

# Water Quality

## GLOSSARY

### Aquifer

A large subsurface (underground) formation of sand, gravel, or porous bedrock that yields water.

### Area of concern (AOC)

A location in the Great Lakes identified by the International Joint Commission as having serious water-quality problems; there are 14 AOCs in Michigan.

### Atmospheric (air) deposition

Chemicals or substances in rain or snow or attached to dust-sized, airborne particles that fall to the earth; in an environmental context, usually refers to polluting materials deposited in a quantity sufficient to have a detrimental effect.

### Bioaccumulation

The increase in concentration of a substance by a biological organism above the level found in its food supply or environment; often the concentration increases through successive levels of the food chain.

### Combined sewer overflow (CSO)

Combined sewers carry storm water, domestic sewage, and industrial waste to a wastewater treatment plant in a single pipe; during wet weather, when flow exceeds sewer-pipe capacity, the system is designed to overflow directly into a water body, thus not reaching the treatment plant and carrying whatever contaminants it contains into the water body.

### Ecosystem

The interdependent relationships among members of a biological community and their natural environment.

### Great Lakes Water Quality Initiative (GLI)

An initiative by the U.S. Environmental Protection Agency and the Great Lakes states to reduce sources of pollution to the lakes.

### Groundwater

Water found underground in (1) shallow silt, sand, and gravel deposits or (2) deep, fractured or porous rock.

## BACKGROUND

The State of Michigan and most of its boundaries are defined by water. The Great Lakes cover approximately 40 percent of the state's nearly 97,000 square miles of official surface area, and within state borders there are approximately 35,000 ponds and inland lakes and more than 36,000 miles of rivers and streams.

Michigan law protecting state waters from pollution applies both to *surface* water (Great Lakes, inland lakes, streams, and so on) and *groundwater* (present in subsurface sand, gravel, and rock formations). Groundwater near the surface often has a direct hydrological link to surface waters—that is, lakes, streams, and rivers may receive a substantial portion of their water from groundwater sources. Contaminated groundwater may affect nearby surface and well water.

The law defines water pollution as discharges that impair protected water uses (e.g., swimming and boating; support of fish, wildlife and aquatic organisms; and withdrawals for domestic, agricultural, and industrial purposes). The primary regulatory mechanism is a permit system that requires discharges into Michigan waters to meet water-quality standards established to prevent pollution. Past efforts to protect water quality and water resources (fish, wildlife, water supplies) focused on *point* sources of pollution (discrete discharges from municipal and industrial wastewater treatment systems). Today there is increasing concern about pollution from *nonpoint*, or diffuse, sources; examples are runoff from urban areas or farm fields, air deposition (polluting materials in rain or snow or borne on dust-sized particles), and chemicals being released from historically contaminated surface sites and water sediment.

### Surface Water

Overall, Michigan surface waters are of generally *good* quality—that is, pollution is relatively low, and the waters support the uses protected by law. The inland waters of the Upper Peninsula and the northern lower peninsula and adjacent Great Lakes waters—primarily bounded by forest land—are of generally *high* quality. Waters in southern Michigan tend to be of *lower* quality, a consequence of the more intense agricultural, industrial, commercial, and residential land uses that occur there; these uses are sources of both point and nonpoint water pollution.

There are some problems in the Great Lakes with the presence of *persistent* (remain in the same state for a very long time or indefinitely) toxic chemicals (e.g., DDT, PCBs, chlordane, dieldrin, mercury) that have leached into the lakes through contaminated soil and sediment and/or entered the lakes through atmospheric deposition. Atmospheric mercury deposition, which results from fossil fuel being burned and waste being incinerated, is thought to be the major

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### Heavy metal

One with specific gravity greater than about 5.0, e.g., lead, mercury, copper, zinc, nickel, cadmium; can be toxic even at a relatively low concentration.

### Michigan Environmental Response Act (MERA)

Formerly P.A. 307 of 1982, now incorporated in the Natural Resources and Environmental Protection Act; provides for identification, risk assessment, evaluation, and cleanup of contaminated sites.

### Natural Resources and Environmental Protection Act (NREPA)

Public Act 451 of 1994. Codifies state environmental law; has been amended several times, incorporating dozens of environmental statutes.

