United States General Accounting Office

GAO

Report to the Chairman, Subcommittee on Oversight of Government Management, Committee on Governmental Affairs, U.S. Senate

June 1993

PESTICIDES

Issues Concerning Pesticides Used in the Great Lakes Watershed

GAO/RCED-93-128

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-252519

June 14, 1993

The Honorable Carl Levin
Chairman, Subcommittee on Oversight
of Government Management
Committee on Governmental Affairs
United States Senate

Dear Mr. Chairman:

The Great Lakes contain about 95 percent of the nation's fresh water and provide 3 billion gallons daily for domestic use by about 24 million people. Despite their large size, the lakes are sensitive to the effects of pollution. Some pollutants that enter the lakes, whether by direct discharge along the shores, through tributaries, from land use, or from the atmosphere, are retained in the lakes and become more concentrated over time. Pesticides are one of the sources of chemical pollution of the Great Lakes.

Concerned that no analysis of the use of pesticides in the Great Lakes watershed had been performed, you asked us to obtain information on the amounts and types of pesticides used in the Great Lakes watershed and explain how pesticides may contribute to toxic chemicals in Great Lakes waters. In addition, you asked us to describe the typical storage and disposal practices in the Great Lakes region. We also determined whether pesticides used in the Great Lakes watershed were subject to the Environmental Protection Agency's (EPA) pesticide reregistration program.[1]

Results in Brief

The federal government and private organizations collect information on the amounts of pesticides used in the United States, but no data systems exist that track pesticide usage in the Great Lakes watershed. Using federal and private data sources, we estimate that at least 56 million pounds of pesticides are used annually in the United States and Canada in the Great Lakes watershed, including about 46 million pounds used on agricultural crops.[2] The remaining 10 million pounds include 8 million pounds used annually on lawns and more than 2 million pounds used on golf courses in the U.S. portion of the watershed. While this estimate does not include pesticides used on some agricultural crops in the United States or the nonagricultural pesticides used in Canada, U.S. Department of

[1]An ongoing program to reassess the environmental and health risks of pesticides.

[2]All pesticide amounts in this report are expressed in pounds of active ingredients, except in the section on disposal, where amounts are expressed in pounds of pesticide product.

Agriculture (USDA) and EPA officials believe that it includes the vast majority of the pesticides used in the watershed.

Herbicides, which account for about three-quarters of the 46 million pounds of agricultural pesticides used in the Great Lakes watershed, are generally applied once to field crops, such as corn and soybeans, during the spring by ground or aerial sprayers to control weeds. Fungicides and insecticides, which account for the remaining amount of agricultural pesticides, are applied to fruits and vegetables as many as eight times during the year to control diseases and pests. (The amounts of pesticides applied to major agricultural crops in each watershed county are shown in apps. VI and VII.)

Persistent pesticides that enter the Great Lakes are retained in the lakes and become more concentrated with time because less than 1 percent of Great Lakes water flows out of the lakes annually. The long retention time permits some pesticides to settle in lake-bottom sediments and to bioaccumulate in the food chain. Fish-tissue monitoring shows that persistent pesticides long since banned or restricted are still being detected at high concentrations. EPA is measuring the concentrations in the lakes of nine herbicides in current use, and preliminary results show that these pesticides may also be more persistent than previously thought. EPA needs to complete this water quality monitoring program and use the accurate and up-to-date data in its reregistration program, in which these pesticides are required by law to be reassessed for their health and environmental effects.

In addition to the pesticides already present in area waters, data indicate that millions of pounds of unusable pesticides being stored on farms present disposal problems in the Great Lakes states. EPA has instituted a program in the region that has disposed of some of these pesticides, but large quantities remain, including banned, spoiled, or no-longer-needed pesticides.

Background

About 1.1 billion pounds of pesticides are used annually on more than 900,000 farms and in about 80 million households in the United States to control or kill a large variety of unwanted plants or pests. The major classes of pesticides are herbicides, which control weeds; insecticides, which control insects; and fungicides, which control plant diseases. While pesticides are significant and important components in meeting the increasing demand for food and in the fight against insect-borne diseases,

they also have the potential to create serious problems affecting human health and the environment.

The five Great Lakes—Superior, Michigan, Huron, Erie, and Ontario—form the largest freshwater system on earth, containing 20 percent of the world's fresh water. The Great Lakes watershed includes the five lakes and all or parts of 213 counties in eight states—Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, and New York. On the Canadian side, the watershed includes all or parts of 51 counties in the province of Ontario.

Despite their large size, the Great Lakes are sensitive to the effects of pollutants. Persistent pollutants that enter the lakes are retained in the system because less than 1 percent of the water flows out of the lakes annually. This long retention time permits persistent pesticides to accumulate in sediments, be mixed back into the water, bioaccumulate in the food chain,[3] and be recycled. The large surface area of the lakes also makes them vulnerable to direct deposition of atmospheric pollutants that fall with rain or snow and as dust on the lakes' surface.

Several federal agencies are responsible for regulating pesticides; major responsibilities are assigned to EPA. EPA is responsible for registering pesticides using risk-benefit balancing to ensure that pesticide use will not result in unreasonable adverse effects on human health or on the environment. Basically, registrations are licenses for specific pesticide uses that state the terms, conditions, and cautions of these uses.

Millions of Pounds of Pesticides Are Used in the Great Lakes Watershed Annually

Federal agencies, including EPA and USDA, and private organizations, such as Resources for the Future, collect information on the amounts of pesticides used in the United States, but they do not track pesticide usage in the Great Lakes watershed. Working with information supplied by USDA's Soil Conservation Service and the International Joint Commission of Canada and the United States, we developed a methodology and estimated that at least 56 million pounds of pesticides are used annually in the Great Lakes watershed (see table 1). Forty-six million pounds (82 percent) of this total are agricultural pesticides—31 million pounds in the United States and 15 million pounds in Canada. EPA estimates that the remaining 10 million pounds are used annually in the U.S. portion of the

[3]Process by which pesticide concentrations in living organisms increase as they breathe contaminated air, drink contaminated water, or eat contaminated food.

watershed—8 million pounds on lawns and more than 2 million pounds on golf courses.

Although information was not available on pesticides used on some U.S. field crops and on Canadian lawns and golf courses, USDA and EPA officials said that the 56-million-pound estimate includes the vast majority of pesticides that are used in the watershed annually. USDA officials believe this estimate includes 85 to 90 percent of the pesticides used in the watershed. (For details on the methods used to estimate the amounts of pesticides used, see app. I.)

Table 1: Estimated Annual Pesticide Usage in the Great Lakes Watershed (in Pounds)

	United States	Canada	Total
Corn, soybean and field crops[a]	24,547,600	12,781,000	37,328,600
Fruits	5,324,900	1,283,900	6,608,800
Vegetables	1,315,200	848,900	2,164,100
Lawns	8,000,000	[b]	8,000,000
Golf courses	2,400,000	[b]	2,400,000
Total	**41,587,700**	**14,913,800**	**56,501,500**

[a]The U.S. pesticide usage estimate includes the amounts used on corn and soybeans only. The Canadian estimate includes the amounts used on all field crops, including corn and soybeans.

