

2. Methodology

Attempting to take an inventory of all ecological monitoring efforts in a basin as wide in area as the Lake Michigan basin is a mammoth undertaking. Thousands of separate efforts may be ongoing, and few people outside project participants may be aware of many of them. Striving to become aware of all of these efforts is high goal — a goal that one cannot expect to achieve on the first attempt. We view the products of Lake Michigan Tributary Monitoring Project as comprising a foundation of a monitoring inventory. Over time, if the foundation is strong enough and enough people become aware of it, the inventory can be built upon so that it will eventually become complete. We envision the inventory as a dynamic product that should constantly be updated to reflect new discoveries and changes in monitoring efforts.

In this vein, the methods used to collect information and develop the inventory consisted of the following general elements:

- A two-tiered survey of potential monitoring organizations;
- Review and collection of supplemental or specific geographic monitoring information; and
- Development of an organizing framework for the inventory.

Monitoring Inventory Survey

A short survey (25 questions, 2 pages) was developed to solicit information about possible monitoring projects in the basin (See Appendix C for the survey). Questions in the survey ask respondents to provide information on a variety of characteristics about monitoring projects. Generally, these characteristics include basic contact information, locational information, indicators monitored, logistical information, quality assurance and controls, and staff and training information.

The survey was distributed on two levels – local and state/federal. In an effort to collect a greater amount and higher quality of local monitoring information, the Great Lakes Commission partnered with local groups in 14 key tributaries to Lake Michigan. The tributaries included all ten Areas of Concern (AOCs), as well as Grand Traverse Bay, Grand River, St. Joseph River, and Door County (see Appendix B for a list of project participants). The GLC conducted the survey of state, federal and other basinwide organizations.

Two workshops were conducted to provide training and technical assistance to project participants so that the survey could be administered as effectively as possible. At the first workshop, the survey, along with a set of supporting materials, was distributed to project participants. These materials were reviewed and subsequently adapted to reflect participant feedback. A process was established at the meeting, whereby participants committed to carry out the following steps:

- *Develop a contact list for delivering surveys.* Participants were encouraged to meet with their local advisory groups and develop a list of entities in the watersheds that might be conducting monitoring programs, including local municipalities, utilities, educational institutions, business/industry groups, environmental and conservation organizations and recreational groups among others.
- *Distribute surveys with informational materials.* Participants were subsequently sent a set of materials that could be tailored to their local area. Methods to encourage high response were also discussed.
- *Enter returned surveys into electronic format.* Participants were given a database template to be used for data entry. The final datasets were sent to the GLC for incorporation into the project database. The final database is being developed for public use on the Internet as a geographically-searchable database.
- *Follow up to encourage high response.* Several strategies were discussed to increase the response rate.

- *Report findings.* A framework and timeline were established for reporting on local survey results. These reports were submitted to the GLC for integration into this final report.
- *Final workshop.* A workshop was held to review the overall findings of the project and to share information and ideas about how local groups could build on the results in future projects.

A second meeting was held midway through the project to troubleshoot survey and reporting difficulties. The main difficulty was determined to be response rate. Following the meeting, GLC crafted a press release that the project participants adapted and sent out to local media outlets. This was used to create greater awareness of the project, thereby encouraging better response.

Local Methodologies

Each project participant tailored the general methodology to achieve the best results for their watersheds. The specific methodologies used by the project participants, along with general information about survey results, are provided below.

Grand Traverse Bay

Description of the Research Process

The purpose of this research project is to identify the overall state of ecosystem monitoring being conducted in the Grand Traverse Bay watershed. In addition to water quality monitoring, ecosystem monitoring includes collecting data on selected parameters that effect the biological, physical, chemical, and human health condition of the watershed. Parameters such as fish and wildlife habitat, wetland coverage, land use development patterns, construction of infrastructure, atmospheric deposition, climatic conditions, groundwater contamination, watershed hydrology, and others are useful in assessing the condition of a watershed.

Collaboration and Communication With Watershed Groups

The survey project was presented to the Grand Traverse Bay Water Quality Monitoring Team to solicit their support and assistance in identifying organizations to receive the survey. Promotion of the survey was also made at public meetings, monthly meetings with natural resource managers, monthly meetings with the Grand Traverse Regional Environmental Health Committee, and presentations about Grand Traverse Bay sponsored by Grand Traverse Bay Watershed Initiative (GTBWI).

Number of Entities Contacted and Number of Responses

The Grand Traverse Bay Watershed Monitoring Inventory Form was mailed to 96 selected organizations located in the Grand Traverse Bay Watershed.