### Nonpoint source discharge

A diffuse discharge (does not have a single point of discharge)—e.g., rain, runoff from adjacent lands, or air deposition that enters a water body; may carry pollutants.

### Point-source pollution

A single, identifiable source of pollutants (e.g., pipe or smokestack).

### Protected water uses

The purposes for which state and federal law protect water: swimming and boating; supporting fish, wildlife, and aquatic organisms; and domestic, agricultural, and industrial use.

### Runoff

Precipitation that travels over the surface of the land, in contrast to that which permeates the soil.

### Separate sewers

Sewer systems in which storm water is carried separately from sanitary and industrial waste.

### Surface water

In Michigan, the Great Lakes and inland lakes, ponds, rivers, streams, creeks, certain wetlands, and open drains; legal definition may vary by statute.

### Water pollution

Discharges that impair protected water uses.

### Water resources

Natural-resource benefits associated with water: e.g., fish, wildlife, and water.

### Watershed

A land area that drains to a particular river system; a region or area bounded peripherally by a divide and draining ultimately to a particular watercourse or water body.

reason for unacceptably high mercury levels found in fish in certain areas of the Great Lakes and in many inland waters. The state has issued fish-consumption advisories recommending that sensitive populations (e.g., children, and women of childbearing age) restrict their consumption of certain species from designated waters due the concentration of mercury or other toxic substances.

To protect state waters, Michigan has developed water quality standards under the provisions of the state Natural Resources and Environmental Protection Act (NREPA), P.A. 451 of 1994. Michigan's water quality standards are intended to

- establish water quality requirements for the Great Lakes and connecting waterways and all other surface waters within Michigan jurisdiction;
- protect public health and welfare;
- enhance and maintain water quality;
- protect natural resources, and
- meet the requirements of the federal Clean Water Act and the U.S.–Canada Great Lakes Water Quality Agreement.

Michigan also is developing limits for toxic substances found in the Great Lakes; they will be consistent with the requirements of the federal Great Lakes Water Quality Initiative (GLI) and U.S.–Canada agreements.

To determine if surface waters are meeting water quality standards, the Michigan Department of Environmental Quality (MDEQ) employs a monitoring and assessment program by which every state watershed is evaluated every five years. This program examines water chemistry, evaluates fish and biologic samples, measures the rate at which fish and micro invertebrates are incorporating toxic pollutants, and evaluates lake and river sediment.

The most recent surface-water monitoring data indicate that almost all Great Lakes water within Michigan jurisdiction is safe for recreation, agriculture, domestic and industrial use, and navigation. The exceptions are a small shoreline area that is unsafe for swimming (some Lake St. Clair beaches have been closed intermittently, when the lake has had a high bacteria level), and portions of the Saginaw Bay that do not meet drinking-water standards.

### Areas of Concern

The Great Lakes Water Quality Agreement between the United States and Canada was signed in 1972 and amended in 1978 and 1987. Separate from the GLI, this agreement outlines programs and practices necessary to reduce pollutant discharges to the Great Lakes system. Forty-three specific locations, known as areas of concern (AOCs), in the Great Lakes have been identified as having serious water quality problems; many do not meet state standards. Michigan has the following 14 AOCs:

- Five in the Upper Peninsula: Deer and Torch lakes and Manistique, Menominee, and St. Mary's rivers
- Nine in the southern lower peninsula: Muskegon and White lakes, and the Clinton, Detroit, Kalamazoo, Raisin, Rouge, Saginaw (includes the bay), and St. Clair rivers

Water-quality problems in these AOCs include the presence of heavy metals (e.g., mercury, chrome), organic compounds, contaminated sediment and the necessity for fish-consumption and wading/swimming advisories. The agreement calls for local plans to remediate (correct the problems) these areas. Remedial action plans have been developed and reviewed by the state for all 14 areas, and they are in various implementation stages. State officials report that physically removing contaminated sediment in the Raisin and Manistique rivers has been extremely helpful in improving water quality in these areas. They also report that in both the Muskegon Lake and White Lake areas, public education efforts involving citizen volunteers—such as “Lake Watch” and “Adopt-a-Stream”—have been very helpful in improving water quality.

