOL2 BUTETACET,2 BUT CELLOSOL CARBITOL CARB ACETATE CELLOSOLVE CELLOSLV ACE DIETH GLY BE METH CARBITO METH CELLOSO HEXYL CARB PHEN CELLO PROPYL CELLO
<b>Heptachlor</b>	<b>Heptachlor</b>	<b>76-44-8</b>	<b>HEPTACHLOR</b>
<b>Hexachloro-1,3-butadiene</b>	<b>Hexachloro-1,3-butadiene</b>	<b>87-68-3</b>	<b>HEXCL-13-BUT</b>

<b>Pollutant Grouping</b>	<b>Substance Name</b>	<b>CAS #</b>	<b>RAPIDS Code</b>
<b>Hexachlorobenzene</b>	<b>Hexachlorobenzene</b>	<b>118-74-1</b>	<b>HEXCLBENZENE</b>
<b>Hexachlorocyclopentadiene</b>	<b>1,2,3,4,5,5-Hexachloro-1,3-cyclopentadiene</b>	<b>77-47-4</b>	<b>HEXACL-1,3-C</b>
<b>Hexachloroethane</b>	<b>Hexachloroethane</b>	<b>67-72-1</b>	<b>HEXCHLORETH</b>
<b>Hexamethyl phosphoramidate</b>	<b>Hexamethyl phosphoramidate</b>	<b>680-31-9</b>	<b>HXMETH PHOSP</b>
<b>Hexamethylene-1,6-diisocyanate</b>	<b>Hexamethylene-1,6-diisocyanate</b>	<b>822-06-0</b>	<b>HEXAMETHYL16</b>
<b>Hexane</b>	<b>N-hexane</b>	<b>110-54-3</b>	<b>HEXANE</b>
<b>Hydrazine</b>	<b>Hydrazine</b>	<b>302-01-2</b>	<b>HYDRAZINE</b>
<b>Hydrochloric acid</b>	<b>Hydrochloric acid</b>	<b>7647-01-0</b>	<b>HCL</b>
<b>Hydrogen cyanide</b>	<b>Hydrogen cyanide</b>	<b>74-90-8</b>	<b>HYDROGEN CYA</b>
<b>Hydrogen fluoride</b>	<b>Hydrogen fluoride</b>	<b>7664-39-3</b>	<b>HF</b>
<b>Hydrogen sulfide</b>	<b>Hydrogen sulfide</b>	<b>7783-06-4</b>	<b>HYDROGEN SUL</b>
<b>Hydroquinone</b>	<b>Hydroquinone</b>	<b>123-31-9</b>	<b>HYDROQUINONE</b>
<b>Indeno(1,2,3-c,d)pyrene</b>	<b>Indeno(1,2,3-c,d)pyrene</b>	<b>193-39-5</b>	<b>INDN(123CDPY</b>
<b>Isophorone</b>	<b>Isophorone</b>	<b>78-59-1</b>	<b>ISOPHORONE</b>
<b>Lead</b>	<b>Lead</b> Lead acetate Lead arsenate Lead arsenite Lead carbonate Lead chromate Lead chromate oxide Lead compounds Lead fluoroborate Lead in ore Lead naphthenate Lead neodecanoate Lead nitrate Lead oxide Lead phosphate Lead stearate Lead subacetate Lead sulfate Lead tetroxide Lead titanate Lead titanate zircon	<b>7439-92-1</b> 301-04-2 7784-40-9 10031-13-7 598-63-0 7758-97-6 18454-12-1  13814-96-5  61790-14-5 27253-28-7 10099-74-8 1317-36-8 7446-27-7 7428-48-0 1335-32-6 7446-14-2 1314-41-6 12060-00-3 12626-81-2	<b>LEAD</b> LEAD ACETATE LEAD ARSENAT LEAD ARSENIT LEAD CARB LEAD CHROMAT LEAD CHR OXI LEAD CMP LEAD FLBOR LEAD IN ORE LEAD NAPTH LEAD NEODEC LEAD NITRATE LEAD OXIDE LEAD PHOS LEAD STEAR LEAD SUBACET LEAD SULF LEAD TETOX LEAD TITANAT LEAD TIT ZIR
<b>Lindane (gamma HCH)</b>	<b>Lindane, (all isomers)</b>	<b>58-89-9</b>	<b>LINDANE ISO</b>
<b>Maleic anhydride</b>	<b>Maleic anhydride</b>	<b>108-31-6</b>	<b>MALEIC ANHYD</b>
<b>Manganese</b>	<b>Manganese</b> Manganese compounds Manganese dioxide Manganese hypophosphite Manganese naphthenate Manganese nitrate Manganese oxide Manganese sulfate Manganese tallate Manganese tetroxide Manganese trioxide	<b>7439-96-5</b>  1313-13-9 7783-16-6 1336-93-2 10377-66-9 1317-34-6 7785-87-7 8030-70-4 1317-35-7 1317-34-6	<b>MANGANESE</b> MANGANES CMP MANGAN 02 MANGAN HYPO MANGAN NAPH MANGAN NITR MANGANESEOXI MANGAN SULF MANGAN TALL MANGAN 04 MANGAN O3
<b>M-Cresol</b>	<b>M-cresol</b>	<b>108-39-4</b>	<b>CRESOL,M</b>
<b>Mercury</b>	<b>Mercury</b> Mercuric chloride Mercury compounds Mercury (organic)	<b>7439-97-6</b> 7487-94-7  22967-92-6	<b>MERCURY</b> MERCURIC CL MERCURY CMP MERCURY,ORG

Pollutant Grouping	Substance Name	CAS #	RAPIDS Code
Methanol	Methanol	67-56-1	METHANOL
Methoxychlor	Methoxychlor	72-43-5	METHOXYCHLOR
Methyl bromide	Bromomethane	74-83-9	BROMOMETH
Methyl chloride	Methyl chloride	74-87-3	METHYL CHLOR
Methyl ethyl ketone	Methyl ethyl ketone	78-93-3	METH ETH KET
Methyl hydrazine	Methyl hydrazine	60-34-4	METH HYDRAZI
Methyl iodide	Methyl iodide	74-88-4	METH IODIDE
Methyl isobutyl ketone	Methyl isobutyl ketone	108-10-1	METH ISOBUT
Methyl isocyanate	Methyl isocyanate	624-83-9	METH ISOCYAN
Methyl methacrylate	Methyl methacrylate	80-62-6	METH METHACR
Methyl tert-butyl ether	Methyl tert butyl ether	1634-04-4	METH TERT BU
Methylene chloride (dichloromethane)	Methylene chloride	75-09-2	METHYLENE CL
M-Xylene	M-xylene	108-38-3	XYLENE,M
N,N-Dimethyl carbamoyl chloride	N,n-dimethyl carbamoyl chloride	79-44-7	NDIMETH CARB
N,N-Dimethylformamide	Dimethylformamide, n,n-	68-12-2	DIMETHFORMAM
Naphthalene	Naphthalene	91-20-3	NAPHTHALENE
Nickel	Nickel Nickel (ii) sulfate hexahydrate Nickel (iii) oxide Nickel acetate Nickel acetate tetrahydrate Nickel bromide Nickel carbide Nickel carbonate Nickel carbonyl Nickel chloride Nickel compounds Nickel hydroxide Nickel nitrate Nickel refinery dust from the pyrometallurgical pro Nickel subsulfide Nickel sulfamate Nickel sulfate Nickel(ii) oxide (1:1)	7440-02-0 10101-97-0 1314-06-3 373-02-4 6018-89-9 13462-88-9 12710-36-0 3333-39-3 13463-39-3 7718-54-9  12054-48-7 13138-45-9  12035-72-2 13770-89-3 7786-81-4 1313-99-1	NICKEL NI(II)SULHEX NI(III)OXIDE NI ACETATE NI ACET DIHY NI BROMIDE NI CARBIDE NI CARBONATE NI CARBONYL NI CHLORIDE NICKEL CMP NI HYDROX NI NITRITE  NI DUST NI SUBSULF NI SULFAMATE NI SULFATE NI(II) OXIDE
Nitrobenzene	Nitrobenzene	98-95-3	NITROBENZ
N-Nitrosodimethylamine	N-nitrosodimethylamine	62-75-9	NITROSODIMET
N-Nitrosomorpholine	N-nitrosomorpholine	59-89-2	NITROSOMORPH
N-Nitroso-N-methylurea	N-nitroso-n-methylurea	684-93-5	NITROSO-N,N
O-Anisidine	O-anisidine	90-04-0	ANISIDINE,O-
O-Cresol	O-cresol	95-48-7	CRESOL,O
O-Toluidine	O-toluidine	95-53-4	TOLUIDINE,O-
O-Xylene	O-xylene	95-47-6	XYLENE,O
Parathion	Parathion	56-38-2	PARATHION
P-Cresol	P-cresol	106-44-5	CRESOL,P
Pentachloronitrobenzene	Pentachloronitrobenzene	82-68-8	PENTCLNITBEN
Pentachlorophenol	Pentachlorophenol (pcp)	87-86-5	PCP
Phenanthrene	Phenanthrene	85-01-8	PHENANTHRENE
Phenol	Phenol	108-95-2	PHENOL
Phosgene	Phosgene	75-44-5	PHOSGENE
Phosphine	Phosphine	7803-51-2	PHOSPHINE
Phosphorus	Phosphorus (yellow or white)	7723-14-0	PHOSPHORUS

