

# United States Geological Survey

## Programs in Michigan



The USGS provides maps, reports, and information to help others meet their needs to manage, develop, and protect America's water, energy, mineral, and land resources. We help find natural resources needed to build tomorrow, and supply scientific understanding needed to help minimize or mitigate the effects of natural hazards and environmental damage caused by human activities. The results of our efforts touch the daily lives of almost every American.

### Contaminant Pathways to the Great Lakes

The Great Lakes that surround Michigan are a magnet for the people that make tourism and recreation a 14 billion dollar per year industry in Michigan (fig. 1). Contamination of the Great Lakes ecosystem limits recreational uses, threatens productivity of commercial and sport fisheries, and increases costs of water-supply treatment. The International Joint Commission has identified 14 Areas of Concern along Michigan's Great Lakes shorelines and 6 of these are along the connecting channels between Lake Superior and Lake Huron and between Lake Huron and Lake Erie. Potential pathways for contaminants to reach the connecting channels include ground water and surface water. Before 1989, the relative importance of ground water as a contami-



**Figure 1.** Sleeping Bear Dunes National Lakeshore, Leelanau County, Michigan

nant source to the channels was unknown, which limited managers' ability to efficiently target financial resources.

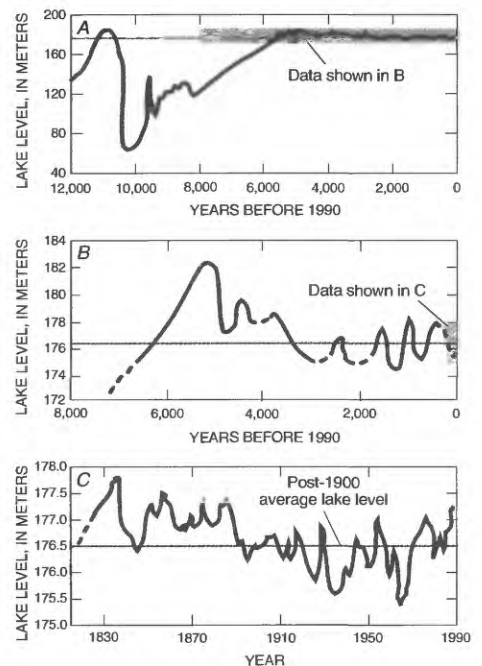
Although ground water could be a major pathway for some contaminants to the Great Lakes, a recent U.S. Geological Survey (USGS) study calculated ground-water flow to the connecting channels in Michigan to be a small percentage of the total flow through the channels. This finding aided water-resource managers and policy-makers in focusing efforts on quantifying the role of surface water as a contaminant pathway. Currently, the USGS is measuring annual contaminant loads to the Detroit River from combined sewer overflows for the City of Detroit and Southeast Michigan Council of Governments, and measuring annual contaminant loads from major rivers tributary to Lake Michigan for the Department of Natural Resources.

### Water-Level Fluctuations in Lake Superior

Changes of only a few feet in Great Lakes' water levels have significant economic effects on shipping and shoreline erosion. Scientists from the USGS and Michigan Sea Grant Program are studying long-term, water-level fluctuations at Bay Mills, Michigan on the south shore of Lake Superior a few miles west of Sault Ste. Marie. Submerged sand spits, formed at Bay Mills during the past 2,000 years, indicate periods of extended low lake levels with mean levels 1.52 meters lower than the present mean level of 183.4 meters (fig. 2). Natural climatic change lowered Lake Superior for extended periods, perhaps centuries. This new research provides planners a long-term historical framework to view popular projections of global warming effects on Great Lakes levels.