Of the 96 organizations receiving the survey, 24 returned the survey. Of the 24 respondents, 17 administer a monitoring program.

Muskegon and White Lakes

Surveys were mailed to over 275 potential monitoring entities in the Muskegon and White Lake AOC/River Watersheds. All county level governments, drain commissions, health departments, road commissions and conservation districts were surveyed. Contacts with the PACs and other conservation organizations initially helped to form a mailing list of townships, planning commissions, schools, sport fishing/conservation and lake associations with an interest in water quality, habitat and environmental education projects. This mailing list was compiled and used in the survey. Through a network of conservation districts, individuals and organizations throughout the watershed, a list of individuals, businesses, city governments, schools and

university contacts was developed and used in the survey. Personal contacts, phone calls and follow up mailings were performed as more information became available.

Of the survey contacts made, 70 responses were received by the Muskegon Conservation District. Of these, 23 responded with monitoring information. Thirteen of these respondents were from the Muskegon Lake AOC/River Watershed and eight were from the White Lake AOC/River Watershed. A total of 47 respondents indicated that they did not perform any monitoring.

Four public meetings were held to support the RAPs and two newsletters were developed in conjunction with the Muskegon and White Lake Public Advisory Councils to raise awareness and solicit participation for this project. The newsletters were mailed and/or distributed to over 2000 members of the public. An additional survey mailing about the occurrence of “projects” in the Muskegon River Watershed was completed to supplement knowledge about activities and opportunities which could be useful to the Muskegon River Watershed Assembly. A meeting to discuss public involvement in contaminated sediments remediation will be held in the White Lake area as part of this project as well. An educational brochure about Muskegon County watersheds (Muskegon and White being the two largest) is also being developed to promote watershed awareness and public involvement opportunities.

Grand River

Research began with contacting Grand Valley State University-Water Resources Institute (GVSU-WRI) and obtaining mailing lists for different individuals involved in water related projects that were already known to the Institute. This proved to be the best resource since the Grand River does not have a public advisory council or committee established at the time of this study.

A list was also comprised from the Michigan Water Environment Association’s 1998-99 membership directory. Surveys sent to these organizations were asked to provide information on monitoring that was above and beyond what they report for compliance purposes.

Contacts were obtained by searching through publications, reports, and news articles for individuals and groups that were in the media. Internet sites were also searched, but unfortunately most of the information found was outdated and websites did not give a good representation of the watershed as a whole. Another search method was the Know Your Watershed software published by Conservation Technology Information Center, which can be found at <http://www.ctic.purdue.edu/KYW/>. The information was obtained for local groups working within different watersheds. The publication date was in 1996, so some of the groups were no longer active. Other names came from individuals that completed the survey.

A total of 325 surveys were sent out in two bulk mailings. Additional surveys were mailed individually as more contacts were discovered. The University had 25 successful responses and 28 negative responses. The majority of surveys sent out were never returned. Inquiries were made by non-monitoring groups on the project, and results will be sent to them.

Kalamazoo River

In an effort to share responsibilities on this project, as well as avoid repetition of surveying, the Kalamazoo River Watershed Public Advisory Council (KRWPAC) partnered with a local project known as the Watershed Information Management Project (WIMP). This group seeks to compile monitoring data and store it in a publically accessible format. After several initial meetings with this group, it became evident that the decision making process between the two groups was preventing our project from commencing on schedule for our November 1, 1999 deadline. We decided to go ahead with our surveying efforts, and agree to share the information acquired with the WIMP group when the time had come.

Utilizing a mailing list obtained from the Michigan Department of Environmental Quality (MDEQ) for the Allegan Lake TMDL project, our first contact included a mailing of 272 surveys to the various contact persons on the list. Initial response yielded about 20 surveys. The surveys requested a two week turnaround time. At four weeks past the date they were mailed an intern conducted follow up calls. Most agencies did not respond to the surveys because they are not conducting any monitoring. We did receive a few surveys that were mailed or faxed back indicating that no monitoring efforts were taking place. The follow up calls did yield an additional four surveys.

A second mailing utilized a list obtained from the Kalamazoo Foundation, a private non-profit foundation that had recently held a Sustainable Community Watershed Conference. Using a list generated from those attending the conference, an additional 50 surveys were sent out. Response from this mailing yielded approximately five responses. Follow up calls did not yield any responses.