<b>Pollutant Grouping</b>	<b>Substance Name</b>	<b>CAS #</b>	<b>RAPIDS Code</b>
<b>Phthalic anhydride</b>	<b>Phthalic anhydride</b>	<b>85-44-9</b>	<b>PHTHALIC ANH</b>
<b>Polychlorinated biphenyls (PCBs)</b>	<b>Polychlorinated biphenyls (pcbs)</b>	<b>1336-36-3</b>	<b>PCBS</b>
<b>Polychlorinated dibenzodioxins, total</b>	<b>Polychlorinated dibenzodioxins, total</b> 1,2,3,4,6,7,8-Heptachlorodibenzodioxin 1,2,3,4,7,8-Hexachlorodibenzodioxin 1,2,3,6,7,8-Hexachlorodibenzodioxin 1,2,3,7,8,9-Hexachlorodibenzofuran 1,2,3,7,8-Pentachlorodibenzofuran Heptachlorodibenzodioxin, all isomers Hexachlorodibenzodioxins, all isomers Octachlorodibenzodioxins, all isomers Pentachlorodibenzodioxins, all isomers Tetrachlorodibenzodioxins, all isomers	35822-46-9 39227-28-6 57653-85-7 40321-76-4 19408-74-3  34465-46-8 3268-87-9	<b>PCDD</b> HPCDD,1234678 HXCDD,123478 HXCDD,123678 PECDD,12378 HXCDD,123789 HPCDD,TOT HXCDD,TOT OCDD,TOT PECDD,TOT TCDD,TOT
<b>Polychlorinated dibenzofurans, total</b>	<b>Polychlorinated dibenzofurans, total</b> 1,2,3,4,6,7,8-Heptachlorodibenzofuran 1,2,3,4,6,7,9-Heptachlorodibenzofuran 1,2,3,4,6,8,9-Heptachlorodibenzofuran 1,2,3,4,7,8,9-Heptachlorodibenzofuran 1,2,3,4,7,8-Hexachlorodibenzofuran 1,2,3,4,8- Pentachlorodibenzofuran 1,2,3,6,7,8-Hexachlorodibenzofuran 1,2,3,7,8,9-Hexachlorodibenzodioxin 1,2,3,7,8-Pentachlorodibenzodioxin 1,2,4,6,7,9-Hexachlorodibenzofuran 1,3,7,8-Tetrachlorodibenzofuran 2,3,4,6,7,8-Hexachlorodibenzofuran 2,3,4,7,8-Pentachlorodibenzofuran 2,3,6,8-Tetrachlorodibenzofuran Heptachlorodibenzofuran, all isomers Hexachlorodibenzofurans, all isomers Octachlorodibenzofurans, all isomers Pentachlorodibenzofurans, all isomers Tetrachlorodibenzofurans, all isomers	67562-39-4 70648-25-8 69698-58-4 55673-89-7 70648-26-9 67517-48-0 57117-44-9 57117-41-6 72918-21-9 75627-02-0 57117-35-8 60851-34-5 57117-31-4 57117-37-0  39001-02-0	<b>PCDF</b> HPCDF,1234678 HPCDF,1234679 HPCDF,1234689 HPCDF,1234789 HXCDF,123478 PECDF,12348 HXCDF,123678 PECDF,12378 HXCDF,123789 HXCDF,124679 TCDF,1378 HXCDF,234678 PECDF,23478 TCDF,2368 HPCDF,TOT HXCDF,TOT OCDF,TOT PECDF,TOT TCDF,TOT
<b>P-Phenylenediamine</b>	<b>P-phenylenediamine</b>	<b>106-50-3</b>	<b>PHENYLENED,P</b>
<b>Propionaldehyde</b>	<b>Propionaldehyde</b>	<b>123-38-6</b>	<b>PROPIONALDEH</b>
<b>Propoxur</b>	<b>Propoxur</b>	<b>114-26-1</b>	<b>PROPOXUR</b>
<b>Propylene dichloride</b>	<b>Propylene dichloride</b>	<b>78-87-5</b>	<b>PRPLENE DICH</b>
<b>Propylene oxide</b>	<b>Propylene oxide</b>	<b>75-56-9</b>	<b>PRPLENE OXID</b>
<b>P-Xylene</b>	<b>P-xylene</b>	<b>106-42-3</b>	<b>XYLENE,P</b>
<b>Pyrene</b>	<b>Pyrene</b>	<b>129-00-0</b>	<b>PYRENE</b>
<b>Quinoline</b>	<b>Quinoline</b>	<b>91-22-5</b>	<b>QUINOLINE</b>
<b>Quinone</b>	<b>Quinone</b>	<b>106-51-4</b>	<b>QUINONE</b>
<b>Radionuclides</b>	<b>Radionuclides</b>		<b>RADIONUCLIDE</b>
<b>Selenium</b>	<b>Selenium</b> Selenium compounds Selenium dioxide Selenium disulfide Selenium oxide Selenium sulfide	<b>7782-49-2</b>  7446-08-4 7488-56-4 12640-89-0 7446-34-6	<b>SELENIUM</b> SELENIUM CMP SELENIUM O2 SELEN DISULF SELEN OXIDE SELEN SULF
<b>Styrene</b>	<b>Styrene</b>	<b>100-42-5</b>	<b>STYRENE</b>
<b>Styrene oxide</b>	<b>Styrene oxide</b>	<b>96-09-3</b>	<b>STYRENE OXID</b>
<b>Tetrachloroethylene (Perc)</b>	<b>Tetrachloroethylene</b>	<b>127-18-4</b>	<b>PERC</b>

<b>Pollutant Grouping</b>	<b>Substance Name</b>	<b>CAS #</b>	<b>RAPIDS Code</b>
<b>Titanium tetrachloride</b>	<b>Titanium tetrachloride</b>	<b>7550-45-0</b>	<b>TITAN TETCL</b>
<b>Toluene</b>	<b>Toluene</b>	<b>108-88-3</b>	<b>TOLUENE</b>
<b>Toluene-2,4-diisocyanate</b>	<b>Toluene-2,4-diisocyanate</b> Toluene diisocyanate	<b>584-84-9</b> 26471-62-5	<b>TOLUENE24DII</b> <b>TOLUENEDIISO</b>
<b>Toxaphene</b>	<b>Toxaphene</b>	<b>8001-35-2</b>	<b>TOXAPHENE</b>
<b>Trichloroethylene</b>	<b>Trichloroethylene</b>	<b>79-01-6</b>	<b>TRICHLORETHY</b>
<b>Triethylamine</b>	<b>Triethylamine</b>	<b>121-44-8</b>	<b>TRIETHAMINE</b>
<b>Trifluralin</b>	<b>Trifluralin</b>	<b>1582-09-8</b>	<b>TRIFLURALIN</b>
<b>Vinyl acetate</b>	<b>Vinyl acetate</b>	<b>108-05-4</b>	<b>VINYL ACETAT</b>
<b>Vinyl bromide</b>	<b>Vinyl bromide</b>	<b>593-60-2</b>	<b>VINYL BROMID</b>
<b>Vinyl chloride</b>	<b>Vinyl chloride</b>	<b>75-01-4</b>	<b>VINYL CHLOR</b>
<b>Vinylidene chloride</b>	<b>Vinylidene chloride</b>	<b>75-35-4</b>	<b>VINLIDENE CL</b>
<b>Xylene (mixed isomers)</b>	<b>Xylenes (mixed isomers)</b> Xylene, m,p	<b>1330-20-7</b>	<b>XYLENES ISO</b> XYLENE, M,P

Data summaries of the 2002 inventory and all previous inventories are available online at the Great Lakes Information Network (GLIN, <http://www.great-lakes.net>). Additional information, including background documents, the emissions protocol document and list of products for the project are located on the emission inventory project's web site (<http://www.glc.org/air/>).

The air emissions inventory project is funded primarily by the U.S. EPA from the Great Lakes Geographic Initiative air program grant funds designated for regional projects that address air toxics and the Great Lakes.

The eight states and Ontario will continue to work collaboratively to improve and refine the toxics inventory and strengthen its ability to support sound regulatory decisions at all levels of government.

## 2. Results

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The following results represent summary emissions from point, area, and mobile sources in the Great Lakes region for calendar year 2002. The regional emission inventory includes emissions from 672 distinct source categories and 2706 distinct source classification codes (SCC).

Definitions of point and area sources are dependent on data collection methods, as reporting requirements for toxic air emissions are different among states and provinces. An emission source defined as an area source in one state or province may be covered as a point source in another state or province. Mobile sources are subcategorized as on-road and non-road sources. On-road source emissions include those from 26 vehicle types and 12 roadway types. Non-road sources include 10 equipment types (such as agricultural equipment and recreational equipment), aircraft, locomotives, and commercial marine vessels.

### Emissions from All Sources

The 2002 emissions were estimated for 211 target compounds, however, data were only available to obtain emissions for 195 of these, including 16 polycyclic aromatic hydrocarbons (PAHs), 14 metal compounds, and 165 non-metal compounds. Emissions are not included for several target compounds for several reasons. These may include a lack of emission factors, a lack of activity data, a lack of identified sources and a lack of estimation methodology. Table 2-1 shows pollutant names and estimated emissions from point, area and mobile sources. Table 2-5 lists those targeted pollutants for which no emissions were able to be estimated.

Estimations of point source emissions include 195 out of 211 pollutants while area source estimations include 140 pollutants. Pollutant emissions from onroad and nonroad mobile sources numbered 43 and 52, respectively. Figure 2-1 shows the number of pollutants emitted from each source category in 2002. In total, nearly 12,000 point sources are included in the regional inventory.