[b]Information not available.

Types of Pesticides Used in the Watershed

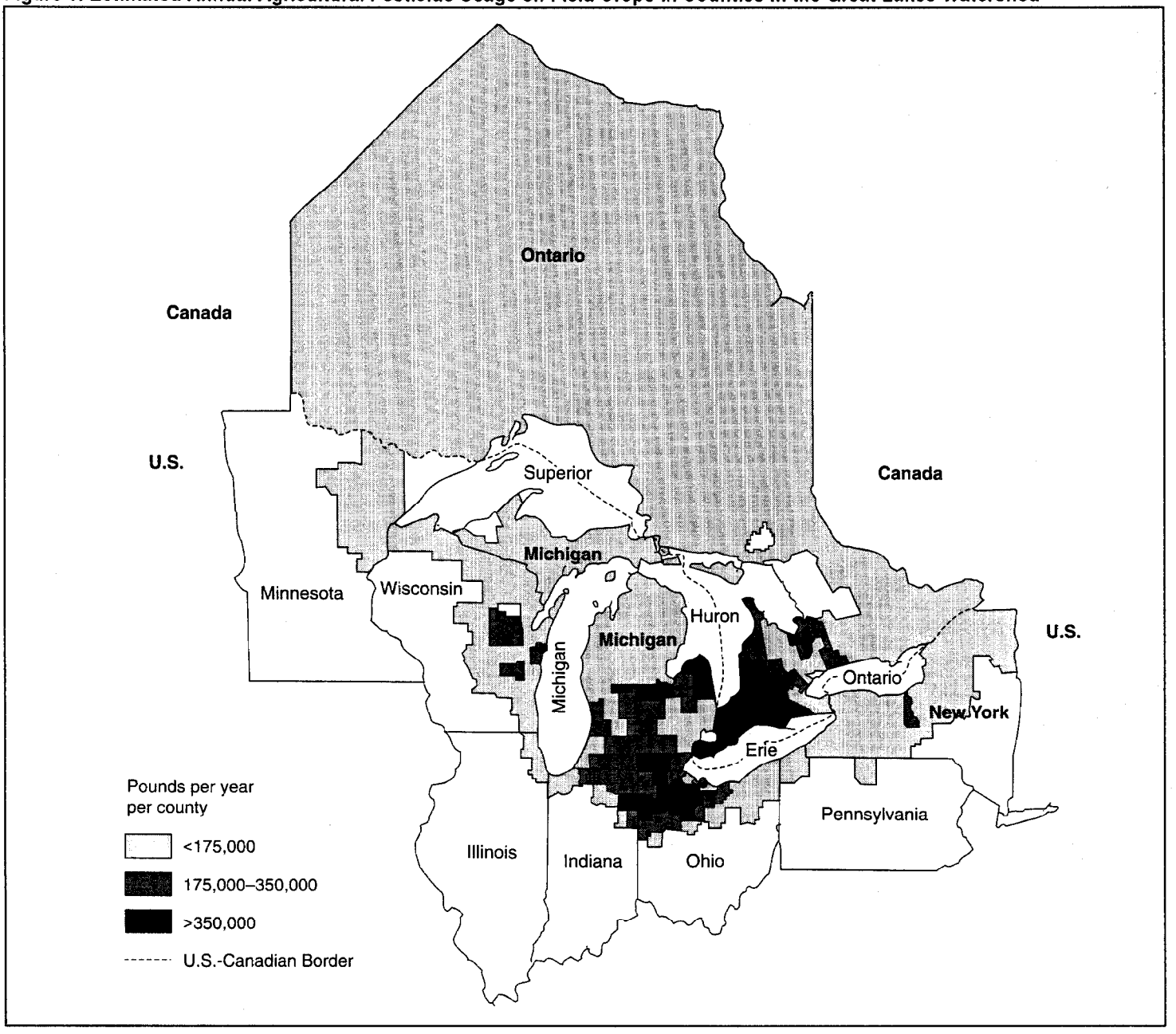
Agricultural pesticides are applied by ground or aerial sprayers at various times of the year depending on the crop and the pesticide's intended use. Herbicides are applied for weed control usually once during the spring when crops are planted and emerge. Approximately 34 million pounds (74 percent) of the agricultural pesticides used in the watershed are herbicides used primarily on corn and soybeans. The herbicides atrazine, metolachlor, alachlor, and cyanazine make up 74 percent of the pesticides used on these crops in the United States. (See apps. II and III for the types and amounts of pesticides used on corn and soybeans.)

In contrast to herbicides, insecticides and fungicides are applied during the year as many as 8 times to fruits and 10 times to vegetables to control or kill pests and diseases. These pesticides account for 89 percent of pesticides used on fruits and vegetables in the United States. (See apps. IV and V for the pesticides used on fruits and vegetables.) No overall information was readily available on the types of pesticides used on lawns or golf courses.

Amounts of Pesticides Used, by County

Using available information, we were able to estimate the amounts of pesticides used on U.S. corn and soybean crops and all Canadian agricultural crops for each watershed county. The amounts of pesticides used in each county varied widely because of two factors—the number of agricultural acres within the watershed and the pesticide application rates. For example, the amounts of pesticides applied to corn and soybean crops ranged from 40 pounds to more than 525,000 pounds per county in the 213 U.S. counties, and from about 500 pounds to more than 1,750,000 pounds on field crops per county in the 51 Ontario counties. To visualize the pesticide usage within the watershed's counties, see figure 1. For the amounts of pesticides applied in each U.S. county, see appendix VI; for each Canadian county, see appendix VII. No information was available to calculate pesticide use by county on U.S. fruits, vegetables, lawns, or golf courses.

Figure 1: Estimated Annual Agricultural Pesticide Usage on Field Crops in Counties in the Great Lakes Watershed



Note: The map represents pesticide usage in the latest years available. U.S. data include amounts used on corn and soybean crops in 1991. Canadian data include amounts used on all field crops in 1988.

County borders are shown where they coincide with ranges of pesticide use. In some counties not all of the land area shown lies within the Great Lakes watershed.

Various Studies Have Shown Nationwide Effects of Pesticides on Water Quality

Although EPA's herbicides study discussed in the following section is the only Great Lakes-specific study of pesticide concentrations we are aware of, a number of national studies are available whose findings include some of the states in the Great Lakes watershed. A nationwide EPA study analyzed fish for pesticide residues and found the presence of banned pesticides, such as the insecticide dieldrin: The test locations included sites in the watershed. The Food and Drug Administration's fish samples from all 50 states have also shown low levels of pesticide residues in fish. Tests by the Water Quality Laboratory at Heidelberg College in Ohio, by EPA, and by the U.S. Geological Survey (USGS) have shown that runoff from agricultural pesticides has entered surface and groundwater, including drinking water, and that measurable amounts of pesticides are present in waters in states bordering the Great Lakes. Other studies by the Heidelberg Water Quality Laboratory and USGS have shown that pesticides are present in rainfall, indicating the possibility of widespread deposition of pesticides in the air over some Great Lakes states. In addition, a Wisconsin study found pesticides in soils across the state, and a Michigan study found that some wells had been contaminated beneath pesticide dealers' sites. (Further details on these studies and their findings are in app. VIII.)