In early August, a press release was sent to the major newspapers in the Watershed as well as a few news-oriented radio stations. It is unclear as to how many of these publications actually ran the article. A few responses were received via phone, but these were general inquiry about the Watershed Council. No survey results were attained from the press release.

St. Joseph River

The first stage of the assessment was to identify various organizations that might be monitoring for information on the St. Joseph River watershed, either on water, land, wildlife or any other benchmark. Numerous telephone calls were made to speak with individuals involved in some kind of watershed monitoring. Newspapers serving all watershed counties except Berrien published the press release, proposed by the GLC. The next step was to utilize the survey form designed by the GLC/EPA. Telephone interviews were conducted with several individuals. If they did not return the survey form, the details of their programs were not made available. Comments from some of the organizations that did not return forms are included in the Excel spreadsheet under the comment column. A few personal interviews were conducted and these actually are most effective way to conduct surveys but time or lack of available resources did not permit this as a routine method. The names of the contacts are listed in the Excel spreadsheet even if they did not respond. The ones that responded with a completed form are designated in italics.

A total of about 40 organizations were contacted but only nine completed survey forms were returned. The organizations that were contacted included county health departments, wetland conservation groups, nature centers, volunteer “water watchers”, lake and stream association members, river environmental groups, “steelheaders”, county conservation offices, colleges and newspapers. The small number of returned forms reflects what appears to be a low level of formal programs that are in place that possess the discipline and resources required to monitor the parameters listed on the survey form. For example, only one organization, “Water Watcher”, of Indiana, reported monitoring Atrazine and Acetichlor.

Grand Calumet River

An initial list of likely monitoring organizations or contact people was constructed from the membership of the Citizens Advisory for the Remediation of the Environment (CARE) Committee, the Interagency Task Force on *E. coli* member lists, participants in the TMDL stakeholder process, and other local partnership efforts. The Indiana Department of Environmental Management (IDEM) Volunteer Monitoring Coordinator and the Indiana Department of Natural Resources Hoosier Riverwatch Coordinator was also consulted for a list of local participants in their volunteer water quality monitoring programs. The Riverwatch program did supply a list of past participants in their projects in Lake, Porter, and LaPorte County, Indiana. This information confirmed that in fact, no volunteer water quality or aquatic biota monitoring actually occurs in the Grand Calumet River system. This is most likely the result of the real or perceived dangers of exposing

volunteers to a waterbody with a large accumulation of highly contaminated sediments. Despite this limitation, a substantial list of contacts and organizations was constructed. Groups which might be collecting water quality data in other Lake Michigan tributaries and those which might collect other types of environmental information were added to the list. An internet search was conducted for local chapters of national organization such as Audubon and Sierra Club which might participate in bird and wildlife counting activities. Faculty members involved in ecological or environmental research at local universities were also included. In addition, lists of local governments such as park departments, water departments, and others were provided by the Northwest Indiana Regional Planning Commission. Most of the lists provided by others provided addresses only.

In addition to Internet and phone research, information about this project was presented at a number of local meetings and partnerships. Members of the CARE Committee, the Interagency Task Force on *E. Coli*, and the TMDL stakeholders were informed of the project and advised that they would likely be receiving surveys. Presentations and surveys were also distributed at the annual meeting of the Indiana Hub of the Great Lakes Aquatic Habitat Network, a consortium of local environmental organizations and individuals interested in environmental issues.

An initial mailing of letters, fact sheets, and surveys was distributed to 20 individuals and organizations. Since project funding was actually received by Indiana University as a member of the *E. Coli* Task Force, the letters were sent on Task Force letterhead and signed by Kathy Luther as the Task Force Co-Chair. No responses were received as a result of this initial mailing.

Limited follow up calling was done to those organizations known to be conducting monitoring. A total of two responses were received as a result of this calling effort. Because of earlier decisions regarding project funding, there was insufficient staff time dedicated to this project to permit more extensive calling efforts. Based on conversations with other project participants, 10 percent seems to be a fairly consistent response rate. Follow up phone calls indicated that many recipients did not consider the work they might be doing to be monitoring. This may be one reason for poor survey response rates.

After a mid-term Lake Michigan Tributary Monitoring Project participant meeting in Chicago revealed that GLC was having limited response from state and federal agencies, an effort was made to contact local branches of some of these agencies by phone and fax out surveys. Surveys were sent to the IDNR, to Illinois-Indiana Sea Grant, and the USGS Research Station at the Indiana Dunes National Lakeshore. No responses were received as a result of these surveys. IDEM completed survey forms for those partnerships and organizations for which IDEM is a substantial participant. Despite limited responses to surveys IDEM is confident that a comprehensive list of state agency efforts will capture most if not all ongoing water quality monitoring that is occurring in the Grand Calumet River and this Area of Concern. As a result staff time was largely dedicated to completing online the surveys for all IDEM monitoring programs.