Area sources contributed 50% or more of total emissions for 14 of the 16 PAHs and more than 50% of total emissions for 39 non-metal compounds. Point sources were responsible for more than 50% of total emissions for 14 metal compounds and 111 non-metal compounds. Onroad and nonroad mobile sources together emitted a significant portion (more than one third) of total regional emissions for acetaldehyde, acrolein, benzene, 1,3-butadiene, ethylbenzene, formaldehyde, hexane, methyl tert butyl ether, propionaldehyde, 2,2,4-trimethylpentane, styrene and toluene.

Although point source emission estimations included many more pollutants than area and mobile sources, the amount of emissions from point sources was 24% of total emissions in the region by weight, less than contributions of area sources and mobile sources (30% and 46%, respectively). Figure 2-2 provides percentage contributions from each principal source category.

Among the 195 pollutants, toluene was estimated to have the highest emissions at 588,900,000 pounds, while beta-propiolactone emissions were the lowest estimated at about 0.0005 pounds.

## Specific Pollutants

A closer look was taken at the top five non-metal compounds and the top five metal compounds according to the emission totals. The source contribution to emissions for the selected 10 pollutants was analyzed by the first two digits of the SIC codes for point sources, sub-category for area and nonroad mobile sources, and vehicle types for onroad mobile sources. The most significant source categories and their contributions are shown in Tables 2-2 and 2-3. The selected pollutants are toluene, xylene (includes o, m, and p), hydrochloric acid, benzene, 2,2,4-trimethylpentane, manganese, chromium, lead, copper, and nickel.

Light Duty Gasoline Vehicles are the most significant sources for four out of the five top non-metal compounds, toluene, xylene, benzene, and 2,2,4-trimethylpentane. Electric, Gas, and Sanitary Services (SIC code 49xx), a category of point sources, contribute 88% of hydrochloric acid emissions.

In contrast with the top five non-metal compounds, point sources dominate the emissions of the top five metal compounds, accounting for about more than 92% of total regional emissions. As shown in Table 2-3, the most significant source category for the top five metal compounds is Primary Metal Industries (SIC code 33xx). Primary Metal Industries accounts for between one third and three fourths of the total regional emissions for these five metal compounds.

## Progressive Emission Changes

The 2002 inventory is the sixth since the 1996 inventory. Eighty two pollutants were targeted in the regional emission inventories in 1996 - 1998 while 211 pollutants have been targeted since the 1999 inventory. Figure 2-3 shows the number of pollutants estimated in each inventory. The overall regional emissions for 1996 - 2002 are summarized in Table 2-4. The emission differences among years are mainly due to the following factors:

- 1) increased number of pollutants in the emission inventories;
- 2) increased number of sources inventoried;
- 3) improvements and increased availability of emission estimation methods, emission factors, and activity data; and
- 4) different emission models used for mobile sources.

For example, the chromium emission factor for residential natural gas combustion used in the 1996 inventory is 45 times higher than the revised one used in the 1997-2002 inventories. The sum of emission factors for 16 PAHs in the 1999-2002 inventories are less than half of the value in the 1997 and 1998 inventories for residential wood burning - certified, catalytic stoves. Also, SCCs inventoried increased with time, particularly between the 1998 inventory and the 1999 inventory. Figures 2-4 and 2-5 show the number of SICs and SCCs with emissions in each inventory year. A large increase in number of SCCs is also observed from the 2001 inventory to the 2002 inventory. This is mainly due to the introduction of 492 new and more detailed SCCs for onroad vehicles. These new SCCs specify emission types to evaporative, exhaust, tire wear, and brake wear.

Therefore, **the results should not be viewed as a trend analysis**. A back-calculation using the 2002 approaches for previous years could provide emission trends. However, this resource intensive effort has not been undertaken.

Figures 2-6 to 2-8 show emissions of three groups of pollutants estimated from 1996 to 2002. The pollutants in 16-PAH and metal-compound groups have not changed with calendar years, so that the difference among calendar years reflects factors 2, 3, and 4 listed above. Factors 2, 3, and 4 also influenced emissions of non-metal compound (excluding 16 PAHs) group. However, the primary cause of the increase of total regional emissions of non-metal compounds since the 1999 inventory is due to addition of pollutants. Some of the newly inventoried pollutants showing high emissions are hydrochloric acid, 2,2,4-trimethylpentane, hexane, methanol, and methyl ethyl ketone. These pollutants are ranked in the top twelve with regard to the total emissions since 1999.

Data summaries of the 2002 inventory and all previous inventories are available at the Great Lakes Commission (<http://www.glc.org>) and the Great Lakes Information Network (<http://www.great-lakes.net>) web sites. Additional information, including background documents, the emission protocol document and lists of products for the project, is located on the emission inventory project's web site (<http://www.glc.org/air>). Data is also available through the interactive CAROL website (<http://mds.glc.org/carol/>). If updates to the 2002 emissions data are made, there will be included in the online CAROL system.

**Table 2-1: Summary of the 2002 air toxics emissions from the Great Lakes Region.**

Pollutant Code (CAS Number)	Emissions (lbs.)					Percent (%)			
	Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad
<b>16 PAHs</b>									
Acenaphthene (83-32-9)	78,900	89,170	20,580	16,640	205,300	38.43	43.43	10.02	8.11
Acenaphthylene (208-96-8)	4142	1,738,000	111,800	40,120	1,894,000	0.22	91.76	5.90	2.12
Anthracene (120-12-7)	13,190	124,400	14,220	10,770	162,600	8.11	76.51	8.75	6.62
Benz(a)anthracene (56-55-3)	26,320	174,100	4923	6193	211,500	12.44	82.32	2.33	2.93
Benzo(g,h,i)perylene (191-24-2)	13,740	45,410	7253	10,000	76,400	17.98	59.44	9.49	13.09
†Benzo(a)pyrene (50-32-8)	39,210	39,230	3256	5422	87,120	45.01	45.03	3.74	6.22
Benzo(b)fluoranthene (205-99-2)	5764	53,850	3864	4950	68,430	8.42	78.69	5.65	7.23
Benzo(k)fluoranthene (207-08-9)	3630	21,440	3864	4962	33,890	10.71	63.26	11.40	14.64
Chrysene (218-01-9)	30,810	110,800	3099	5461	150,200	20.51	73.77	2.06	3.64
Dibenz(a,h)anthracene (53-70-3)	6352	24,740	3,317	996.9	32,090	19.79	77.10	0.01	3.11
Fluoranthene (206-44-0)	67,390	180,700	26,000	20,490	294,500	22.88	61.36	8.83	6.96
Fluorene (86-73-7)	6749	197,300	43,050	31,120	278,200	2.43	70.92	15.47	11.19
Indeno(1,2,3-c,d)pyrene (193-39-5)	3677	121,600	2057	5139	132,500	2.78	91.77	1.55	3.88
Naphthalene (91-20-3)	890,200	7,615,000	2,780,000	616,200	11,900,000	7.48	63.99	23.36	5.18
Phenanthrene (85-01-8)	44,280	695,600	71,620	57,090	868,600	5.10	80.08	8.25	6.57
Pyrene (129-00-0)	12,580	215,400	35,980	23,440	287,400	4.38	74.95	12.52	8.16
16 PAH – submitted as group		219,900		12.77	220,000		99.95		0.01
7 PAH – submitted as group		38,910		0.1259	38,910		100.00		0.00
<b>16 PAH Total</b>	<b>1,247,000</b>	<b>11,710,000</b>	<b>3,131,000</b>	<b>859,000</b>	<b>16,940,000</b>	<b>7.36</b>	<b>69.13</b>	<b>18.48</b>	<b>5.07</b>

Pollutant Code (CAS Number)	Emissions (lbs.)					Percent (%)			
	Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad
<b>Metal Compounds</b>									
*Antimony (7440-36-0)	33,210	2007		24.62	35,240	94.24	5.70		0.07
*Arsenic (7440-38-2)	294,000	8151	4937	6.612	307,100	95.73	2.65	1.61	0.00
*Beryllium (7440-41-7)	13,180	1585		242	15,000	87.87	10.57		1.61
*Cadmium (7440-43-9)	78,060	5088		300.7	83,450	93.54	6.10		0.36
*Chromium (7440-47-3)	1,525,000	18,470	13,160	1360	1,558,000	97.88	1.19	0.84	0.09
*Chromium VI (18540-29-9)	19,870	362.8	3305	3368	26,910	73.84	1.35	12.28	12.52
*Cobalt (7440-48-4)	81,320	2831		28.23	84,180	96.60	3.36		0.03
*Copper (7440-50-8)	1,144,000	5230	4572	5.815	1,153,000	99.22	0.45	0.40	0.00
*Lead (7439-92-1)	1,264,000	52,300	849.4	56,530	1,373,000	92.06	3.81	0.06	4.12
*Alkylated lead	22.73	27.68			50.41	45.09	54.91		
*Manganese (7439-96-5)	2,198,000	21,280	15,530	5528	2,240,000	98.13	0.95	0.69	0.25
*Mercury (7439-97-6)	64,190	3397	4952	282.4	72,820	88.15	4.66	6.80	0.39
*Nickel (7440-02-0)	858,800	44,820	11,210	18,580	933,400	92.01	4.80	1.20	1.99
*Selenium (7782-49-2)	362,300	6771	204.2	109.8	369,300	98.10	1.83	0.06	0.03
Titanium tetrachloride (7550-45-0)	561				561	100.00			
<b>Metal Total</b>	<b>7,935,000</b>	<b>172,300</b>	<b>58,720</b>	<b>86,370</b>	<b>8,253,000</b>	<b>96.15</b>	<b>2.09</b>	<b>0.71</b>	<b>1.05</b>
<b>Non-Metal Compounds (Excluding 16 PAHs)</b>									
1,1,1-Trichloroethane (71-55-6)	149,400	53,840,000		1.107	53,990,000	0.28	99.72		0.00
1,1,2,2-Tetrachloroethane (79-34-5)	13,880	7814			21,690	63.99	36.03		
1,1,2-Trichloroethane (79-00-5)	3740	40.47			3780	98.94	1.07		
1,1-Dichloroethane (75-34-3)	27,110	1360			28,470	95.22	4.78		

\* This item represents a group of pollutants, as identified in table 1-1

† Benzo(a)pyrene is being assessed by the regional emissions inventory Steering Committee to improve accuracy and consistency of emissions estimates. This process will include an update to the 2002 benzo(a)pyrene emissions estimates. These updates will be posted in the CAROL repository (<http://mds.glc.org/carol/>) and the project website ([www.glc.org/air/](http://www.glc.org/air/)) by the end of 2006.