Effective Pesticide Reregistration Depends on Accurate and Up-To-Date Information

Under the 1972 amendments to the Federal Insecticide, Fungicide, and Rodenticide Act, EPA is required to reregister all pesticide products that were previously registered with less information on health and environmental effects than is now required. EPA determines whether pesticides are eligible for reregistration by evaluating data submitted by the product's registrant and determining whether the pesticide would cause unreasonable adverse effects when it is used in accordance with the product's label directions and restrictions.

EPA's Great Lakes National Program Office provided $89,000 for a project to measure the concentrations of nine high-use herbicides in Lakes Michigan, Erie, Huron, and Ontario. The pesticides include atrazine, alachlor, metolachlor, and cyanazine, which we found are the four pesticides used in the largest amounts in the Great Lakes watershed. The project began in September 1991 and a final report is expected in early 1994. In addition, the program will attempt to measure the concentrations of the pesticides in the air and rain over the lakes.

Preliminary data from this ongoing project raise questions on the persistence of the high-use pesticides. The data indicate that the

concentrations of atrazine—a herbicide used for weed control on corn, sorghum, and other crops—in the water were higher than expected and varied little in readings at depths down to 500 feet. According to the project's principal investigator, these concentrations indicate that the half-life of atrazine—the time required for it to lose half of its effect on the environment—is at least a year, and may be several years, in Great Lakes waters. On the basis of evidence that currently used pesticides may potentially impair Lake Michigan, EPA initiated action to form a work group to study the levels and effects of these pesticides in Lake Michigan as part of its ongoing effort to develop a lakewide management plan. This plan is called for by the Great Lakes Water Quality Agreement between the United States and Canada to reduce toxic loadings in the Great Lakes.[4] As of April 1993, this group had not been formed.

The EPA project officer expects the final report to be widely disseminated within EPA and hopes that the principal investigator publishes the findings in environmental journals and magazines. If the final report indicates serious potential for adverse environmental impacts, he believes EPA would consider funding additional projects.

About 80 percent of the 118 pesticides being used in large quantities in the Great Lakes watershed need to be reregistered, and 64 percent of them are on EPA's list of highest priorities for reregistration. The findings of EPA's Great Lakes National Program Office's ongoing project to measure the concentrations of nine high-use pesticides would provide valuable information in the current reregistration assessment of the health and environmental effects of these pesticides. The results may very well show that these pesticides are much more persistent than previously believed. The EPA project officer also thought that these findings could have some impact on the reregistration of pesticides and will give the study's results to the appropriate reregistration officials.

Large Amounts of Unusable Pesticides Present Disposal Problems

EPA records indicate that large amounts of unusable pesticides are stored in Great Lakes states. These include pesticides that have been banned, have spoiled, or are no longer needed. Michigan, Minnesota, and Wisconsin each estimates that it has 3 million to 4 million pounds of these pesticides stored in its state. Agricultural "clean-sweep" programs to collect and dispose of these pesticides began in 1988 in EPA Region V, which includes six of the eight Great Lakes states. EPA provided $334,000

[4]The Critical Programs Act of 1990 requires that the lakewide management plan for Lake Michigan be published in the Federal Register by January 1, 1994.

to support clean-sweep programs in the states in Region V. As of January 1993, 400,000 pounds had been collected and disposed of, including 232,000 pounds in the Great Lakes watershed.

While these programs uncovered large quantities of unusable pesticides, only some have been disposed of to date. For example, Wisconsin's 1990 clean-sweep program found that a large quantity of the pesticides stored on farms and in rural homes was not used because it had been damaged, predominantly because of improper storage. The program disposed of more than 39,000 pounds of unusable pesticides. An estimated additional 24,000 pounds of unusable pesticides were not disposed of because the program ran out of funds.

To address the problems of spoiled and damaged pesticides, EPA submitted draft regulations on pesticide storage containers to the Office of Management and Budget in March 1993. In addition, it has identified the problems of pesticide disposal as having the potential to create a material weakness in its December 1992 annual report on compliance with the Federal Managers Financial Integrity Act.

Conclusions

No data bases exist to track pesticide use in the Great Lakes watershed. However, using available pesticide usage data for the eight Great Lakes states, we were able to estimate that at least 56 million pounds are used annually inside the watershed boundaries. While this estimate does not include all the pesticides used, it appears to represent the vast majority of the pesticides used in the watershed.

EPA has analyzed studies and documented that banned and restricted-use pesticides are among the toxic pollutants that present the most serious threats to the Great Lakes environment and hazards to human health. Studies of the pesticides currently being used in large quantities in the Great Lakes watershed indicate that, although these pesticides may be less toxic, they are pervasive in ground water, surface water, and the Great Lakes environment. Data from the ongoing EPA study to assess the persistence and the concentrations of these pesticides in the Great Lakes indicate that these newer pesticides may be more persistent than previously thought. However, this study will not be completed for another year. EPA should complete its analysis of the levels of these pesticides in Great Lakes waters and incorporate the results in its assessment of the safety of these pesticides in its pesticides reregistration program.

Recommendation

To more effectively reregister pesticides, we recommend that the Administrator, EPA, direct the Office of Pesticide Programs to incorporate the results of the Great Lakes National Program Office's study of pesticides in the Great Lakes in EPA's reregistration reassessment of these pesticides.

Agency Comments

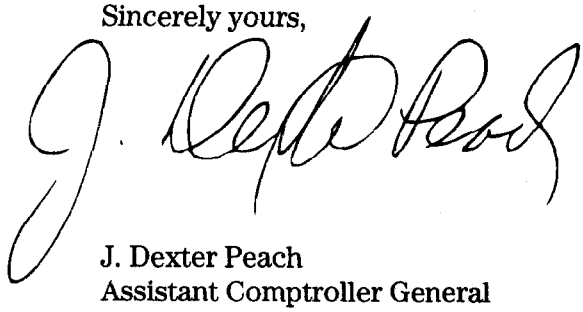
As requested, we did not provide a draft of this report to EPA officials for written comments. However, we discussed its contents with EPA's Director, Policy and Special Projects Division, Office of Pesticide Programs, and her staff; with EPA's Deputy Director, Great Lakes National Program Office, and his staff; with USDA's Executive Secretary, Water Quality Working Group; and with the head of USDA's Environmental Statistics Group. They generally agreed with the findings in the report. We incorporated their comments and suggestions where appropriate.