### Great Lakes Coastal Wetlands

Coastal wetlands of Lakes Michigan, Superior, Huron, and Erie protect Michigan's drinking water and Michigan's shoreline communities. Many processes have been interacting to cause the deterioration of Great Lakes wetlands since the glaciers melted. The USGS, in cooperation with Michigan Department of Natural Resources, Saginaw Band of the Chippewa, several State universities, and other Federal agencies, is collecting and analyzing sediment cores to unravel the history of wetland changes in the Great Lakes States. The analysis is delineating high stands of the lakes, timing of peat



**Figure 2.** Scales of lake-level change in the past. A, In the last 12,000 years, the lake has experienced dramatic change due to changing outlets and ground tilting. B, For the past 5,000 years, climatically-controlled fluctuations have been superimposed on a general falling trend. C, For the last 160 years, lake level has fluctuated, but each peak of this century has been higher than the last.

deposition, changing climatic regimes, the history of wetland deterioration and regrowth, and the history of early human effects on the wetlands. Results of the analyses are being incorporated into digital mapping products which can provide land-use planners, policy makers, and scientists with a predictive tool that incorporates reasonable geological limits on wetland management and preservation.

## Ground-Water Availability

Ground water is the major source of drinking water for domestic supplies in Michigan and for municipal supplies in Lansing, Battle Creek, Kalamazoo, and Jackson. Throughout Michigan, the availability of ground water is a significant issue because of competing uses, particularly during periods of drought. The USGS has investigated the availability of ground water in many counties, including Huron, Kalamazoo, Marquette, Monroe, Oakland, and Washtenaw. In Monroe County, the USGS installed a network of 33 observation wells to define the complex ground-water flow system in the Silurian-Devonian carbonate aquifer and to investigate water-level declines caused by competing uses. Results of the study are being used by the County Planning Department to plan for protection of the critical recharge area and by the County Health Department to develop well-construction guidelines that provide greater assurance of uninterrupted domestic well production in areas with competing uses and during droughts.

## Agricultural Chemicals in Ground Water

Agriculture and related products are a 37 billion dollar per year industry in Michigan. About 29 percent of Michigan's land use is agriculture. Agricultural chemicals greatly enhance the productivity of Michigan's cropland, yet are potential threats to safe, drinkable ground-water supplies. State and local agricultural and health agencies need to know the susceptibility of ground-water resources to contamination from agricultural chemicals to develop stewardship practices. During the 1980's, the Department of Natural Resources urged the USGS to study the relationship between agricultural land use and the occurrence

of agricultural chemicals in ground water. The USGS, in cooperation with county health agencies in Huron, Grand Traverse, Kalamazoo, Monroe, and Van Buren Counties completed water-resources studies in 5 major agricultural counties. In Kalamazoo County, which relies on a sole-source aquifer, the USGS sampled wells, located areas of contamination, and mapped the susceptibility of the aquifer to contamination. The Kalamazoo County Health Department used the USGS findings to recommend deeper wells in some areas, the expansion of municipal water systems, and to develop a ground-water protection strategy for the County. The USGS continues to play a vital role in protecting Michigan's ground water. The USGS is delineating recharge areas for municipal wells in the Greater Lansing Area to assist the Tri-County Regional Planning Commission in developing a regional wellhead protection plan. Additionally, the USGS provides technical assistance and guidance as a member of State and regional ground-water protection councils.

## Mapping of Glacial Deposits

The USGS has mapped the texture and thickness of glacial deposits across Michigan and converted the map to digital form for analysis and publication on a CD-ROM. A major use of the map is the construction of derivative maps for planning. For example, one derivative map uses the glacial-deposits map to show the susceptibility of shallow ground water to contamination by field application of agricultural chemicals. This statewide map has been used by the Michigan Department of Agriculture to prioritize areas for remedial assistance and for more detailed evaluations of contamination susceptibility.

## Collection of Streamflow Data

Michigan has an abundance of surface-water resources. In addition to inland lakes and the Great Lakes, there are 242 streams with a total length of 36,350 miles. Because of the State's peninsular configuration, 93 percent of the basins are entirely within State boundaries. Most of Michigan's population depends on surface-water supply. The USGS, in cooper-

ation with about 45 local, State, and Federal agencies, collects streamflow data at sites throughout the State. These data are critical for long-term management and day-to-day administration of water resources. Long-term data from the USGS stream-gaging network are used by various agencies to design bridges and culverts for predicted peakflows and for floodplain mapping to minimize flood damages. Hydroelectric utility operators, waste-water treatment plant operators, and the National Weather Service use streamflow data on a daily basis. Additionally, managers of fisheries and wildlife sanctuaries use USGS streamflow data during periods critical to maintaining suitable habitats for the fauna and flora they manage.