Pollutant Code (CAS Number)	Emissions (lbs.)					Percent (%)			
	Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad
1,1-Dimethylhydrazine (57-14-7)	260				260	100.00			
1,2,4-Trichlorobenzene (120-82-1)	33,490	3274			36,760	91.10	8.91		
1,2-Dibromo-3-chloropropane (96-12-8)	78.1				78.1	100.00			
1,2-Dibromoethane (106-93-4)	8551	755.6			9306	91.89	8.12		
1,2-Dichloroethane (107-06-2)	18,260	33,200			51,460	35.48	64.52		
1,2-Epoxybutane (106-88-7)	3464				3464	100.00			
1,2-Propylenimine (75-55-8)	77.7				77.7	100.00			
1,3-Butadiene (106-99-0)	552,900	8,095,000	12,380,000	5,711,000	26,740,000	2.07	30.27	46.30	21.36
1,3-Dichloropropene (542-75-6)	1014	9,752,000			9,753,000	0.01	99.99		
1,4-Dichlorobenzene (106-46-7)	69,760	6,583,000			6,652,000	1.05	98.96		
1,4-Dioxane (123-91-1)	10,570	1512			12,090	87.43	12.51		
2,2,4-Trimethylpentane (540-84-1)	77,730	2,496,000	90,510,000	55,130,000	148,200,000	0.05	1.68	61.07	37.20
2,3,7,8-Tetrachlorodibenzofuran (51207-31-9)	1.733	2.183	0.01613	5.655	9.588	18.07	22.77	0.17	58.98
2,3,7,8-Tetrachlorodibenzo-p-dioxin (1746-01-6)	12.11	239	0.01566	0.002782	251.2	4.82	95.14	0.01	0.00
2,4,5-Trichlorophenol (95-95-4)	28				28	100.00			
2,4,6-Trichlorophenol (88-06-2)	20.43	0.01344			20.44	99.95	0.07		
2,4-D (2,4-Dichlorophenoxyacetic acid) (94-75-7)	42.53	3,690,000			3,690,000	0.00	100.00		
2,4-Dinitrophenol (51-28-5)	184.2	0.11			184.3	99.95	0.06		
2,4-Dinitrotoluene (121-14-2)	164.4	1730			1894	8.68	91.34		
2-Acetylaminofluorene (53-96-3)	74.62				74.62	100.00			
2-Chloro-1,3-butadiene (Chloroprene, 126-99-8)	2515	854.6			3370	74.63	25.36		
2-Chloroacetophenone (532-27-4)	1521	2.81			1524	99.80	0.18		
2-Nitropropane (79-46-9)	30.5	152.5			183	16.67	83.33		

Pollutant Code (CAS Number)	Emissions (lbs.)					Percent (%)			
	Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad
3,3'-Dichlorobenzidine (91-94-1)	12				12	100.00			
3,3'-Dimethylbenzidine (119-93-7)	260.5				260.5	100.00			
4,4'-Methylene bis(2-chloroaniline) (101-14-4)	79.8				79.8	100.00			
4,4'-Methylenedianiline (101-77-9)	1855				1855	100.00			
4,4'-Methylenediphenyl diisocyanate (101-68-8)	419,000	4313			423,300	98.98	1.02		
4,6-Dinitro-O-cresol (534-52-1)	7244				7244	100.00			
4-Aminobiphenyl (92-67-1)	3.5				3.5	100.00			
4-Nitrobiphenyl (92-93-3)	0.3				0.3	100.00			
4-Nitrophenol (100-02-7)	7846	2084			9930	79.01	20.99		
Acetaldehyde (75-07-0)	1,988,000	1,317,000	16,700,000	12,800,000	32,800,000	6.06	4.02	50.91	39.02
Acetamide (60-35-5)	5	10.07			15.07	33.18	66.82		
Acetonitrile (75-05-8)	229,200	12,410			241,600	94.87	5.14		
Acetophenone (98-86-2)	40,050	3051			43,100	92.92	7.08		
Acrolein (107-02-8)	358,700	1,080,000	1,761,000	1,487,000	4,687,000	7.65	23.04	37.57	31.73
Acrylamide (79-06-1)	1715				1715	100.00			
Acrylic acid (79-10-7)	62,460	87.28			62,550	99.86	0.14		
Acrylonitrile (107-13-1)	303,000	52,480			355,400	85.26	14.77		
Allyl chloride (107-05-1)	409.3	696			1105	37.04	62.99		
Aniline (62-53-3)	46,820				46,820	100.00			
Asbestos (1332-21-4)	542				542	100.00			
Atrazine (1912-24-9)	584	7,768,000			7,769,000	0.01	99.99		
Benzene (71-43-2)	3,662,000	32,520,000	100,300,000	36,000,000	172,500,000	2.12	18.85	58.14	20.87
Benzidine (92-87-5)	3.46				3.46	100.00			
Benzyl chloride (100-44-7)	137,300	574			137,800	99.64	0.42		
Beta-propiolactone (57-57-8)	0.0005				0.0005	100.00			

Pollutant Code (CAS Number)	Emissions (lbs.)					Percent (%)			
	Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad
Biphenyl (92-52-4)	114,200	13,710			127,900	89.29	10.72		
Bis(2-chloroethyl)ether (111-44-4)	301.5				301.5	100.00			
Bis(chloromethyl)ether (542-88-1)	6.49				6.49	100.00			
Bromoform (75-25-2)	11,530	15.66			11,550	99.83	0.14		
Captan (133-06-2)	935	141,500			142,400	0.66	99.37		
Carbaryl (63-25-2)	479	93,360			93,840	0.51	99.49		
Carbon disulfide (75-15-0)	4,082,000	157,600			4,240,000	96.27	3.72		
Carbon tetrachloride (56-23-5)	33,350	47,990			81,340	41.00	59.00		
Carbonyl sulfide (463-58-1)	8,877,000	1971			8,879,000	99.98	0.02		
Catechol (120-80-9)	774.3				774.3	100.00			
Chlordane (57-74-9)	1.61				1.61	100.00			
Chlorine (7782-50-5)	1,664,000	245,600	12,820		1,922,000	86.58	12.78	0.67	
Chloroacetic acid (79-11-8)	71				71	100.00			
Chlorobenzene (108-90-7)	191,800	5,334,000			5,526,000	3.47	96.53		
Chlorobenzilate (510-15-6)	0.8				0.8	100.00			
Chloroethane (75-00-3)	100,800	627,600			728,400	13.84	86.16		
Chloroform (67-66-3)	216,500	707,600			924,100	23.43	76.57		
Chloromethyl methyl ether (107-30-2)	250				250	100.00			
Coke oven emissions	1,360,000				1,360,000	100.00			
Cresol (mixed isomers) (1319-77-3)	191,000	47.96			191,000	100.00	0.03		
Cresol, M- (108-39-4)	4911				4911	100.00			
Cresol, O- (95-48-7)	9585	713.9			10,300	93.06	6.93		
Cresol, P- (106-44-5)	712.1	1444			2156	33.03	66.98		
Cumene (98-82-8)	444,700	189,800			634,500	70.09	29.91		