The two basic objectives of this review were to obtain information on the amounts and types of pesticides used in the Great Lakes watershed and explain how pesticides may contribute to toxic chemicals in Great Lakes waters. We analyzed federal and private pesticide data reports and estimated the amounts that were used inside the watershed boundaries. We interviewed various federal, state, and private officials and reviewed reports and studies on the potential effects that pesticides may have on the environment. (App. I contains details on our objectives, scope, and methodology.) We conducted our review between April 1992 and April 1993 in accordance with generally accepted government auditing standards.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies to appropriate congressional committees; the Administrator of EPA; the Secretary of Agriculture; the Director of the Office of Management and Budget; and other interested parties. This work was performed under the direction of

Richard L. Hembra, Director, Environmental Protection Issues, who can be reached on (202) 512-6111 if you or your staff have any questions. Major contributors to this report are listed in appendix IX.

Sincerely yours,



J. Dexter Peach
Assistant Comptroller General

Contents

Abbreviations

DDT	dichloro diphenyl trichloroethane
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
NASS	National Agricultural Statistics Service
PCBs	polychlorinated biphenyls
USDA	U.S. Department of Agriculture

Objectives, Scope, and Methodology

As requested by the Chairman, Subcommittee on Oversight of Government Management, Senate Committee on Governmental Affairs, the objectives of this review are to identify (1) the data systems tracking pesticide usage in the Great Lakes watershed; (2) the major users and the types and amounts of pesticides used, on a county-by-county basis, in the latest year for which data are available; (3) how they are applied and during what times of the year; (4) how they are typically stored and disposed of; (5) how they may contribute to toxic chemical pollution of the Great Lakes; and (6) the weaknesses in existing data and data base systems to track pesticide use in the Great Lakes watershed. We also determined whether the pesticides used in the Great Lakes watershed were subject to the Environmental Protection Agency's (EPA) pesticide reregistration program.

To satisfy these objectives we interviewed officials and reviewed records at EPA headquarters Office of Pesticides Programs, EPA Region V's Pesticides and Toxic Substances Branch, EPA's Great Lakes National Program Office, and the Food and Drug Administration (FDA). We interviewed officials and reviewed records at the U.S. Department of Agriculture's Soil Conservation Service, Agricultural Stabilization and Conservation Service, Water Quality Working Group, and National Agricultural Statistics Service (NASS). We interviewed officials at the Department of Interior's U.S. Geological Survey and U.S. Fish and Wildlife Service. We also interviewed officials at the National Coalition Against the Misuse of Pesticides; World Wildlife Fund; National Agricultural Chemical Association; Natural Resources Defense Council; Water Quality Laboratory at Heidelberg College, Tiffin, Ohio; and Resources for the Future, an organization that analyzes data on pesticide usage in the United States.

We found no data systems tracking pesticide usage in the Great Lakes watershed area. To estimate the amounts of agricultural pesticides used in the watershed, we obtained NASS' latest surveys of pesticides used by states on field crops and fruits (1991) and vegetables (1990). NASS' field crop survey covered pesticides used on corn in seven of the eight Great Lakes states (all except New York) and soybeans in four states (Minnesota, Ohio, Illinois, and Indiana); its vegetable survey covered Michigan; and its fruit survey covered Michigan, New York, and Pennsylvania. In addition, NASS' records showed that 12 additional crops, such as oats, barley, and hay, are grown in one or more of the eight watershed states but that pesticide usage data was not collected on these crops. NASS officials said that these crops will generally receive less pesticides and that they lack the resources to collect data on all crops.

To estimate how much of the pesticides used in each of the eight states was used inside the Great Lakes boundaries, we (1) obtained the number of corn and soybean acres planted in each county in 1991 from the Conservation Technology Information Center, (2) calculated the numbers of acres planted inside the boundaries of the Great Lakes watershed using information from the Federal Information Processing System, (3) calculated the amounts of pesticides used inside the watershed boundaries using NASS' survey of pesticide application rates, and (4) summed the amounts of the various pesticides applied. For pesticides used on fruits and vegetables, we were limited to reviewing those used in Michigan, which is completely inside the watershed boundaries. Lacking fruit acreage data, we were unable to estimate how much of the pesticides used in New York and Pennsylvania were used inside the Great Lakes watershed boundaries.

Since NASS did not survey all eight Great Lakes states, we had to use pesticide application rates of the surveyed states for some of the states not surveyed. For example, NASS reports show that the pesticide application rates for corn crops ranged from 2.7 pounds to 3.4 pounds per acre per year in the seven Great Lakes states surveyed. To estimate pesticides used on corn in New York, which was not surveyed, we used Pennsylvania's rate of 2.7 pounds, the lowest surveyed rate. For soybeans, NASS reported that pesticide application rates ranged from 1 pound to 1.5 pounds per acre per year among the four surveyed states. We used Minnesota rates (1 pound per acre per year) to estimate Wisconsin and Michigan usage and Ohio rates (1.5 pounds per acre per year) to estimate amounts for Pennsylvania and New York.

Of the total estimate of nearly 24.5 million pounds of pesticides used in the United States on corn and soybeans in 1991, 21.2 million pounds (86 percent) are based on surveyed pesticide application rates and 3.3 million pounds (14 percent) are estimates for states not surveyed. According to NASS officials, the amounts of pesticides used will generally vary by state and county on the basis of soil types, slope of land, and farming practices; however, using adjacent states' rates is a reasonable way to estimate the amounts used inside the watershed boundaries. In addition, USDA officials also said that they believe that our estimate includes at least 75 percent, and more likely 85 to 90 percent, of all the pesticides used in the Great Lakes watershed.

NASS' pesticides usage reports are based on interviews of random samples of 5,759 farmers in the 17 states that accounted for 90 percent of U.S. corn

acres, 4,443 farmers in 16 states accounting for 90 percent of soybean acres, an unspecified number of vegetable farmers in 4 states, and an unspecified number of fruit farmers in 12 states. The reports do not show the reliability of the data collected from farmers or the actual sample size for the various crops and the corresponding response rate. However, the reports state that the pesticide usage estimates are statistically representative of the pesticide usage on the crops in the surveyed states, because the samples were probability samples.[1] In addition, the reports state that, at the 67-percent confidence level, the estimates of pesticides used will vary within a range depending on the size of state samples and the percentage of acres treated. In general, the larger the percentage of acres treated, the smaller the sampling variability of the estimate. For example, in the corn and soybean report, when the pesticide was applied to 75 percent or more of the acres, the sampling variability of the pesticide usage estimate ranged from 1 percent to 5 percent for large and small state samples, respectively; when the pesticide was applied to 10 percent to 24 percent of the acres, the sampling variability of the pesticide usage estimate ranged from 10 percent to 30 percent. According to the reports, the sampling variability of the estimates varied considerably by pesticide and crop.