## Real-Time Flood Data

Major floods are infrequent in Michigan, but they can be severe. The September 1986 flood in Michigan caused more than 400 million dollars in damages to homes, businesses, utilities, governmental structures, and harvest-ready agricultural crops. A 28-county area was declared a Federal disaster area. The USGS statewide stream-gaging network served a critical need during and after the 1986 flood. Flood stage and streamflow were measured at 23 stream gages in eight major river basins discharging to Lake Michigan and Lake Huron. Real-time data from USGS stream gages were used by the National Weather Service to forecast floods, which reduced economic losses in flooded areas. The USGS also reported expected flood peaks and arrival times to hydroelectric utility operators who were able to manage storage and release of water at dams to reduce flooding. Information from the stream-gaging network was used to justify declaration of the Federal disaster area and for post-flood planning to reduce effects of future flooding.

## National Water Quality Assessment Program

The long-term goals of the National Water Quality Assessment (NAWQA) Program are to describe the status and trends in the quality of a large, representative part of the Nation's surface- and ground-water resources and to identify the natural and human factors that affect



**Figure 3.** Water-quality data-collection sites in Michigan

their quality. The NAWQA Program provides a wealth of water-quality information useful to policy-makers and water managers at the local, State, and national levels.

Two NAWQA Program studies are underway in Michigan—the Western Lake Michigan and the Lake Erie-Lake St. Clair. These studies benefit from a large amount of available USGS water-quality data in Michigan (fig. 3). A variety of reports to local, State, and Federal agencies are planned as results become available.

A critical requirement of the NAWQA program is up-to-date information on land use and land cover to determine their influence on water quality. The USGS, in cooperation with several other Federal agencies, is acquiring satellite image data for the entire United States. These data are processed according to a consistent standard, then forwarded to NAWQA

Program projects, as well as to other water-resource agencies, for water-quality research applications.

### Minerals Resource Assessment

Economic growth and development in the upper Midwest depend, in part, on the availability of local sources of minerals for use in industry, manufacturing, and maintaining and upgrading the region's infrastructure. Michigan has identified resources of iron, copper, nickel, and platinum-group minerals of national and global importance whose extraction and processing can form the basis for an enhanced regional economy. The USGS, in cooperation with the Michigan Geological Survey, is preparing an inventory of known mineral resources and an assessment of the potential for undiscovered mineral resources, based on geological, geophysical and geochemical studies. Maps and reports will assist Federal and

State land-management agencies, regional planners, industry, and local governments in ensuring adequate supplies of minerals at the lowest possible cost and promoting sound management of the region's substantial mineral resources.

### New Potential Oil and Gas Resources

The Michigan basin produces significant amounts of gas and oil. New potential gas resources in fractured shales are located in the deeper part of the basin. The USGS is initiating a project to investigate the structure, stratigraphy, fracturing mechanisms, reservoir characteristics, and the potential amount of resources that could be produced. In light of pressure to reduce hydrocarbon emissions and provide clean burning fuels, addition of a new gas supply to the nation is extremely important.