Pollutant Code (CAS Number)	Emissions (lbs.)					Percent (%)			
	Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad
*Cyanide (57-12-5)	590,000	10,440			600,500	98.25	1.74		
Dibenzofuran (132-64-9)	7849	2019			9868	79.54	20.46		
Dichlorvos (DDVP) (62-73-7)	31.4				31.4	100.00			
Diethanolamine (111-42-2)	25,930	269.2			26,200	98.97	1.03		
Diethyl sulfate (64-67-5)	4520				4520	100.00			
Diethylhexyl phthalate (117-81-7)	48,880	96.31			48,970	99.82	0.20		
Dimethyl aminoazobenzene (60-11-7)	0.8				0.8	100.00			
Dimethyl phthalate (131-11-3)	93,500	411			93,910	99.56	0.44		
Dimethyl sulfate (77-78-1)	14,610	61.93			14,680	99.52	0.42		
Dimethylalanine (121-69-7)	858.8	9845			10,700	8.03	92.01		
Di-N-butyl phthalate (84-74-2)	24,380	1,489,000			1,513,000	1.61	98.41		
Di-N-octyl phthalate (117-84-0)	330.3				330.3	100.00			
Epichlorohydrin (106-89-8)	74,710	138.3			74,850	99.81	0.18		
Ethyl acrylate (140-88-5)	21,000	83.93			21,090	99.57	0.40		
Ethyl benzene (100-41-4)	3,899,000	9,203,000	35,600,000	22,740,000	71,430,000	5.46	12.88	49.84	31.84
Ethyl carbamate (51-79-6)	71				71	100.00			
Ethylene glycol (107-21-1)	739,000	11,660,000			12,390,000	5.96	94.11		
Ethylene oxide (75-21-8)	131,500	639,300			770,900	17.06	82.93		
Ethylenethiourea (96-45-7)	61.88				61.88	100.00			
Fine mineral fibers	3619				3619	100.00			
Formaldehyde (50-00-0)	11,760,000	4,209,000	40,860,000	29,330,000	86,160,000	13.65	4.89	47.42	34.04
*Glycol ethers	12,360,000	12,570,000			24,930,000	49.58	50.42		
Heptachlor (76-44-8)	1.17				1.17	100.00			
Hexachloro-1,3-butadiene (87-68-3)	595.9	24.96			620.8	95.99	4.02		

\* This item represents a group of pollutants, as identified in table 1-1

Pollutant Code (CAS Number)	Emissions (lbs.)					Percent (%)			
	Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad
Hexachlorobenzene (118-74-1)	231.4	34.63			266	86.99	13.02		
Hexachlorocyclopentadiene (77-47-4)	86.9	20.02			106.9	81.29	18.73		
Hexachloroethane (67-72-1)	552.9				552.9	100.00			
Hexamethylene-1,6-diisocyanate (822-06-0)	7566	0.89			7567	99.99	0.01		
Hexane (110-54-3)	16,670,000	36,770,000	29,330,000	16,440,000	99,210,000	16.80	37.06	29.56	16.57
Hydrazine (302-01-2)	324.5				324.5	100.00			
Hydrochloric acid (7647-01-0)	349,800,000	14,180,000			364,000,000	96.10	3.90		
Hydrogen cyanide (74-90-8)	114,700	3,010,000			3,125,000	3.67	96.32		
Hydrogen fluoride (7664-39-3)	42,820,000	1,549,000			44,370,000	96.51	3.49		
Hydrogen sulfide (7783-06-4)	4,193,000				4,193,000	100.00			
Hydroquinone (123-31-9)	9268	44,240			53,510	17.32	82.68		
Isophorone (78-59-1)	191,800	81,800			273,600	70.10	29.90		
Lindane (gamma HCH) (58-89-9)	3				3	100.00			
Maleic anhydride (108-31-6)	168,500				168,500	100.00			
Methanol (67-56-1)	26,900,000	56,010,000			82,910,000	32.44	67.56		
Methoxychlor (72-43-5)	320.6				320.6	100.00			
Methyl bromide (74-83-9)	113,200	15,310,000			15,420,000	0.73	99.29		
Methyl chloride (74-87-3)	1,797,000	800,100			2,597,000	69.20	30.81		
Methyl ethyl ketone (78-93-3)	18,080,000	55,500,000		7435	73,580,000	24.57	75.43		0.01
Methyl hydrazine (60-34-4)	34,780	68.24			34,850	99.80	0.20		
Methyl iodide (74-88-4)	423.3				423.3	100.00			
Methyl isobutyl ketone (108-10-1)	6,179,000	27,220,000			33,400,000	18.50	81.50		
Methyl isocyanate (624-83-9)	61				61	100.00			
Methyl methacrylate (80-62-6)	848,100	27,600			875,700	96.85	3.15		
Methyl tert-butyl ether (1634-04-4)	455,000	1,530,000	7,082,000	4,388,000	13,450,000	3.38	11.38	52.65	32.62

Pollutant Code (CAS Number)	Emissions (lbs.)					Percent (%)			
	Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad
Methylene chloride (dichloromethane) (75-09-2)	5,516,000	13,940,000			19,460,000	28.35	71.63		
N,N-Dimethyl carbamoyl chloride (79-44-7)	5				5	100.00			
N,N-Dimethylformamide (68-12-2)	60,200	663,300			723,500	8.32	91.68		
Nitrobenzene (98-95-3)	508.4	234.4			742.8	68.44	31.56		
N-Nitrosodimethylamine (62-75-9)	0.3005				0.3005	100.00			
N-Nitrosomorpholine (59-89-2)	4.001				4.001	100.00			
Pentachloronitrobenzene (82-68-8)	1120				1120	100.00			
Pentachlorophenol (87-86-5)	1204	81.03			1285	93.70	6.31		
Phenol (108-95-2)	3,086,000	359,700		19,800	3,466,000	89.04	10.38		0.57
Phosgene (75-44-5)	181	1.122			182.1	99.40	0.62		
Phosphine (7803-51-2)	3802	971.1			4773	79.66	20.35		
Phosphorus (7723-14-0)	56,190	1085		44.36	57,320	98.03	1.89		0.08
Phthalic anhydride (85-44-9)	139,600				139,600	100.00			
Polychlorinated biphenyls (PCBs) (1336-36-3)	38.79	4386			4425	0.88	99.12		
*Polychlorinated dibenzodioxins, tot.	46.81	22.57	1.019	0.3787	70.78	66.13	31.89	1.44	0.54
*Polychlorinated dibenzofurans, tot.	56.53	105.5	0.1929	0.06353	162.3	34.83	65.00	0.12	0.04
P-Phenylenediamine (106-50-3)	23,210				23,210	100.00			
Propionaldehyde (123-38-6)	246,200	35,930	1,974,000	2,662,000	4,918,000	5.01	0.73	40.14	54.13
Propoxur (114-26-1)	10				10	100.00			
Propylene dichloride (78-87-5)	20,700	1412			22,120	93.58	6.38		
Propylene oxide (75-56-9)	59,980	55,590			115,600	51.89	48.09		
Quinoline (91-22-5)	2473				2473	100.00			
Quinone (106-51-4)	5201				5201	100.00			

\* This item represents a group of pollutants, as identified in table 1-1

Pollutant Code (CAS Number)	Emissions (lbs.)					Percent (%)			
	Point	Area	Onroad	Nonroad	Total	Point	Area	Onroad	Nonroad
Styrene (100-42-5)	13,460,000	1,911,000	7,194,000	1,682,000	24,250,000	55.51	7.88	29.67	6.94
Styrene Oxide (96-09-3)	2773				2773	100.00			
Tetrachloroethylene (Perc) (127-18-4)	1,448,000	24,090,000			25,540,000	5.67	94.32		
Toluene (108-88-3)	30,410,000	171,000,000	240,100,000	147,400,000	588,900,000	5.16	29.04	40.77	25.03
*Toluene-2,4-diisocyanate (584-84-9)	6006	802			6808	88.22	11.78		
Toluidine, O- (95-53-4)	67.08	63.74			130.8	51.28	48.73		
Trichloroethylene (79-01-6)	6,819,000	21,810,000			28,630,000	23.82	76.18		
Triethylamine (121-44-8)	1,045,000	67,970			1,113,000	93.89	6.11		
Trifluralin (1582-09-8)	1010	689,700			690,700	0.15	99.86		
Vinyl acetate (108-05-4)	480,600	72,420			553,000	86.91	13.10		
Vinyl chloride (75-01-4)	247,800	59,440			307,300	80.64	19.34		
Vinylidene chloride (75-35-4)	2805	20,850			23,650	11.86	88.16		
*Xylene (mixed isomers) (1330-20-7)	25,110,000	120,100,000	135,700,000	101,600,000	382,500,000	6.56	31.40	35.48	26.56
Xylene, M- (108-38-3)	34,570	1,277,000		156,400	1,467,000	2.36	87.05		10.66
Xylene, O- (95-47-6)	543,500	5,238,000		88,700	5,870,000	9.26	89.23		1.51
Xylene, P- (106-42-3)	7862	373,400			381,200	2.06	97.95		
<b>Non-Metal Compounds Total</b>	<b>612,600,000</b>	<b>748,400,000</b>	<b>719,400,000</b>	<b>437,700,000</b>	<b>2,518,000,000</b>	<b>24.33</b>	<b>29.72</b>	<b>28.57</b>	<b>17.38</b>
<b>Grand Total</b>	<b>621,800,000</b>	<b>760,300,000</b>	<b>722,600,000</b>	<b>438,700,000</b>	<b>2,543,000,000</b>	<b>24.45</b>	<b>29.90</b>	<b>28.42</b>	<b>17.25</b>

\* This item represents a group of pollutants, as identified in table 1-1

**Table 2-2: The most significant source categories for the top five non-metal compounds.**

<b>Pollutant Name</b>	<b>Regional Total Emissions (lb)</b>	<b>Most Significant Source Category</b>	<b>% Contribution to Total</b>
Toluene	588,900,000	Light Duty Gasoline Vehicles	20.52
Xylenes (includes o, m, and p)	382,500,000	Light Duty Gasoline Vehicles	17.82
Hydrochloric acid	364,000,000	Electric, Gas, and Sanitary Services (SIC code 49xx)	88.19
Benzene	172,500,000	Light Duty Gasoline Vehicles	26.63
2,2,4-Trimethylpentane	184,200,000	Light Duty Gasoline Vehicles	30.95