To ascertain the amounts of agricultural pesticides used on the Canadian side of the Great Lakes watershed, we reviewed Ontario's Survey of Pesticide Use in Ontario, 1988, the latest year for which data were available. The survey, conducted every 5 years, includes pesticides used on field crops, fruits, and vegetables in each county, including the amounts used inside the watershed boundaries. The 1988 pesticide usage data are based on questionnaire responses from stratified random samples of 10,000 field crop farmers and 3,200 fruit and vegetable growers. About 2,600 field crop questionnaires and 525 fruit/vegetable questionnaires were returned and used to estimate the pesticides used in each county and drainage basin area. In a study made in the early 1980s, a telephone follow-up of the responding versus nonresponding field crop farmers in 1983 determined that nonresponding farmers were representative of responding farmers; therefore, the telephone follow-up was not repeated. The report shows how the estimated quantities of pesticides used were computed, but the sampling errors are not shown.

To ascertain the amount of nonagricultural pesticides used, we reviewed the Great Lakes National Program Office's June 1991 Great Lakes Basin

[1]NASS' reports state that it received some reports that additional pesticides were used on corn, soybeans, fruits, and vegetables, but the reports were insufficient to estimate the amounts used in the states.

Risk Characterization Study, which was prepared to assess the nature and extent of current health and environmental risks in the U.S. portion of the Great Lakes watershed. The study estimates, on the basis of the proportion of the population residing in the Great Lakes watershed, that 12 percent of the lawn care pesticides used in the nation—over 8 million pounds—is used inside the watershed. On a similar basis, the study estimates that more than 2 million pounds of pesticides are used on golf courses in the watershed annually.

Our work was performed in accordance with generally accepted government auditing standards from April 1992 to April 1993.

Estimated Annual Amounts of Agricultural Pesticides Used in the Great Lakes Watershed (in Pounds)

Crop	Herbicides	Insecticides	Fungicides	Other	Total
United States					
Corn	17,884,900	1,534,800[a]	0	0	19,419,700
Soybeans	5,127,900	0	0	0	5,127,900
Fruits	68,700	2,132,800	3,117,700	5,700	5,324,900
Vegetables	602,200	239,800	412,400	60,800	1,315,200
Total	**23,683,700**	**3,907,400**	**3,530,100**	**66,500**	**31,187,700**
Canada					
Agricultural crops[b]	10,332,100	756,300	1,347,000	2,478,400	14,913,800
Total	**34,015,800**	**4,663,700**	**4,877,100**	**2,544,900**	**46,101,500**

[a]Amount does not agree with the amount in appendix III because of rounding.

[b]Includes corn, soybeans, fruits, vegetables, and other field crops.

Estimated Amounts of Pesticides Used on U.S. Corn and Soybean Crops in the Great Lakes Watershed in 1991

	Number of pounds[a]
Herbicides	
Atrazine	6,040,600
Metolachlor	5,248,000
Alachlor	4,535,100
Cyanazine	2,252,200
Pendimethalin	1,040,700
Trifluralin	601,400
EPTC	549,000
Glyphosate	430,600
Butylate	353,900
Dicamba	352,400
Metribuzin	320,900
Linuron	254,800
Bentazon	249,000
2,4-D	229,500
Clomazone	74,600
Ethalfluralin	69,600
Imazethapyr	68,100
Simazine	61,800
Chloramben	55,700
Acifluorfen	43,000
Imazaquin	38,000
Bromoxynil	35,500
Paraquat	33,600
Flauzifop-P-butyl	25,600
Chlorimuron	23,300
Sethoxydim	22,200
Quizalofop	1,400
Nicosulfuron	1,300
Thifensulfuron Methyl	500
Propachlor	300
Total herbicides	**23,012,600**
Insecticides	
Chlorpyrifos	661,200
Terbufos	415,500
Fonofos	231,200
Carbofuran	130,300

(continued)

	Number of pounds[a]
Phorate	93,000
Tefluthrin	3,500
Total insecticides	**1,534,700**
Total pesticides	**24,547,300**

[a]Amounts do not agree with amounts in appendix II because of rounding.

Estimated Amounts of Pesticides Used on U.S. Fruit Crops in the Great Lakes Watershed in 1991

	Number of pounds[a]
Herbicides	
Simazine	23,600
Paraquat	13,100
Glyphosate	12,800
Diuron	10,300
2,4-D	5,500
Terbacil	3,100
Hexazinone	300
Total herbicides	**68,700**
Insecticides	
Petroleum distillate	1,409,700
Azinphos-methyl	150,300
Phosmet	134,900
Chlorpyrifos	92,800
Carbaryl	66,400
Propargite	62,200
Malathion	50,500
Endosulfan	39,200
Methomyl	36,300
Ethyl parathion	20,200
Dimethoate	15,100
Phosphamidon	12,100
Oxamyl	10,300
Formetanate hydrochloride	8,800
Methyl parathion	8,000
Permethrin	6,800
Fenbutatin-oxide	4,100
Oxythioquinox	2,700
Esfenvalerate	1,700
Diazinon	700
Total insecticides	**2,132,800**
Fungicides	
Sulfur	1,578,200
Captan	1,003,200
Chlorothalonil	151,400
Dodine	58,800

(continued)

	Number of pounds[a]
Ferbam	52,800
Copper oxychloride sulfate	47,600
Mancozeb	34,500
Metiram	31,000
Ziram	28,500
Thiram	22,900
Benomyl	15,100
Copper hydroxide	14,500
Copper sulfate	13,700
Triforine	12,800
Iprodione	12,000
Streptomycin	10,500
Thiophanate-methyl	7,100
Fenarimol	6,500
Myclobutanil	5,900
Calcium polysulfide	4,100
Triadimefon	3,600
Dinocap	1,100
Oxytetracycline	1,000
Basic copper sulfate	700
Vinclozin	200
Total fungicides	**3,117,700**
Other pesticides	
Ethephon	4,300
NAA (Alpha-Naphthylacetic Acid)	700
Zinc phoside	500
Gibberellic acid	200
Total other	**5,700**
Total pesticides	**5,324,900**

[a]Includes pesticides used on fruits grown in Michigan only.