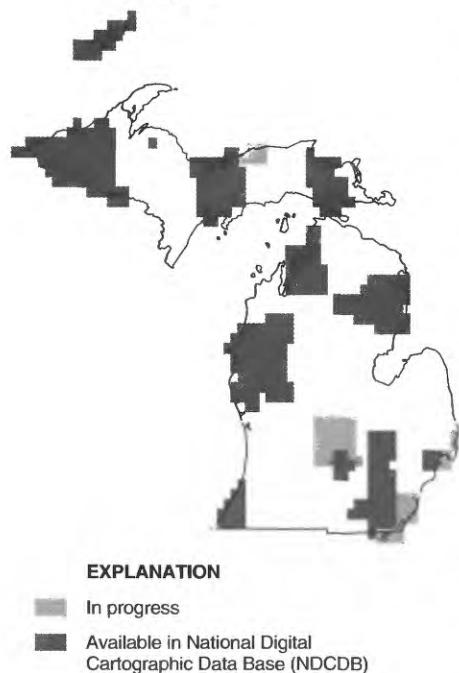
### Earth Observation Data

Through its Earth Resources Observation Systems (EROS) Data Center near Sioux Falls, South Dakota, the USGS distributes a variety of aerial photographs and satellite-image data products that cover the entire State. Mapping photos of some sites go back at least forty years. Satellite images can be used to study changes in regional landscapes dating from 1972.

### National Mapping Program

Among the most popular and versatile products of the USGS are its topographic maps at the scale of 1:24,000 (one inch on the map represents 2,000 feet on the ground). These maps depict basic natural and cultural features of the landscape, such as lakes and streams, highways and railroads, boundaries, and geographic names. Contour lines are used to depict the elevation and shape of terrain. The entire State is covered by 1,282 maps at this scale, which is useful for civil engineering, land-use planning, natural resource monitoring, and other technical applications. These maps have long been favorites with the general public for outdoor uses, including hiking, camping, exploring, and back-country fishing expeditions.

The USGS is cooperating with the U.S. Army Corps of Engineers, Detroit District, to produce digital elevation models, digital map features, and digital image photographs in southeast Michigan. These digital data can be used by the Corps or State and local agencies to produce composite maps for structural and environmental planning. Digital elevation models are available for many areas of the State (fig. 4).



**Figure 4.** 1:24,000-scale Digital Elevation Model (DEM) coverage for the State of Michigan.

## Geologic Information Centers

The Center for Environmental Geochemistry and Geophysics (CEGG) focuses on environmental geoscience research and information exchange. CEGG coordinates and supports basic and applied research on the natural and human-induced environmental effects associated with geologic sources—especially those related to mineral and energy resources and their development. Some examples of currently supported investigations include: environmental geochemistry of historic mining and smelting activities, behavior and transport of toxic elements in natural systems, and use of naturally occurring minerals as scavengers for toxic metals.

## Cooperative Programs

The USGS cooperates with more than 50 local, State, and Federal agencies in Michigan. Cooperators include county and municipal public works departments, public health agencies, natural-resource agencies, county and regional planning agencies, water and sanitation districts, and other Federal agencies. Cooperative activities include water-resources data collection, interpretive water availability and water-quality studies, mineral-resource assessments, and mapping. When local and State agencies are involved, activities typically are funded on a matching-funds basis. In addition to

agencies already mentioned, the USGS cooperates with the Michigan Department of Transportation, Michigan Department of Public Health, Tri-County Regional Planning Commission, the Bay Mills Indian Community, the Sault Ste. Marie Tribe of the Chippewa, to name only a few.

The USGS provides support to the Institute of Water Research at Michigan State University, which conducts a program of research, education, and information and technology transfer.

---

### For more information contact any of the following:

#### For water information

District Chief  
6520 Merchantile Way, Suite 5  
Lansing, Michigan 48911  
(517) 887-8903

#### For map information

Chief, Mid-Continent Mapping Center  
1400 Independence Road  
Rolla, Missouri 65401  
(314) 341-0880

#### For geologic information

Assistant Chief Geologist  
953 National Center  
Reston, Virginia 22092  
(703) 648-6660

#### Great Lakes Environmental Research

Laboratory  
USGS-Marine Geology  
2205 Commonwealth Blvd.  
Ann Arbor, Michigan 48105  
(313) 741-2041

#### Center for Environmental Geochemistry and Geophysics

Denver Federal Center Mail Stop 973  
Denver, Colorado 80225  
(303) 236-3301

#### Additional earth science information

can be found by accessing the USGS "Home Page" on the World Wide Web at "<http://www.usgs.gov>".

For more information on all USGS reports and products (including maps, images, and computerized data), call 1-800-USA-MAPS.