Initially, IDEM believed that all information necessary for the Tributary Monitoring Project would be collected in the TMDL process. While this was not the case, some important data was discovered which might not have been learned from the survey project. Information was collected about data that National Pollutant Discharge Elimination System (NPDES) dischargers have collected during discrete time periods as part of special projects. This information is not part of ongoing continuous data collection efforts or any organized monitoring programs and so is not a good fit with the database format of this project. The information was included because it might be useful for any efforts to compile historical data. The regular monitoring of operations and outfalls which NPDES holders undertake as part of the regulatory requirements of their permits is not included in this report. However, it may be useful to remember that information of this type is collected regularly and reported to state agencies.

Waukegan Harbor

The following steps were implemented prior to contacting a company or agency:

- A press release was sent to all local newspapers. Lake County Chamber of Commerce Newsletter published the press release.
- Announcements of the survey were made at the Audubon Society, Waukegan Harbor Citizens Advisory Group, and Liberty Prairie Conservancy meetings.
- Networking was done by telephoning approximately 150 companies, agencies, schools, and lead contacts furnished by telephone contacts. For future reference of sources for information, a database of 52 contacts was developed. Some contacts expressed interest in being a part of future monitoring programs. There were eight surveys returned out of fourteen mailed.

Milwaukee River

Meetings were held with Wisconsin Department of Natural Resources (WDNR) staff, RAP leaders, and others to develop a list of stakeholders and managers working in the basin (DNR, County Land Conservation Departments, University of Wisconsin-Extension Offices, Non-Governmental Organizations (NGOs) etc.). Identified organizations were then contacted by telephone to describe the goals and objectives of the project. Some of the entities contacted provided valuable information regarding their monitoring activities and mentioned some other entities that should be contacted. In most cases however this was not the case, either the groups were no longer active or they were monitoring for compliance with state and federal regulations. In total, over 200 entities were contacted with only 63 actively monitoring. However, of the 63 active programs, only 16 were applicable and responded to this project. After further investigation it was apparent that many of the applicable programs were connected in some way or form to state agencies, mainly the DNR and UW-Extension.

Sheboygan River

A procedure similar to the one used for the Milwaukee River watershed was used to collect information on the Sheboygan River watershed. In total, over 100 entities were contacted with only 28 actively monitoring. However, of the 28 active programs, only 12 were applicable to this project, as many were subsets of a broader program. For example, Testing the Waters involves numerous schools, teachers, and students in the basin. After further investigation it was apparent that many of the applicable programs were connected in some way or form to state agencies, mainly the DNR and the UW-Extension.

The two largest and most active monitoring programs in the Sheboygan River Basin, Testing the Waters and the Pigeon River Water Action Volunteers (WAV), fit the trend previously mentioned. The DNR and the UW-Extension have played active roles in providing equipment and technical guidance for both programs. The Testing the Waters program incorporates local high school and middle school students to actively monitor various tributaries throughout the Sheboygan River Basin (Pigeon, Sheboygan, and Mullet River Watersheds). This program has been very successful, involving several schools over the past eight years. The WAV program, very similar to the Testing the Waters program, utilizes local citizens to monitor water quality. WAV monitoring teams consisted of either adult volunteers or school classes. In both cases, the DNR and UW-Extension provided the initial support and training to develop these programs, but now rely on their local team leaders (teachers and others) to facilitate the efforts. This initial involvement by the DNR and UW-Extension (training, quality control, and equipment) has provided the assurance that the data collected by Testing the Waters and WAV are deemed worthy for ecological assessment, as stated by various stakeholders.

Other smaller programs were also found monitoring in the Sheboygan River Basin. These programs or projects involved land trust and conservation offices, local colleges/universities, as well as a few industrial facilities.

Fox-Wolf Basin

Fox-Wolf Basin 2000 established a list of 131 individuals or entities thought to be conducting some kind of ongoing monitoring program in the basin. This list was derived from our database--focusing on agencies, organizations and university researchers. Additional contacts were provided through a Wisconsin Department of Natural Resources Water Action Volunteer (WAV) database.