Estimated Amounts of Pesticides Used on U.S. Vegetable Crops in the Great Lakes Watershed in 1990

	Number of pounds[a]
Herbicides	
Stoddard solvent	282,100
EPTC	41,100
Naptalam	27,400
Metolachlor	24,100
Linuron	22,800
Simazine	20,900
Pendimethalin	20,200
Trifluralin	17,700
Diuron	16,900
Cyanazine	13,600
Chloramben	12,600
Ethalfluralin	10,300
Atrazine	9,900
Bensulide	9,400
Pebulate	9,300
2,4-D	8,700
Alachlor	8,100
Napropamide	8,000
Glyphosate	6,600
Prometryn	5,900
Metribuzin	5,100
Paraquat	3,800
DCPA	3,000
Pronamide	2,700
Flauzifop-P-butyl	2,300
Oxyfluorfen	1,900
Propachlor	1,700
Butylate	1,600
Norflurazon	1,200
Bentazon	900
Diphenamid	800
Terbacil	700
Bromoxynil	500
Sethoxydim	400
Total herbicides	**602,200**

(continued)

	Number of pounds[a]
Insecticides	
Carbaryl	76,500
Disulfoton	23,100
Acephate	16,200
Chlorpyrifos	15,500
Ethyl parathion	13,000
Malathion	12,900
Methyl parathion	12,100
Diazinon	11,300
Endosulfan	10,500
Carbofuran	10,000
Azinphos-methyl	8,100
Methomyl	7,100
Permethrin	5,100
Oxamyl	3,900
Fonofos	3,100
Mevinphos	2,500
Terbufos	1,900
Thiodicarb	1,600
Naled	1,300
Esfenvalerate	1,100
Cypermethrin	900
Dimethoate	700
Lindane	500
Oxydemeton-methyl	400
Fenbutatin-oxide	300
Methamidophos	200
Total insecticides	**239,000**
Fungicides	
Chlorothalonil	166,800
Mancozeb	68,600
Copper hydroxide	48,600
Sulfur	43,200
Basic copper sulfate	18,400
Maneb	14,600
Captan	13,200
Anilazine	11,800

(continued)

	Number of pounds[a]
Copper oxychloride	4,900
Iprodione	4,400
Metiram	3,600
Benomyl	3,400
Copper oxychloride sulfate	3,000
Metalaxyl	2,800
PCNB	2,100
Thiophanate-methyl	1,000
Vinclozolin	1,000
Triphenyltin hydroxide	700
Tridimefon	300
Total fungicides	**412,400**
Other pesticides	
Dichloropropene	34,100
Metam-sodium	17,300
Ethephon	5,000
Methyl isothiocyanate	2,100
Chloropicrin	1,700
Maleic hydrazide	600
Total other	**60,800**
Total pesticides	**1,315,200**

[a]Includes pesticides used on vegetables grown in Michigan only.

Estimated Amounts of Pesticides Used on Soybeans and Corn in the Great Lakes Watershed by U.S. County in 1991

State	County	Soybeans	Corn	Total
OH	Wood	196,475	328,859	525,334
OH	Hancock	205,193	291,651	496,843
OH	Seneca	207,595	271,812	479,407
OH	Fulton	133,685	334,614	468,299
MI	Lenawee	93,958	334,850	428,807
MI	Huron	5,786	421,638	427,424
OH	Putnam	202,825	224,164	426,990
OH	Van Wert	175,121	244,020	419,141
OH	Henry	141,676	255,033	396,709
MI	Sanilac	45,728	337,310	383,039
IN	Allen	136,398	240,350	376,749
MI	Saginaw	149,463	221,622	371,085
OH	Wyandot	155,077	214,765	369,842
MI	Hillsdale	43,322	316,229	359,550
MI	Gratiot	72,251	284,223	356,474
OH	Paulding	162,795	190,050	352,845
OH	Sandusky	130,229	220,919	351,148
MI	Ingham	38,171	310,130	348,301
OH	Allen	141,656	206,037	347,693
MI	St. Joseph	35,139	301,170	336,309
OH	Huron	131,560	200,993	332,553
WI	Outagamie	3,369	320,472	323,841
MI	Branch	36,448	274,065	310,513
MI	Cass	36,583	271,053	307,636
MI	Jackson	6,450	301,170	307,620
MI	Monroe	91,457	213,831	305,287
MI	Washtenaw	23,586	278,582	302,168
IN	Elkhart	65,070	233,674	298,744
OH	Auglaize	119,352	178,188	297,540
OH	Williams	124,898	161,409	286,307
MI	Tuscola	35,909	241,840	277,748
MI	Allegan	14,869	262,018	276,887
IN	Noble	66,085	208,838	274,923
IN	St. Joseph	72,300	196,954	269,254
OH	Crawford	112,783	154,590	267,374
MI	Ionia	34,657	225,878	260,535
OH	Defiance	144,911	114,282	259,193
MI	Calhoun	26,474	231,299	257,773

(continued)

State	County	Soybeans	Corn	Total
MI	Clinton	64,020	190,897	254,916
IN	Lagrange	32,304	214,980	247,284
IN	Dekalb	85,169	155,393	240,563
WI	Fond Du Lac	8,919	230,179	239,098
OH	Hardin	96,826	135,067	231,893
MI	Lapeer	16,366	210,819	227,185
MI	Ottawa	1,877	221,360	223,237
NY	Cayuga	0	220,777	220,777
MI	Eaton	30,927	186,725	217,652
WI	Shawano	1,925	213,648	215,573
OH	Lorain	71,893	142,570	214,463
MI	Shiawassee	57,059	154,762	211,821
OH	Mercer	68,553	132,550	201,103
MI	Montcalm	12,996	174,679	187,675
WI	Waupaca	2,888	181,601	184,489
IN	Steuben	47,718	133,528	181,246
MI	Kalamazoo	21,966	158,205	180,171
WI	Manitowoc	2,214	175,993	178,207
OH	Lucas	68,717	108,607	177,324
IN	Adams	65,938	110,161	176,098
MI	Bay	42,914	123,242	166,156
IN	Lake	39,042	126,184	165,226
MI	Genesee	28,881	135,527	164,408
OH	Ottawa	96,346	65,903	162,249
WI	Brown	1,203	158,898	160,101
MI	Kent	5,776	153,597	159,373
MI	Berrien	38,556	120,468	159,024
WI	Sheboygan	3,851	153,560	157,410
OH	Erie	43,561	113,507	157,068
WI	Winnebago	11,071	143,411	154,482
MI	Isabella	12,996	140,044	153,041
IN	Porter	43,380	103,484	146,864
WI	Oconto	385	142,877	143,262
NY	Ontario	10,845	128,397	139,242
WI	Green Lake	5,487	133,704	139,191
NY	Wyoming	697	136,095	136,792
MI	Van Buren	14,152	118,962	133,114
MI	Barry	16,366	111,433	127,799
MI	St. Clair	36,583	90,351	126,934

(continued)