**Table 2-3: The most significant source categories for the top five metal compounds.**

<b>Pollutant Name</b>	<b>Regional Total Emissions (lb)</b>	<b>Most Significant Source Category</b>	<b>% Contribution to Total</b>
Manganese	2,240,000	Primary Metal Industries (SIC code 33xx)	56.67
Chromium	1,558,000	Primary Metal Industries (SIC code 33xx)	74.67
Lead	1,373,000	Primary Metal Industries (SIC code 33xx)	43.80
Copper	1,153,000	Primary Metal Industries (SIC code 33xx)	75.23
Nickel	933,400	Primary Metal Industries (SIC code 33xx)	32.49

**Table 2-4: Summary of regional air toxics emissions (1996-2002, expressed in pounds).**

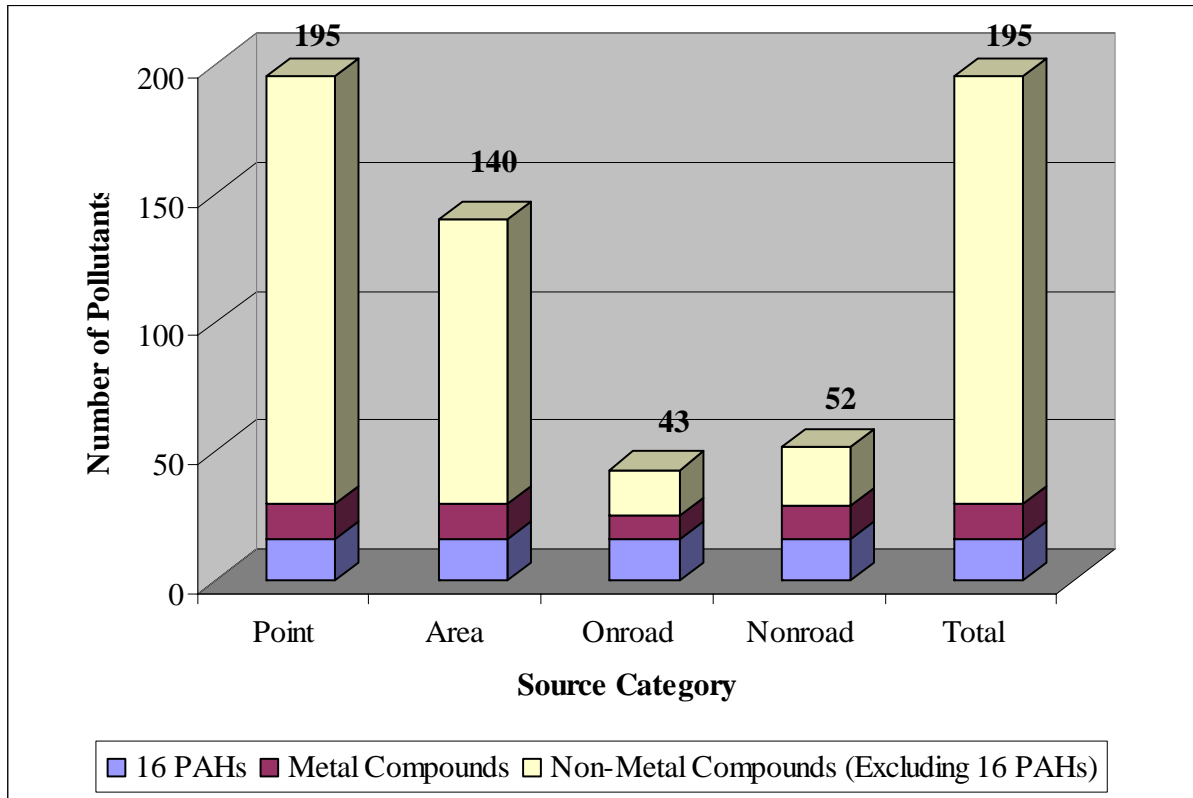
Calendar Year	1996	1997	1998	1999	2001	2002
16 PAHs	31,750,000	17,670,000	20,390,000	18,500,000	18,030,000	16,940,000
Nonmetal Compounds	1,648,000,000	1,442,000,000	1,683,000,000	3,089,000,000	2,911,000,000	2,518,000,000
Metal Compounds	8,269,000	5,795,000	5,925,000	7,006,000	6,785,000	8,253,000
Total	1,688,000,000	1,465,000,000	1,710,000,000	3,114,000,000	2,936,000,000	2,543,000,000

The above emissions should not be used for trend analysis, due to yearly variations in provincial and state emission reporting requirements and improvements in estimation methods

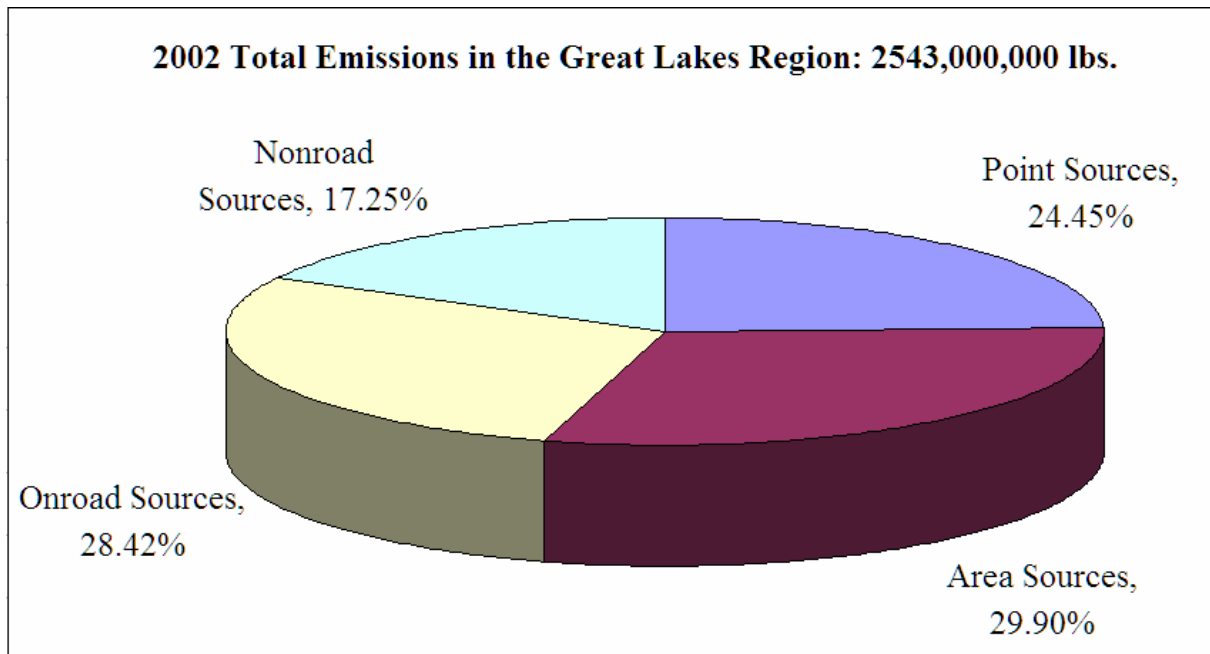
**Table 2-5: Targeted pollutants for which no emission estimates were obtained for 2002**

Pollutant	Reason for lack of emission estimate
1,2-Diphenylhydrazine	No emission factors available through U.S. EPA's FIRE 6.25
1,3-Propane sultone	No emission factors available through U.S. EPA's FIRE 6.25
2,4-Diaminotoluene	No emission factors available through U.S. EPA's FIRE 6.25
3,3'-Dimethoxybenzidine	No emission factors available through U.S. EPA's FIRE 6.25
Benzoic trichloride	No emission factors available through U.S. EPA's FIRE 6.25
Calcium cyanamide	No emission factors available through U.S. EPA's FIRE 6.25
Chloramben	No emission factors available through U.S. EPA's FIRE 6.25
Diazomethane	No emission factors available through U.S. EPA's FIRE 6.25
Ethylenimine	No emission factors available through U.S. EPA's FIRE 6.25
Hexamethyl phosphoramidate	No emission factors available through U.S. EPA's FIRE 6.25
N-Nitroso-N-methylurea	No emission factors available through U.S. EPA's FIRE 6.25
O-Anisidine	No emission factors available through U.S. EPA's FIRE 6.25
Parathion	Emission factors unavailable; Documented use in one Great Lakes state, adequate activity data not available.
Radionuclides	Emission factor available only for Phosphate Rock Processing; no activity data for Great Lakes region.
Toxaphene	No usage data for Great Lakes region; toxaphene usage is banned in the U.S. and Canada.
Vinyl bromide	No emission factors available through U.S. EPA's FIRE 6.25