Cover letters and survey forms were distributed to those for whom addresses were readily available. After waiting a few weeks, follow-up calls were made to selected contacts. Additional e-mail requests were made in early January prior to the compilation of this report. Seventeen responses were received from eight different individuals and entities. The lack of adequate monitoring in the Fox-Wolf basin has long been lamented by citizens and resource managers alike. However, it is likely there are additional monitoring programs being conducted in a Basin of this size. The limited response in this survey is believed to be more the result of FWB 2000 not having the staff or time available to be more diligent in making additional, repeated contacts.

Door County

Research as to the degree to which monitoring or collecting of data is done on a regular basis was conducted in three modes: personal contact; written communications to determine what, if any, monitoring was being done; and personal interviews with key personal in local and state agencies.

There are no specific nonprofit or volunteer watershed groups in the area, other than two lake associations.

Pursuant to 21 telephone and personal contact interviews, ten letters of inquiry were sent to local organizations and individuals. Personal contact interviews were conducted with three staff personal within the Department of Natural Resources, each with different areas of responsibility. Companies located in Sturgeon Bay's Industrial Park gave indications that their activities were not of a nature that monitoring would be a concern.

Menominee River

A procedure similar to the one used for the Milwaukee River watershed and Sheboygan River watershed was used to collect information on the Menominee River watershed. Many of the national environmental organizations (Isaac Walton League, Trout Unlimited, etc) had representatives or chapters in the basin, but were not actively monitoring at the present time. In total, over 50 organizations were contacted with only 8 actively monitoring. After reviewing the list with County Land Conservation managers and WDNR staff, it was apparent that the list was comprehensive.

Manistique River

Description of the research process

Schoolcraft County Economic Development Corporation coordinated research to determine groups, agencies, businesses, governmental entities, and individuals conducting research and monitoring within the Manistique River Watershed.

The following was the process used to collect data for this process:

- 1) List of potential contacts generated by the Corporation and Manistique River/Harbor Public Advisory Council.
- 2) Initial mailing sent to entire mailing list. Mailing included an introductory letter, background document describing basin-wide project, and a survey form. All three of these documents were developed by the Great Lakes Commission with comment by all partners.

- 3) Follow-up mailings of the same packets were delivered to new persons identified by respondents identified and contacted during step two.
- 4) Surveys returned to the Corporation were entered into the required Excel spreadsheet. Respondents were contacted for additional information if needed.
- 5) James Anderson met with Michael Tansy, chairperson of the Manistique River Watershed, and director of the Seney National Wildlife Refuge, and George Lyon with the Luce-Mackinac-Schoolcraft Soil and Water Conservation District office.
- 6) Telephone or personal contacts were made to recipients of the survey who did not respond to determine their level of monitoring activities within the Watershed.

Collaboration / communication with the public advisory council or other watershed groups

During the course of the research the Corporation worked with the Manistique River/Harbor Public Advisory Council to brainstorm monitoring activities occurring within the Watershed, and to develop an initial mailing list for the survey instrument.

The Corporation met with the lead staff person with the local Soil and Water Conservation office, and the chairperson of the organization and director of the Seney Wildlife Refuge to discuss their activities within the watershed. Both shared that beyond the activities of the Refuge, there are very few monitoring activities happening within the watershed. The response from the survey instrument verifies that the assessment made by Mr. Tansy and Mr. Lyon was correct.

Other outreach efforts

In addition to the above activities, a press release developed by the Great Lakes Commission was modified for local informational content, and sent to the local media including radio (WTIQ), and the local newspapers - *Pioneer Tribune* (Manistique / Schoolcraft County), *Munising News* (Alger County), and the *Newberry News* (Luce County). James Anderson, executive director provided updates and information at Corporation board meetings concerning the project which were covered by the media, and discussed the project during a quarterly half-hour interview on WTIQ AM 1490 Community Focus program.

Number of entities contracted and number of responses

Of the 34 surveys sent out, six (6) responses were received. George Lyon with the Soil and Water Conservation indicated that he did not believe either dam operator was involved with any monitoring activities.

General comments on results

Only five surveys were returned indicating that a rather large watershed has very little monitoring or coordination of conservation activities occurring within it. Further, the data returned indicated that most monitoring is for regulatory requirements, with some additional data collection beyond the required level. There does not appear to be any monitoring in terms of land use, soil, and very little monitoring of Fish and Biota / Wildlife beyond that of the Seney National Wildlife Refuge and the United States Department of Agriculture - Hiawatha National Forest.