State	County	Soybeans	Corn	Total
NY	Onondaga	2,789	115,062	117,851
MI	Newaygo	775	115,848	116,623
WI	Calumet	4,814	109,495	114,308
NY	Livingston	3,098	109,976	113,074
MI	Livingston	7,557	103,904	111,461
NY	Seneca	13,168	96,229	109,397
WI	Waushara	5,459	103,352	108,811
NY	Genesee	3,098	104,477	107,576
NY	St. Lawrence	310	104,477	104,787
NY	Niagara	7,746	93,914	101,660
NY	Wayne	9,295	90,730	100,026
OH	Ashtabula	13,275	84,832	98,107
WI	Marquette	3,369	93,471	96,840
NY	Orleans	12,394	81,107	93,501
WI	Kewaunee	1,444	90,800	92,244
MI	Macomb	21,179	66,257	87,437
NY	Jefferson	1,859	82,482	84,341
WI	Racine	15,403	68,234	83,637
WI	Ozaukee	3,851	79,317	83,168
OH	Marion	27,774	52,617	80,392
NY	Erie	310	76,983	77,293
MI	Midland	16,510	58,728	75,238
WI	Washington	3,100	71,786	74,886
NY	Monroe	2,014	67,360	69,374
IN	Kosciusko	17,722	50,519	68,241
MI	Mecosta	96	67,763	67,860
MI	Muskegon	2,503	63,848	66,351
WI	Marinette	193	65,430	65,622
OH	Medina	18,245	43,648	61,893
NY	Oneida	387	60,487	60,874
MI	Wayne	14,729	45,176	59,905
NY	Yates	930	54,988	55,918
IN	Laporte	9,833	41,728	51,560
WI	Door	433	51,008	51,442
MI	Arenac	5,181	46,079	51,260
NY	Tompkins	976	49,489	50,465
NY	Madison	0	49,269	49,269
MI	Menominee	24	48,790	48,814
OH	Portage	5,872	42,931	48,803

(continued)

State	County	Soybeans	Corn	Total
WI	Portage	202	48,071	48,273
MI	Gladwin	2,118	43,850	45,968
NY	Lewis	0	43,990	43,990
MI	Oceana	48	39,754	39,803
NY	Oswego	77	38,492	38,569
OH	Geauga	1,704	34,396	36,100
WI	Columbia	1,473	31,940	33,413
MI	Mason	549	32,508	33,057
MI	Missaukee	0	32,828	32,828
MI	Ogemaw	241	31,623	31,864
NY	Herkimer	0	31,274	31,274
MI	Oakland	510	30,719	31,230
NY	Franklin	0	30,623	30,623
MI	Osceola	0	30,117	30,117
PA	Erie	2,905	26,807	29,711
MI	Grand Traverse	144	28,611	28,756
NY	Allegany	54	26,944	26,998
MI	Clare	193	26,352	26,545
MI	Iosco	235	24,696	24,931
MI	Alpena	193	19,245	19,437
OH	Summit	1,155	17,323	18,479
NY	Steuben	93	17,734	17,827
OH	Ashland	3,780	12,609	16,389
WI	Langlade	58	16,024	16,081
MI	Wexford	29	15,059	15,087
WI	Waukesha	1,273	13,219	14,493
WI	Milwaukee	2,474	12,018	14,492
MI	Charlevoix	0	14,456	14,456
NY	Cattaragus	31	14,297	14,328
MI	Presque Isle	0	13,553	13,553
WI	Kenosha	1,925	10,816	12,741
NY	Chautauqua	0	12,262	12,262
NY	Schuyler	0	11,685	11,685
WI	Marathon	96	11,550	11,647
MI	Antrim	51	11,444	11,495
OH	Shelby	4,175	7,164	11,340
MI	Delta	0	10,929	10,929
MI	Leelanau	0	10,842	10,842
OH	Richland	4,418	5,189	9,607

(continued)

State	County	Soybeans	Corn	Total
MI	Emmet	0	9,186	9,186
PA	Crawford	775	8,248	9,023
NY	Clinton	0	8,890	8,890
WI	Bayfield	0	8,546	8,546
OH	Trumbull	1,165	7,297	8,463
IL	Lake	1,873	5,686	7,559
OH	Cuyahoga	775	6,711	7,486
IN	Wells	2,715	4,632	7,347
MI	Montmorency	104	6,460	6,564
MI	Alcona	46	5,722	5,768
MI	Manistee	39	5,722	5,762
MI	Otsego	0	5,270	5,270
MI	Dickinson	0	4,819	4,819
MN	Pine	598	4,209	4,807
OH	Lake	542	4,027	4,569
NY	Cortland	13	4,555	4,568
MI	Kalkaska	0	4,216	4,216
WI	Ashland	0	4,006	4,006
MI	Benzie	0	3,915	3,915
IL	Cook	910	2,747	3,657
WI	Dodge	70	3,581	3,651
WI	Adams	375	3,138	3,513
MI	Oscoda	0	3,313	3,313
WI	Florence	0	3,205	3,205
MI	Cheboygan	0	2,861	2,861
MN	Carlton	0	2,773	2,773
MI	Lake	19	2,711	2,730
MN	St. Louis	10	2,565	2,575
PA	Potter	0	2,450	2,450
WI	Forest	0	2,203	2,203
NY	Chemung	0	2,069	2,069
MI	Houghton	0	1,355	1,355
MI	Mackinac	0	940	940
MI	Alger	0	919	919
OH	Stark	94	817	911
WI	Iron	0	801	801
MI	Schoolcraft	0	708	708
MI	Marquette	0	669	669
WI	Douglas	0	668	668

(continued)

State	County	Soybeans	Corn	Total
MN	Aitkin	35	519	554
IN	Whitley	146	288	434
MI	Luce	0	376	376
NY	Essex	5	346	351
MI	Baraga	0	301	301
MI	Iron	0	294	294
MI	Chippewa	0	126	126
MI	Crawford	0	120	120
MI	Gogebic	0	81	81
MN	Itasca	1	73	74
WI	Oneida	0	67	67
MI	Roscommon	0	60	60
WI	Vilas	0	40	40
MI	Keweenaw	0	0	0
MI	Ontonagon	0	0	0
MN	Cook	0	0	0
MN	Lake	0	0	0
NY	Hamilton	0	0	0
WI	Menominee	0	0	0
	Totals	**5,127,905**	**19,419,631**	**24,547,535[a]**

[a]Amount does not agree with the amount in appendix III because of rounding. Also, the amounts may not add across because of rounding.

Estimated Amounts of Pesticides Used on Field Crops in Ontario (Canada) Counties in the Great Lakes Watershed in 1988

County name	Number of pounds[a]
Haldimand-Norfolk	1,789,744
Elgin	1,370,138
Middlesex	1,214,356
Kent	1,136,938
Oxford	988,966
Huron	973,104
Lambton	917,466
Essex	675,928
Perth	653,818
Stormont, Dundas, & Glengarry	421,300
Waterloo	387,354
Brant	387,002
Wellington	324,280
Durham	321,530
Bruce	269,434
Simcoe	262,548
Prescott & Russell	257,862
Halton	245,432
Niagara	144,430
Dufferin	136,422
Northumberland	117,392
Lennox & Addington	101,112
Peel	91,872
Victoria	73,656
Hamilton-Wentworth	62,458
Prince Edward	58,806
York	51,128
Leeds & Grenville	38,984
Ottawa-Carleton	32,054
Hastings	23,936
Grey	23,650
Timiskaming	21,626
Nipissing	15,422
Kenora	13,772
Peterborough	11,154
Lanark	10,318
Renfrew	10,296
Algoma	4,840

(continued)

County name	Number of pounds[a]
Rainy River	1,716
Frontenac	1,254
Sudbury	1,100
Cochrane	836
Thunder Bay	814
Manitoulin	528
Haliburton	0
Muskoka	0
Parry Sound	0
Total	**13,646,776[b]**

[a]These amounts include the total pesticides used in each county.

