

1. Introduction and Inventory Objective

This 1998 inventory update, 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 source and emission levels of air toxic contaminants.

The development and release of the inventory is an important step in meeting the goals of the 1986 Great Lakes Toxic Substances Control Agreement (signed by the Great Lakes governors and Premier of Ontario), and sections 112(c)(6), 112(k) and 112(m) of the 1990 U.S. Clean Air Act Amendments (see <http://www.cglg.org/pub/toxics/index.html> and <http://earth1.epa.gov/oar/caa.html> for further details).

The inventory project presents a compilation of the best available data for calendar year 1998 emissions. 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 contribute to the total emissions of toxic contaminants listed in Table 1-1. This list of 82 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 project is strengthening 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 demonstrating the value of client/server technology via the Internet to transmit and exchange environmental data among the Great Lakes jurisdictions and inform the larger Great Lakes community.

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 Lakes Michigan launched this regional effort. To date we have released full inventories for the years 1993, 1996, 1997 and 1998. The 1993 inventory consisted of point

and area sources for 49 pollutants of concern. The subsequent inventories include emissions information from point, area, and mobile sources for 82 toxic air pollutants.

Inventory Methodology

The 1998 update of the Regional Toxic Air Emissions Inventory effort focuses on significant sources of air emissions of 82 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 <http://great-lakes.net/envt/air/airtox.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:

- Assigns responsibilities and procedures to the states, Great Lakes Commission, U.S. EPA Great Lakes National Program Office (GLNPO);
- Outlines procedures to identify and locate emission sources of target compounds;
- Guides selection of specific emission estimation techniques;
- Instructs states on compiling and updating the regional repository at GLNPO;
- Outlines quality assurance/quality control procedures for emission data and estimates; and
- Identifies and explains the full 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:

- **Emitants 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 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).

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.

The protocol refers to certain software tools (e.g. the Regional Air Pollutant Inventory Development System (RAPIDS), discussed below) that can be used to prepare a state or province's portion of the regional inventory. However, the protocol procedures, if followed, will result in emissions data and estimates that are compatible and consistent, whether or not these software tools are used.

RAPIDS Development

The RAPIDS Steering Committee is composed of representatives from each of the air management programs from the eight Great Lakes states and province of Ontario and observers from U.S. EPA. A complete list of members with contact information can be found in Appendix HH. For further information on Steering Committee functions see <http://www.glc.org/air/air3.html>.

The Steering Committee worked closely with the project software development contractor, Windsor Technologies Inc., to enhance emissions estimation and reporting capabilities in RAPIDS. RAPIDS is a client/server system developed in PowerBuilder® with an ORACLE® back-end database. The software takes full advantage of Internet/Great Lakes Information Network (GLIN) connections between the states, the Great Lakes Commission and the U.S. EPA GLNPO office in Chicago. Two software enhancements were developed for this release.

- Incorporating FIRE 6.23 emission factors into RAPIDS, and
- Adding the capability of exporting point source emissions data from RAPIDS into EPA's National Emissions Inventory (NEI) format.

FIRE 6.23 contains the latest available toxic emission factors from USEPA. The RAPIDS export to NEI allowed users to submit their emissions inventory data to USEPA for inclusion into the National Emissions Inventory.

Quality Assurance/Quality Control

Finally, Quality Assurance/Quality Control (QA/QC) of the inventory was performed. The RAPIDS software 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 to each other
 - state emissions by pollutant;
 - state emissions by pollutant and source category (point, area, etc.);

- Comparing emissions of a state to its emissions from the 1997 inventory or 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;
- For each SCC, identified which pollutants each state inventoried and indicated which pollutants were missing or extra.

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

Next steps

For the 1999 inventory, the Steering Committee will extend the pollutant list to include all 188 hazardous air pollutants identified in Section 112(b) of the CAA for point, area and mobile sources.

Ongoing inventory efforts provide for various scientific studies, whether looking at Mercury or PCB concentrations or analyzing the regional impact of 188 hazardous air pollutants. By calculating an annual inventory, the project's Steering Committee provides quality data as a basis for trend analysis.

The 1999 inventory will include an enhanced Mercury inventory as part of a Great Lakes regional study of Mercury concentrations in the Great Lakes system. In addition, the RAPIDS' software will be enhanced to include a RAPIDS/NEI export utility for area and mobile sources; the capability to import point, area and mobile sources data in NEI format, and the creation of a regional clearinghouse to facilitate data reporting and data access through the Internet.

These studies bridge the gap between the science of inventorying toxic air emissions and the public policy debate concerning how these emissions affect human health and the environment and how they should be addressed. Follow-up by state, provincial and federal environmental protection agencies is necessary to make further progress toward these goals. The Steering Committee recommends that regulatory decisions not be based on this data alone.

Table 1-1: List of 82 targeted toxic air pollutants.

Non-Metal Compounds (Excluding PAHs)	
Acetaldehyde	Methyl chloroform (1,1,1-Trichloroethane)
Acrolein	Methylene chloride (Dichloromethane)
Acrylamide	Methylene diphenyl diisocyanate (MDI)
Acrylonitrile	Parathion
Atrazine	Pentachloronitrobenzene (quintobenzene)
Benzene (including benzene from gasoline)	Pentachlorophenol
1,3-Butadiene	Phenol
Carbon tetrachloride	Phosgene
Chlordane	Styrene
Chloroform	2,3,7,8 -tetrachlorodibenzo -furan (TCDF)
Coke oven emissions	2,3,7,8 -tetrachlorodibenzo -p-dioxin (TCDD)
Di-n-butyl phthalate	Tetrachloroethylene (Perchloroethylene)
Di-n-octyl phthalate	Toluene
Dichloroethyl ether (bis(2-chloroethyl) ether)	2,4-Toluene diisocyanate
Diethylhexyl phthalate (Bis(2-ethylhexyl)phthalate) (DEHP)	Total polychlorinated biphenyls (PCBs)
Ethylbenzene	Total polychlorinated dibenzodioxins (PCDDs)
Ethylene dibromide (Dibromoethane)	Total polychlorinated dibenzofurans (PCDFs)
Ethylene dichloride (1,2-Dichloroethane)	Trichloroethylene
Ethylene oxide	2,4,5-Trichlorophenol
Formaldehyde	2,4,6-Trichlorophenol
Glycol ethers	Trifluralin
Heptachlor	Vinyl chloride
Hexachlorobenzene	Xylenes (Meta)
Hexachlorobutadiene	Xylenes (Ortho)
Hexachloroethane	Xylenes (Para)
Hydrazine	Xylenes (Iso)
Methoxychlor	
16 PAHs (POM)	
Acenaphthene	Chrysene
Acenaphthylene	Dibenz(a,h)anthracene
Anthracene)	Fluoranthene
Benz(a)anthracene	Fluorene
Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene
Benzo(b)fluoranthene	Naphthalene
Benzo(ghi)perylene	Phenanthrene
Benzo(k)fluoranthene	Pyrene
Metal Compounds	
Antimony	Copper
Arsenic	Lead
Beryllium	Alkylated lead
Cadmium	Manganese
Chromium	Mercury
Chromium (6)	Nickel
Cobalt	

Data summaries of the 1998 update and all previous inventories are available online at the Great Lakes Information Network (GLIN, <http://www.great-lakes.net>). Additional information, including background documents, GIS maps depicting air emissions across the region, 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/air3.html>).

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.