In terms of the indicators being collected, all 18 indicators are being collected by at least one organization - City of Manistique, Department of Public Works. Further, most monitoring appears to be completed by paid staff who are trained in data collection methodology as well as quality assurance / quality control methods.

Further, the Corporation was surprised to find that only one of three universities in the region has any interest in conducting research within the watershed, and the only effort is driven primarily due to the contamination of the lower watershed with PCB's.

Federal and State Data Collection

The GLC was primarily responsible for collecting data from federal, state, and other organizations conducting monitoring programs basinwide. This was accomplished through two efforts — a survey, and supplemental data search. First, the GLC, in consultation with project participants and members of the Lake Michigan Monitoring Coordination Council (LMMCC), developed a list of federal and state entities that were likely to be conducting monitoring efforts in the basin (see Appendix D for the LMMCC membership list, and Appendix E for a list of survey contacts). In an effort to maintain efficiency, every effort was made to select specific contacts who could respond generally about monitoring programs in their agency, or who would collect information from relevant people in their agency. Follow up phone calls and e-mails were made to non-respondents to solicit a higher response rate. These phone calls led to further contacts (sometimes in other agencies), and additional surveys were distributed. In addition, the survey form was transformed into a web-based format to ease completion by respondents. This generated further responses, as agency contacts often asked multiple people within their agency to complete the web-based form. From an initial distribution of 72 surveys, the GLC received 27 responses. An accurate response rate cannot be calculated, since some agencies returned several surveys (some not directly solicited), while others returned none. The full database of survey responses (including local responses) can be obtained upon request.

The data received from the surveys was supplemented with information on monitoring collected through a general information search. This consisted of a general web review, as well as follow-up from conversations with agency and participant contacts. In many cases, the information collected through this method made it unnecessary to pursue further contacts with specific agencies. Several databases of monitoring information were discovered through this process. The most useful database was the *Better Assessment Science Integrating Point and Nonpoint Sources (BASINS)* system developed by Tetra Tech, Inc. for the U.S. EPA, Office of Water. This system consolidates a number of federal databases to allow easy extraction and use of ecological information on a watershed basis. Several datasets were used in the analysis for this report.

Datasets used to provide monitoring information for this report (including those extracted from BASINS and those obtained elsewhere, are included below. Where possible, dataset summaries are taken directly from metadata provided with the dataset.

The Storage and Retrieval (STORET) System

This dataset provided statistical summaries of water quality monitoring for 47 physical and chemical-related parameters. The parameter specific statistics were computed by station for five-year intervals from 1970 to 1994 and a three-year interval from 1995 to 1997. The data are contributed by a number of organizations including federal, state, interstate agencies, universities, contractors, individuals and water laboratories. Information was extracted from the STORET system for analysis of monitoring coverage for all LaMP pollutants, bacteria, nutrients, and some physical characteristics.

Permit Compliance System (PCS)

PCS is a national computerized management information system that automates entry, updating, and retrieval of National Pollutant Discharge Elimination System (NPDES) data and tracks permit issuance, permit limits and monitoring data, and other data pertaining to facilities regulated under the NPDES program. PCS records water-discharge permit data on more than 75,000 facilities nationwide.

The NPDES permit program regulates direct discharges from municipal and industrial wastewater treatment facilities that discharge into the navigable waters of the United States. Wastewater treatment facilities (also called "point sources") are issued NPDES permits regulating their discharge. Information on the point locations of sites reporting discharges from 1991 through 1996 were included in the analysis for this report.

Toxic Release Inventory (TRI)

This database contains data on annual estimated releases of over 300 toxic chemicals to air, water, and land by the manufacturing industry.

Industrial facilities provide the information, which includes the location of the facility where chemicals are manufactured, processed, or otherwise used; amounts of chemicals stored on-site; estimated quantities of chemicals released; on-site source reduction and recycling practices; and estimated amounts of chemicals transferred to treatment, recycling, or waste facilities.

The TRI data for chemical releases to land are limited to releases within the boundary of a facility. Releases to land include landfills; land treatment/application farming; and surface impoundments, such as topographic depressions, man-made excavations, or diked areas. Air releases are identified as either point source releases or as non-point (i.e. fugitive) releases, such as those occurring from vents, ducts, pipes, or any confined air stream. Surface water releases included discharges to rivers, lakes, streams, and other bodies of water. In addition, the database covers releases to underground injection wells (where chemicals are injected into the groundwater) and off-site transfers of chemicals to either publicly owned treatment works (POTWs) or any other disposal, treatment, storage, or recycling facility.