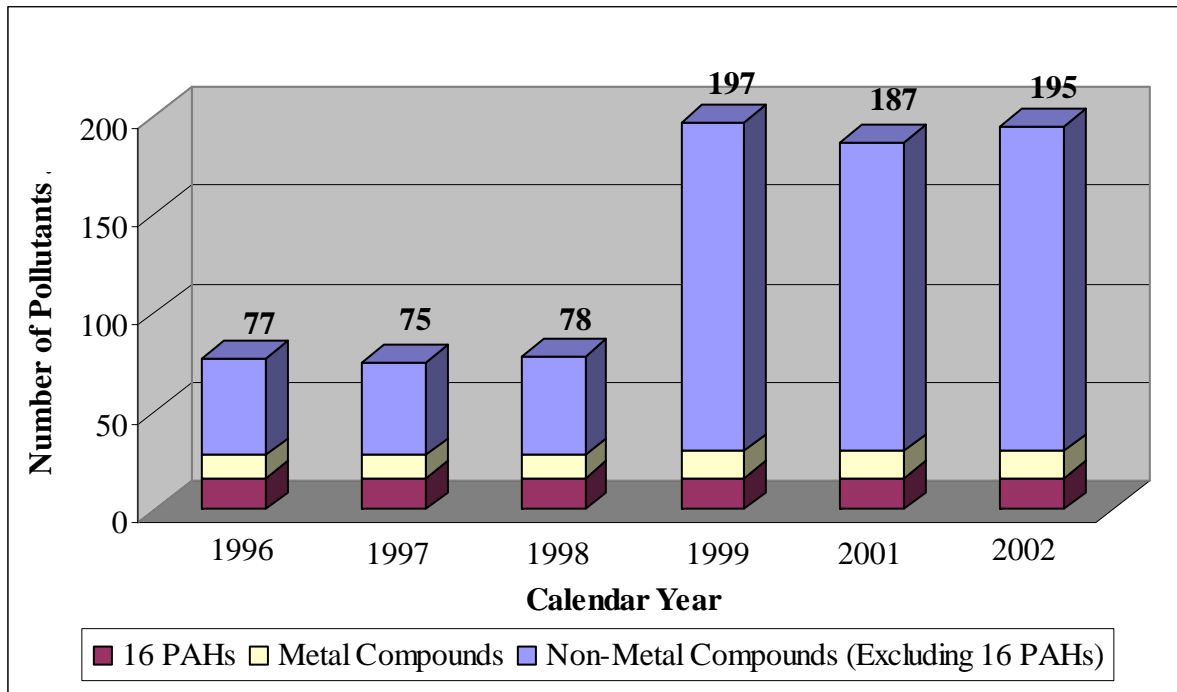
**Figure 2-1: Number of pollutants in the 2002 inventory.**



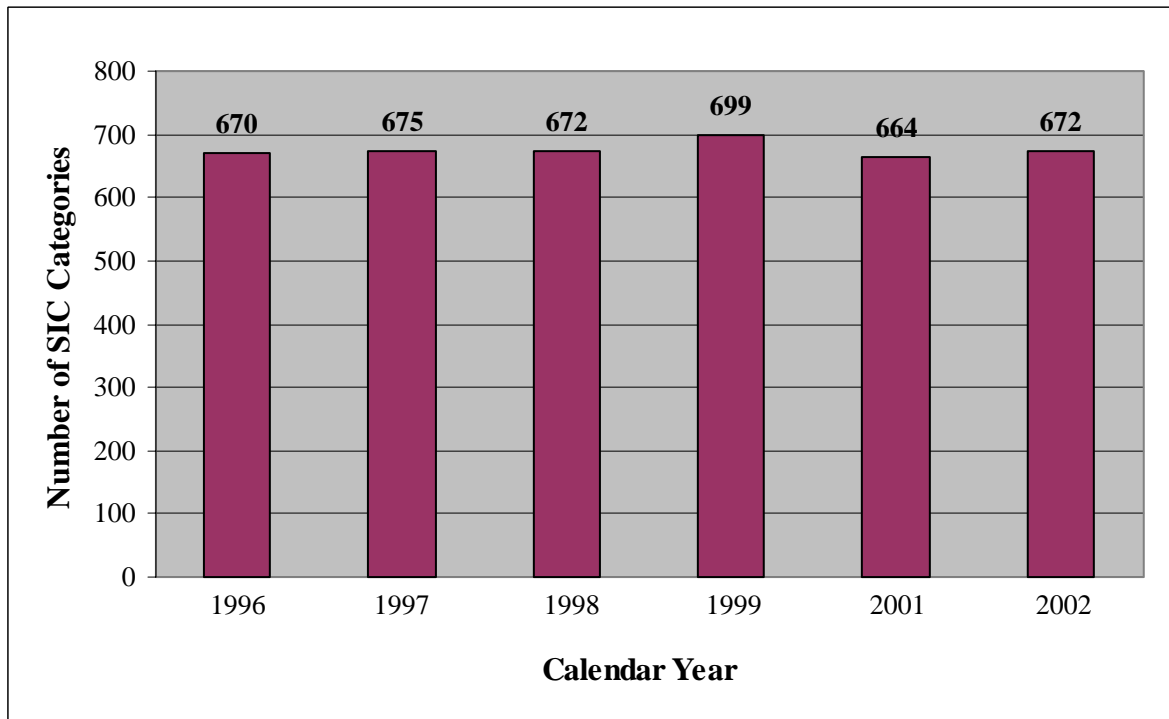
**Figure 2-2: Contributions to 2002 air toxic emissions in the Great Lakes Region.**



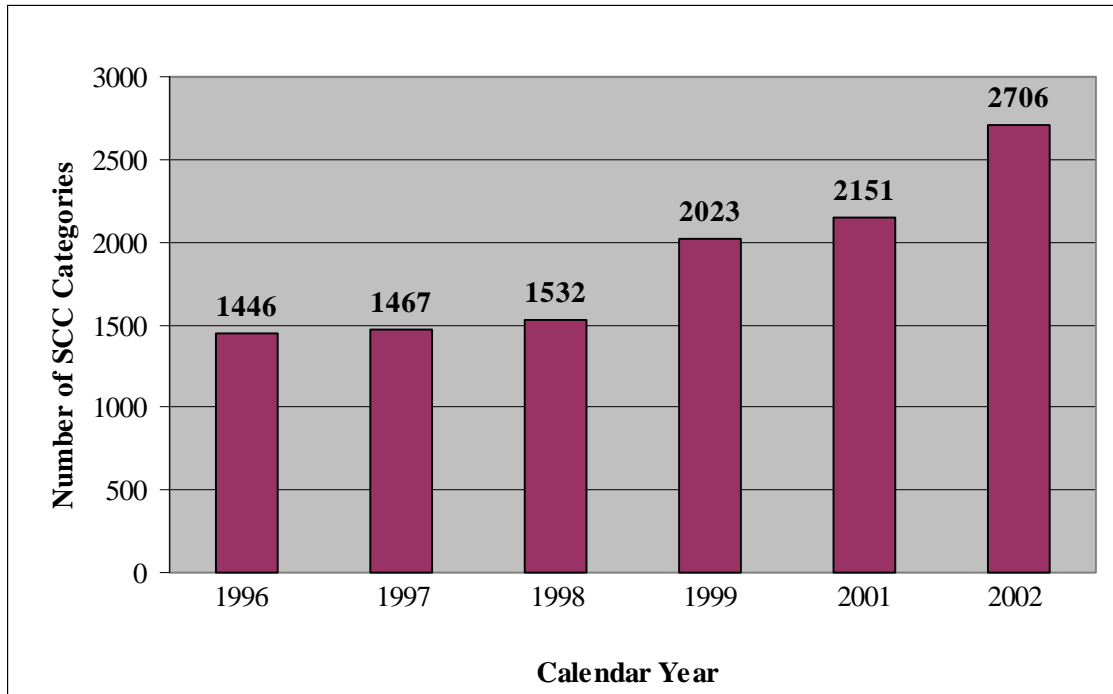
**Figure 2-3: Number of pollutants inventoried (1996-2002).**



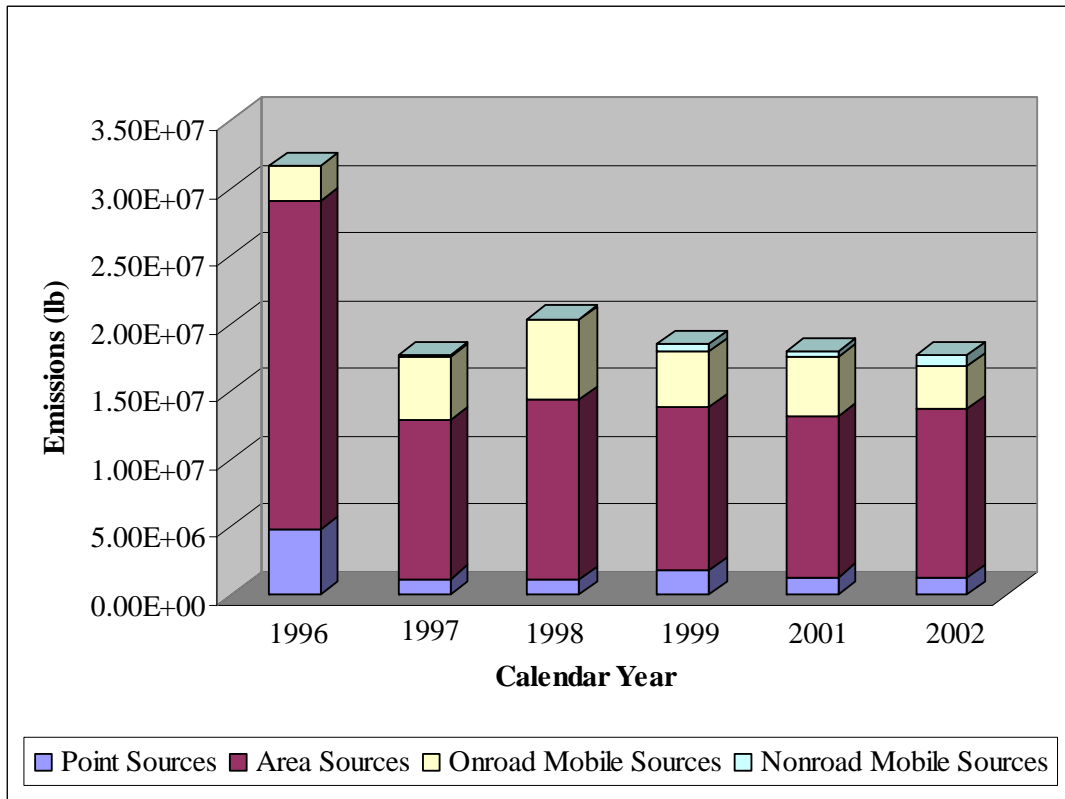
**Figure 2-4: Number of SIC categories inventoried (1996-2002).**