[b]Of this amount, 12,780,966 pounds (94 percent) were used inside the watershed boundaries.

National and State Studies Show That U.S. Waters Contain Measurable Pesticide Residues

EPA's September 1992 National Study of Chemical Residues in Fish indicates that the levels of pesticides and other pollutants in fish have been reduced but that they continue to pose risks to the environment and human health. The study included data from samples of both bottom-feeding and game fish collected from 388 sites around the country between 1986 and 1989. Fish were analyzed for 60 bioaccumulative chemicals, including 21 pesticides. The study showed that some very persistent pollutants were found in fish at many sites. The study concluded that 46 sites were higher-risk sites, where the lifetime cancer risk was greater than 1 in 10,000[1] for persons who ate two 4-ounce fillets of fish per month over their lifetime.

Of the 46 contaminated sites, which includes 28 sites in six Great Lakes watershed states—New York, Pennsylvania, Illinois, Michigan, Minnesota, and Wisconsin—42 are contaminated with Polychlorinated Biphenyls (PCBs), an industrial pollutant, and 6 with dieldrin, an insecticide. Both are essentially banned in the United States but are highly persistent in the environment. These chemicals have accumulated in the sediments of the nation's waters and reenter the food chain from these sediments. Fish consumption advisories or bans were in effect at 41 of these sites. Persons at risk are avid recreational fishers and subsistence fishers who may consume more fish than the average person and more of whose fish could come from these contaminated sites. Pregnant women and nursing mothers may be especially sensitive to the pollutants found, according to the study. The study did not address commercial fishing and concluded that there is no evidence that persons who ate most of their fish from commercial markets had cause for concern.

The Food and Drug Administration's (FDA) monitoring of fish and other foods over the 5 fiscal years (1987-91) led it to conclude that pesticide residues in the U. S. food supply are generally below established safety limits. FDA collects fish and other food samples from all 50 states and analyzes them for pesticide residues. In its 1991 program, it tested for 298 different pesticides and found 108 of them in its various samples. In analyzing 531 samples of fish and shellfish collected nationwide, it found that 41 percent contained pesticide residues, but less than 1 percent contained residues in violation of EPA tolerances. FDA's data showed that 120 of the fish samples came from Great Lakes states, including one violative sample that contained arochlor, a pesticide banned in 1970, in excess of EPA tolerances. FDA's data do not indicate whether any of the fish

[1]EPA's water quality criteria for human consumption of fish is based on a cancer risk of 1 in 1 million.

samples that came from the Great Lakes states came from within the watershed boundaries.

Compared to their predecessors, the pesticides currently being used in the Great Lakes watershed are generally more soluble in water and more likely to run off into surface and groundwater and end up in drinking water supplies. A 1988 study by the Water Quality Laboratory at Heidelberg College showed that although 1 percent or less of the pesticides applied to agricultural croplands runs off into surface waters, they are used in such large quantities that tons of pesticides end up in the Great Lakes tributaries. For example, the laboratory calculated that about 75,000 pounds of 11 pesticides applied ran off into eight Ohio and Michigan tributaries draining into Lake Erie in 1984 and 1985. The study concluded that these pesticides were likely to affect the algae and higher aquatic plants, which could affect fish, invertebrates, and possibly animals in the Great Lakes food chain.

EPA's November 1991 report entitled Pesticides in Groundwater Database states that pesticides have been found in the groundwater of 40 states. Over 48,000 wells were tested from 1979 to 1990 for more than 230 pesticides. Ninety-eight pesticides were found in at least 1 well, 16 were found in 100 or more wells, and 4 were found in more than 1,000 wells. Eighteen of the pesticides found in groundwater are no longer registered for use in the United States.

About 90 percent of the samples were taken in 12 states. Ninety percent of the wells containing one or more pesticides were located in 11 states, including Minnesota, New York, Ohio, and Wisconsin. A study by Heidelberg College's Water Quality Laboratory found that pesticide concentrations in Ohio's surface waters used for drinking water frequently exceeded EPA's drinking water standards during periods following pesticide applications. The study concluded that at times during the year, 0.05 percent of Ohio's population was consuming atrazine in excess of EPA's standards, and that 0.06 percent was consuming alachlor in excess of standards. However, annual average concentrations were in compliance with drinking water standards.

A December 1992 study by the U.S. Geological Survey concluded that there is a clear effect on water quality caused by surface runoff of pesticides after spring application in the 10-state Midwestern corn and soybean belt area, which included five Great Lakes states—Illinois, Indiana, Minnesota, Ohio, and Wisconsin. Although the study was not

specific to the Great Lakes watershed, it reported that more needs to be known about the duration of large herbicide concentrations during storm runoff and the possible implications of storing this water for long-term use. Furthermore, the study concluded that the frequency of samples exceeding EPA's maximum contaminant levels for drinking water reinforced the need for environmental health studies to examine the combined synergistic effects[2] of the major herbicides and their degradation products.

Similarly, an October 1991 Wisconsin study found pesticides in the soils at 25 of 27 randomly selected pesticide dealer sites across the state. Groundwater samples at 15 of the 27 sites contained pesticides, 9 at levels greater than state standards. The most heavily used herbicides—alachlor, atrazine, cyanazine, and metolachlor—were found most often in soils and groundwater. A 1989 Michigan study found that 9 of 50 sample wells (18 percent) from 300 high-risk pesticide dealers' sites contained pesticides, particularly atrazine. In two of the nine wells, the atrazine levels exceeded EPA drinking water standards.

[2]Effects that could occur when a pesticide that is not toxic by itself becomes lethal in the presence of other pesticides.

Major Contributors to This Report

Resources, Community, and Economic Development Division, Washington, D.C.	Peter F. Guerrero, Associate Director J. Kevin Donohue, Assistant Director Molly MacLeod, Reports Analyst Derek Updegraff, Technical Advisor
Chicago Regional Office	James B. Musial, Regional Management Representative Frederick A. Wiener, Evaluator-in-Charge Rosemary Torres Lerma, Staff Evaluator John Zarem, Technical Advisor Lakale Williams, Technical Advisor

Ordering Information

The first copy of each GAO report and testimony is free. Additional copies are $2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary. Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

Orders by mail:

U.S. General Accounting Office
P.O. Box 6015
Gaithersburg, MD 20884-6015

or visit:

Room 1000
700 4th St. NW (corner of 4th and G Sts. NW)
U.S. General Accounting Office
Washington, DC

Orders may also be placed by calling (202) 512-6000 or by using fax number (301) 258-4066.

United States
General Accounting Office
Washington, D.C. 20548

Official Business
Penalty for Private Use $300

First-Class Mail
Postage & Fees Paid
GAO
Permit No. G100