For use in the assessment for this report, information on the locations of facilities discharging pollutants through any of the above media streams from the years 1987 through 1995 were included.

National Sediment Inventory

This dataset describes the accumulation of chemical contaminants in river, lake, ocean, and estuary bottoms and includes a screening assessment of the potential for associated adverse effects on human and environmental health. The U.S. EPA evaluated more than 21,000 sampling stations nationwide using sediment chemistry data, chemical residue levels in edible tissue of aquatic organisms, and sediment toxicity data. Of the sampling stations evaluated, 5,521 stations were classified as Tier 1 (associated adverse effects are probable), 10,401 stations were classified as Tier 2 (associated adverse effects are possible, but expected infrequently), and 5,174 stations were classified as Tier 3 (no indication of associated adverse effects). Ninety-six watersheds were identified as areas of probable concern for sediment contamination. U.S. EPA believes that these watersheds represent the highest priority for further ecotoxicological assessments, risk analysis, temporal and spatial trend assessments, contaminant source evaluation, and management action because of the preponderance of evidence in these areas (although further evaluation is necessary). Also see the related report entitled the *Incidence and Severity of Sediment Contamination in Surface Waters of the United States, Volume 1, National Sediment Quality Survey* (EPA 823-R-97-006, <http://www.epa.gov/OST>) that was published in September 1997.

Stations monitoring for sediment chemistry data, chemical residue levels in edible tissue of aquatic organisms, and sediment toxicity data were used for the inventory. For this report, information on monitoring station locations, monitoring agency, and type of sampling conducted (i.e. sediment chemistry or biotoxicity/tissue residue).

U. S. Geological Survey Gage Stations

This dataset contains the locations and summary data from USGS stream gaging stations. The gage data were retrieved from the Gage File database. These stations are used primarily to collect continuous stream flow and water level information on target waterbodies. Only gage locations were used in this report.

Aerometric Information Retrieval System (AIRS)

The AIRS system inventories and summarizes air pollutant data from air monitoring stations throughout the United States. The system is funded and maintained by U.S. EPA Office of Air Quality Planning and Standards (OAQPS). The system contains information about and from stations that monitor the following criteria pollutants:

- CO - carbon monoxide (gas)
- NO₂ - nitrogen dioxide (gas)
- O₃ - ozone (gas)
- SO₂ - sulfur dioxide (gas)
- PB - lead (a constituent of particulate matter)
- PM₁₀ - particulate matter (particles smaller than 10 micrometers)

Additionally, AIRS data includes emissions estimates for two more pollutants:

- PT - particulate matter (total, all particle sizes - reported in lieu of PM₁₀)
- VOC - volatile organic compounds (precursors that can lead to the formation of ground level ozone)

Data on site locations and pollutant monitored were extracted for use in this report.

National Oceanic and Atmospheric Administration (NOAA) Weather Stations and Weather Data Management (WDM) Sites

This data set provides a location map in ARCVIEW Shapefile format of weather stations and WDM stations for the entire United States and U. S. territories. The spatial data was prepared from the National Climatic Data Center Hourly Precipitation database available from EarthInfo, Inc.

(<http://www.earthinfo.com/earthinfo/>). The shapefile is prepared and distributed by U.S. EPA regions or states. Information on site locations of weather stations was used for this report.

Fish and Wildlife Consumption Advisory Database

The 1996 update for the database, *Listing of Fish Consumption Advisories*, is now available from the U.S. Environmental Protection Agency. This database includes all available information describing state-, tribal-, and federally issued fish consumption advisories in the United States for the 50 states, the District of Columbia, and four U.S. Territories, and has been expanded to include the 12 Canadian provinces and territories. The database contains information provided to U.S. EPA by the states, tribes, and Canada as of December 1996. This includes advisories issued by several Native American tribes.

The number of advisories in the United States rose by 453 in 1996 to a total of 2,193 representing a 25 percent increase over 1995. The number of waterbodies under advisory represents 15 percent of the nation's total lake acres and 5 percent of the nation's total river miles. In addition, 100 percent of the Great Lakes waters and their connecting waters and a large portion of the nation's coastal waters are also under advisory. The number of advisories in the United States increased for four major contaminants (mercury, PCBs, chlordane, and DDT). In 1996, the U.S. EPA contacted health officials in Canada in an effort to identify fish consumption advisories in effect. In Canada, a total of 2,617 advisories were in effect in 1996. All of the Canadian advisories resulted from contamination from five pollutants: mercury, PCBs, dioxin/furans, toxaphene, and mirex. Ninety-six percent of all the advisories resulted from mercury contamination in fish tissues. In addition, 87 percent of the advisories were issued by the provinces of Ontario and Quebec. Information on the location of advisories, species affected, and flagged pollutants were used in this report.