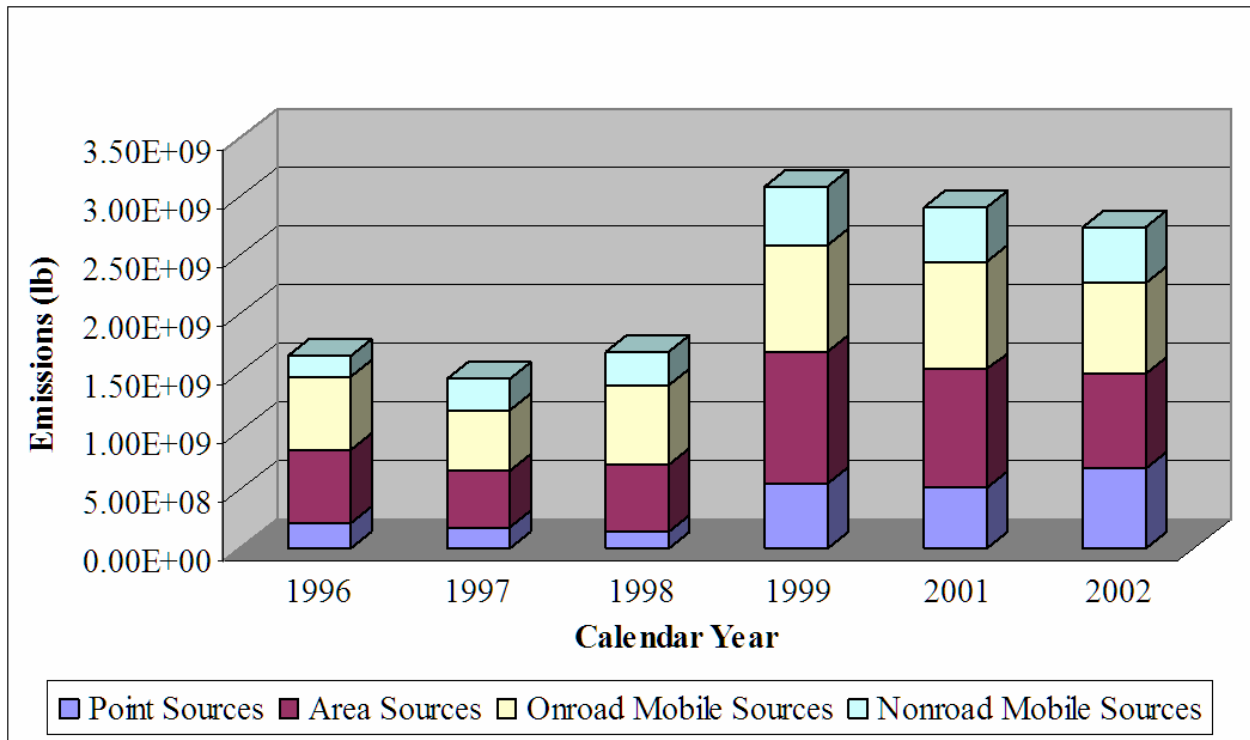
**Figure 2-5: Number of SCC categories inventoried (1996-2002).**



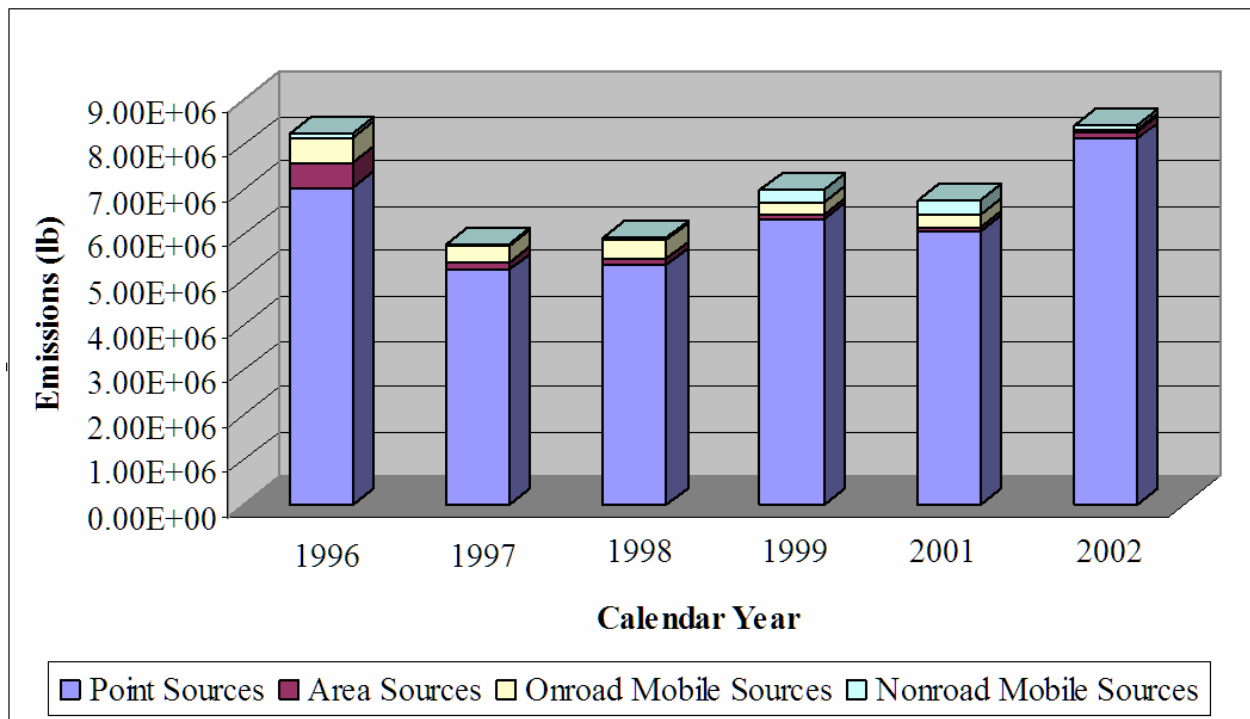
**Figure 2-6: Emissions of 16 PAHs (1996-2002).**



**Figure 2-7: Emissions of non-metal compounds (1996-2002).**



**Figure 2-8: Emissions of metal compounds (1996-2002).**



### 3. Conclusion

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The air regulatory agencies in the eight Great Lakes states and province of Ontario agree that a collaborative effort is vital to successfully implementing an annual inventory of airborne toxic pollutant emissions for the Great Lakes region. They have been working cooperatively towards this goal since 1989. This emissions inventory assists in the successful implementation of key provisions of the Great Lakes Toxic Substances Control Agreement, signed by the Great Lakes governors and premiers in 1986. In addition, this work is consistent with the state activities for the implementation of the Urban Area Source Program required under sections 112(c) and 112(k) under the Clean Air Act Amendments of 1990 and the assessment of atmospheric deposition to the Great Lakes.

The emphasis of this project is to prepare a reliable and technically accurate inventory of estimated emissions for the target compounds in the Great Lakes region. As a regional effort, a high level of coordination is necessary to ensure consistency. The project team has established Quality Assurance/Quality Control (QA/QC) criteria to provide an accurate and useful summary of toxic air emissions at the regional level. The QA/QC plan outlines procedures to maximize the quality and accuracy of the regional inventory's data and estimates. Once a quality controlled and quality assured emissions inventory has been established, regional scientists and researchers can begin to work to define and reduce emissions sources, evaluate control technology, establish guidelines for siting new facilities, and reduce airborne deposition of persistent toxic chemicals to the Great Lakes.

Consistency among states and the province continue to be a focus of the project and opportunities for progress in this area are continually being identified. In many cases, additional research and analysis is needed to resolve these issues. In some cases, emission estimates are originated within the organizations that are collaborating to produce this inventory. However, in many cases, they are not. Some emissions data are estimated and reported by facilities or are obtained from governmental inventories compiled and maintained by other groups, such as the Toxics Release Inventory (TRI) and National Emissions Inventory (NEI) in the U.S. and National Pollution Release Inventory (NPRI) in Canada. Errors or anomalies in such data are therefore more difficult to reconcile or resolve. Nevertheless, when identified, such issues will continue to be addressed by approaching the creators of that data. In addition, the internally-produced data will continue to be assessed for comprehensiveness and consistency, and improvements made wherever feasible.

The overall benefit of maintaining an inventory of air toxic emission sources ultimately belongs to organizations that are able to use the data. The 2002 inventory data, as well as previous regional inventories, are made available to researchers and interested parties from the Centralized Air emissions Repository On-Line (CAROL, <http://mds.glc.org/carol>). By enhancing the access to the emissions database, this tool increases the usefulness of the inventory in meeting the region's air toxic emission information needs. Decision makers and the general public will be able to make better informed decisions toward reduced toxic pollution, protect and restore habitats and support intergovernmental partnerships. Timely access to a comprehensive inventory provides the foundation for sound public policy decisions.