### Groundwater

Almost half of all Michigan residents—those living in Lansing, Battle Creek, Kalamazoo and Jackson, and rural and undeveloped areas—depend on groundwater as their sole source of drinking water.

According to the MDEQ, there are more than 10,000 places in Michigan where groundwater is contaminated. Seventy percent of the sites have been polluted by leaking underground oil- and gasoline-storage tanks and 30 percent by landfills, manufacturing, mining, and bulk-chemical storage facilities. In addition, Michigan has more abandoned wells (over one million) than any other state. An abandoned or improperly plugged well can be a direct conduit to a groundwater aquifer that normally is protected by an overlaying, impermeable clay layer. If contaminated surface runoff or leaks from storage tanks reach an unplugged well, the aquifer subsequently becomes contaminated. Despite advances in computer modeling and testing technology, groundwater contami-

nation is difficult to track and contain: an area that has been contaminated for decades may be thousands of feet long and hundreds of feet wide.

### Cleanup

Under both state law (part 401 of the NREPA) and federal law (Comprehensive Environmental Response, Compensation and Liability Act, or CERCLA), financial responsibility for cleaning up contaminated groundwater usually falls to the person(s) responsible for the discharge or spill that caused the pollution. (In certain cases, current owners of property that is the contamination source may be liable for cleanup costs, even if they were not responsible for the original contamination.) In many cases the parties responsible for the original pollution cannot be found or the legal entity involved no longer exists, and the state and/or the federal government initiates cleanup, using public funds.

State cleanup funds come from environmental bonds approved by the voters. The former Michigan Environmental Response Act, P.A. 307 of 1982 (now part 201 of the NREPA), provides for identifying, assessing risk, evaluating, and cleaning up contaminated sites. Most of the nearly 2,700 sites on the “Act 307” list involve groundwater contamination; Oakland, Macomb, and Wayne counties have the most—each more than 500. The list, which is available from the MDEQ and accessible on the department's Web site, is updated every six months.

Federal cleanup dollars are allocated from the so-called Superfund, which is generated from fees assessed on certain industries. Michigan has 79 sites on the Superfund list, meaning that these sites have been determined by the EPA to be sufficiently polluted to merit federal money for remedial action. Only two states have more sites in the Superfund program.

### Regulation

The EPA regulates groundwater quality through federal pollution-prevention statutes—primarily the Resource Conservation and Recovery Act (RCRA), Toxic Substances Control Act, and Safe Drinking Water Act—and CERCLA standards.

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Other statutes pertaining to groundwater quality are the federal and state Safe Drinking Water acts and the Michigan Solid Waste Management Act; the latter is similar to the federal RCRA and sets design and permit standards for public and private solid-waste facilities. The federal drinking water act was amended in 1997 and now requires states to monitor all groundwater wells that serve more than one household. The MDEQ plans to launch this monitoring effort in 1998, primarily through county health departments. The federal act also requires that municipal and private water suppliers disclose to the public, via water utility bills, when drinking-water quality violations have occurred; guidance on this provision was issued in July 1997.

### DISCUSSION

There has been significant improvement in water quality in Michigan, the Great Lakes, and throughout the nation since the early 1970s, when national standards were adopted and a system instituted that requires anyone discharging waste to surface waters to obtain a permit to do so.

Although continuous point-source discharges now are regulated, there still is the serious problem of municipal sewer systems. In the older, *combined* sewer systems, untreated waste intermittently is discharged, following substantial rain or snowmelt, into a nearby water body; in the newer, *separate* sewer systems, storm water—which picks up pollution as it runs off streets, lawns, commercial establishments, and factories—washes into storm drains and directly into nearby surface water. Another problem is nonpoint pollution—also a runoff problem but occurring in rural as well as urban areas—which largely is uncontrolled in Michigan and across the nation.

#### Combined Sewer Overflows

Combined sewers carry storm water, domestic sewage and industrial waste to a wastewater treatment plant in a single pipe; more than 50 Michigan communities still have such a system. Most are more than 50 years old, and they were designed to overflow into a surface water body when the combined flow of rainwater/snowmelt and wastewater exceeds the pipe's

capacity. This means that in these 50+ communities, raw, untreated sewage and industrial waste are discharged into surface waters—and never reach the wastewater treatment plant—every time there is substantial rainfall or snowmelt in the system's service area. The systems were designed to overflow when pipe capacity is exceeded, so that the pipe will not explode, nor will sewage back up into buildings.