Lake Michigan Mass Balance (LMMB) Monitoring Sites

This is an unpublished dataset that contains information on sites providing information for the Lake Michigan Mass Balance Project. Information includes locations, and purposes for sampling stations, project names and organizations, and indicators analyzed. The information is contained in three separate datasets, and linkages are based only on project names. Data quality is undefined. Information for this report was extracted from this dataset for monitoring locations, media and pollutants monitored, and organizations conducting the monitoring. The sample data itself has been quality assured and is available upon request from GLNPO.

National Water Quality Assessment Monitoring Sites (NAWQA)

This dataset includes the monitoring stations used in the Western Lake Michigan Drainages study unit for the NAWQA program. Information was collected through the study unit's online database, found through <http://wwwdwimdn.er.usgs.gov/nawqa/index.html>. Information included station identification, location, and flags for one of four types of monitoring conducted: surface water, ground water, sediment and tissue, and biological. More extensive data can also be obtained from this site, including parametric measurements.

Additional Federal/State Datasets

Several monitoring data sets were discovered just prior to final publication of this report. Discussion and general analysis of these sets have been included in the report, but in the interest of time, geographic analysis of monitoring site locations was not completed. Geographic locations of monitoring stations in these data sets will be included in the online version of the monitoring inventory when it is released. General information on these data sets are included below.

Regional Toxic Air Emissions Inventory

This is 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 basin. 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, basin wide data on the source and emission levels of 82 toxic contaminants. Source and emission levels are projected by each state or province using the *Regional Air Pollutant Inventory Development System (RAPIDS)*. The most recent inventory report uses 1996 data and can be found at: <http://www.glc.org/air/1996/1996.html>.

Integrated Atmospheric Deposition Network (IADN)

The Integrated Atmospheric Deposition Network is a joint effort of the United States and Canada to measure atmospheric deposition of toxic materials to the Great Lakes. This network includes a number of stations throughout the Great Lakes, but only one is found in the Lake Michigan basin at Sleeping Bear Dunes National Lakeshore. This station monitors for PCBs, chlorinated pesticides, PAHs, and trace metals in air and precipitation. This site was also included in the analysis of the Lake Michigan Mass Balance Project. Please see discussions on that program for more details.

Sea Lamprey Assessment

Through the Great Lakes Fishery Commission, the Sea Lamprey Integration Committee (SLIC) was established to monitor and control Sea Lamprey infestation throughout the Great Lakes. The Sea Lamprey Assessment Task Force within SLIC establishes plans for monitoring to assess the extent of infestation. In general, tributaries of the Great Lakes systematically are assessed for abundance of sea lamprey larvae (quantitative surveys) and distribution (qualitative surveys) to determine when and where lampricide

treatments are required and effectiveness of past treatments. Results of these assessments are published in annual reports.

R/V Lake Guardian Sampling

The U.S. EPA's Great Lakes National Program Office (GLNPO) annually tours the Great Lakes and samples for phyto- and zooplankton at specified locations. The *R/V Lake Guardian* is used to conduct sampling tows at different depths to obtain data on changes in plankton populations. In addition, the vessel takes a set of standard baseline measurements including conductivity, temperature and depth.

Lakewide Assessment Plan for Lake Michigan Fish Communities

This plan was developed through the Great Lakes Fishery Commission (GLFC) by Departments of Natural Resources from Wisconsin, Michigan and Illinois, as well as the USFWS and USGS-BRD. The plan establishes guidelines for annual sampling of lake trout, chinook salmon, and burbot populations throughout Lake Michigan. For lake trout and burbot, six sampling sites are randomly selected from within eleven regions each year for a total of 66 sampling locations. For chinook salmon, randomly-selected sites are selected along the length (south to north) of the lake in the spring and summer, with 22 sites selected in each season.

Status and Trends of Prey Fish Populations in Lake Michigan, 1999

This report from the USGS Great Lakes Science Center details the monitoring and findings related to sampling of prey fish populations through 1999. The surveys are performed using standard 12-meter bottom trawls towed along contour at depths of 9 to 110 m at each of seven to nine index transects. Information is collected on abundance, species composition, population characteristics, and general fish health.