Under current federal and state regulations, communities must develop and implement plans to address the pollution that results when combined sewers overflow (CSO). They may (1) construct separate pipes for storm water and sanitary sewage or (2) build large retention basins to hold and treat excess flow arising from substantial rainwater/snowmelt. Both approaches are very expensive. For example, just correcting the problem of CSO discharges to the Rouge River will cost Detroit and the older suburban communities it serves more than \$1 billion. Lansing, Grand Rapids, Saginaw, and other older Michigan cities have faced or will face similarly large expenditures in addressing their CSO problems.

To help communities defray the expense of improving their wastewater systems, the state participates with the federal government in a revolving loan program. Municipalities may use the state revolving loan fund to reduce interest rates on bonds they sell to finance the capital costs involved in correcting their CSO problem.

In 1992, Wayne County was awarded a several-hundred-million-dollar EPA demonstration grant to study and find solutions to pollution problems caused by rain and snowmelt in urban areas. Eight demonstration projects have been completed, using sewer separation and/or retention-basin construction to control CSO discharges into the Rouge River; two-thirds of the CSO discharges to the river remain to be addressed. Because storm-water discharge and nonpoint pollution also are factors in the river's degradation, the demonstration project also (1) has developed a public education program to inform residents and businesses about the harmful effects of storm-water discharges and nonpoint pollution and (2) is funding pilot projects to help vari-

ous communities develop approaches that will enable them to reduce these sources of pollution to the river and thus the Great Lakes.

Communities that have begun CSO corrective programs are encountering stiff local resistance to the high costs involved, and lawmakers can expect them to push for more financial help from state government. If they fail to obtain it, many communities will have to request an extension in meeting the deadline for having the corrections in place.

### Storm-Water Management

Nationwide surveys and studies indicate that storm water—which washes from streets, yards, commercial establishments, and factories through storm drains directly into nearby surface water—is a major pollution source, and in 1993 Congress took action in that regard. Lawmakers amended federal Clean Water Act, requiring that in *separate* municipal sewer systems (whereby storm-water is handled separately from sanitary and industrial waste), storm-water discharges into a water body must be regulated. The EPA is promulgating regulations to phase in storm-water pollution-control requirements, and in 1995 Michigan adopted the minimum Phase I federal storm-water discharge requirements. This means that certain industries, new construction on sites larger than five acres, municipal operations (e.g., airports), and separate storm-water systems serving a population over 100,000 must obtain a storm-water control permit.

Five Michigan cities are affected by the Phase I regulations: Ann Arbor, Flint, Grand Rapids, Lansing, and Warren. The problem is that a single community may have thousands of storm-water “outfalls” (pipes) that empty into a river or lake, and putting a treatment system at each pipe’s end is out of the question. The cities and state regulators are struggling to find practical and effective ways to prevent polluted storm water—tainted from the streets, yards, parking lots, and buildings over which it has flowed—from coursing through storm drains into nearby surface water. The Phase I permits issued to the five cities have required them to (1) initiate public edu-

cation programs that inform people about the consequences of inappropriately using storm drains as a way to dispose of household or commercial waste and (2) discover and remove improper sanitary sewer connections to the storm-water system.

Even before Phase I results are evaluated, the EPA is beginning to implement Phase II. The second phase will require virtually all the heavily urbanized (densely populated) municipalities with separate storm water systems to obtain a storm-water discharge permit; most such sewer systems were built in the last 50 years. Phase II draft regulations were published in January 1998 and will be finalized by fall; they will go into effect in 2001.

The challenge in storm-water management will come during the next few years, as the federal requirements are promulgated for storm-water discharges in cities under 100,000 population and separate sewer systems: Among others, they will affect almost all communities in metropolitan Detroit. (They also will affect public agencies—e.g., county road commissions and universities—that own or operate a storm-water system, perhaps to drain roadways.) To help such communities, in 1997 the MDEQ instituted a voluntary *general* storm-water permit program that encourages communities to use a cooperative, watershed approach to storm-water management; the program offers them the flexibility to develop innovative management approaches that fit local conditions, and it appears to meet most if not all the anticipated federal Phase II requirements. Several Wayne County municipalities in the Rouge River watershed have passed resolutions indicating their intention to apply for a general storm-water permit, and some Oakland and Washtenaw county communities have expressed interest. The Michigan Municipal League supports the state’s voluntary permit program because it allows communities flexibility in designing their programs.

### Great Lakes Water-Quality Concerns

The Great Lakes Water Quality Initiative (GLI) was launched by the EPA in 1995, to put into effect agreement among the eight Great Lakes states on estab-

lishing uniform limits on certain pollutants; this is important because it will provide consistency in state regulations, taking away the incentive for companies and industries to locate in a state because it has weaker regulations than another. Of special concern are persistent toxic chemical compounds known to bioaccumulate in fish and other animals. These compounds, known as bioaccumulative chemicals of concern, are targeted because (1) the EPA and Great Lakes states believe the Great Lakes system has unique physical, chemical, and biological characteristics that warrant special protection, and (2) there is documented evidence of environmental harm to the Great Lakes ecosystem from the past and continuing presence of these pollutants.

Michigan, Wisconsin, and Indiana already are implementing the agreement's terms, which include establishing uniform standards for waste disposal and imposing strict limits on chemicals that may be discharged into the Great Lakes. The other Great Lakes states (New York, Pennsylvania, Ohio, Minnesota, and Illinois) are in the process of adopting regulations. An emerging issue related to the GLI will be whether regulations will be *implemented* consistently among the states.

Another Great Lakes water-quality issue concerns whether chlorine and chlorine-containing compounds should be banned from use as an industrial feedstock (raw material used for industrial processes). In 1991 the International Joint Commission (IJC), a group of U.S. and Canadian officials, recommended discussing this issue as part of a broader recommendation to eliminate persistent toxic compound discharges anywhere in the Great Lakes basin (the region drained by the five lakes). The recommendation—which has generated heated debate between certain environmental organizations and industry representatives—was based in part on preliminary research that indicates that a wide range of chlorine-containing compounds may be causing abnormalities observed in certain Great Lakes species. The EPA believes that the relationship of chlorine compounds to the

observed problems needs further study, and Environment Canada indicates that it believes there is not enough scientific evidence to support such a ban.

Although no action has been taken on this issue at the state level, discussions may resurface in connection with the GLI and concern about toxic pollutants. The Michigan Manufacturers Association and other industry groups oppose banning chlorine because it is a widely used, efficient building block for several chemical products.

### Pollution Prevention

Certain water-pollution problems cannot effectively be addressed through the traditional approach of relying on treatment to remove contaminants before waste water is discharged into rivers or lakes. Some pollution simply must be reduced and some prevented. For example, one way to manage storm water is to induce homeowners, industrial and commercial establishments, and public road agencies to reduce (or better yet, eliminate) their use of contaminants that can reach surface waters in rain and snowmelt. For toxic chemicals that bioaccumulate, it is very difficult (if not impossible) to reduce or remove even small concentrations through wastewater treatment. For these, the only effective control is to prevent them from entering the wastewater system in the first place. The MDEQ has established several programs in which various industry segments voluntarily develop pollution-prevention programs that will reduce the waste they generate that eventually must be disposed into the water, air, or a landfill.

*See also* Agriculture; Air Quality; Environmental Audits; Environmental Quality Indicators; Great Lakes Concerns; State-Local Relations.

### FOR ADDITIONAL INFORMATION

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Environmental Reference Desk  
Great Lakes Information Network  
[www.great-lakes.net/refdesk/refdesk.html](http://www.great-lakes.net/refdesk/refdesk.html)

Great Lakes Natural Resource Center  
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506 East Liberty Street  
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[www.nwf.org/nwf/greatlakes/index.html](http://www.nwf.org/nwf/greatlakes/index.html)

Groundwater Education in Michigan Consortium  
[www.gem.msu.edu/gem/aboutgem.html](http://www.gem.msu.edu/gem/aboutgem.html)

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[www.deq.state.mi.us/swq](http://www.deq.state.mi.us/swq)  
[See especially, "Water Quality and Pollution Control in Michigan: 1996 Report," Michigan 305(b) report to U.S. Environmental Protection Agency]

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