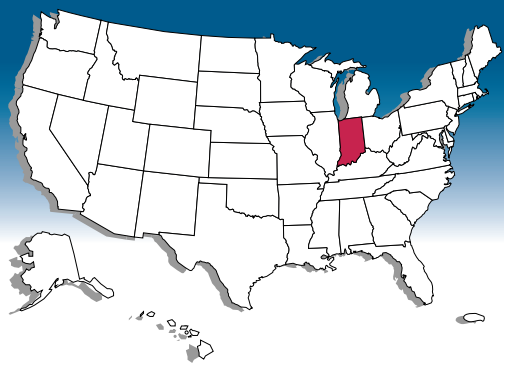
U.S. Geological Survey Programs in Indiana



U.S. Department of the Interior ■ U.S. Geological Survey

To make wise management decisions for the people of Indiana regarding the natural resources of the State, policymakers require accurate and objective geologic, topographic, biological, and hydrologic information. The U.S. Geological Survey (USGS) is a primary source of earthquake information, mineral data, energy sources, satellite imagery, and high-quality maps and maintains readily accessible data bases on surface and ground waters and water quality. Through cooperative work with local, State, and other Federal agencies, the USGS fulfills the need for this unbiased information.

In Indiana, the USGS has participated in studies that address the availability of ground water for public supplies, agriculture, and industry; locations and quality of mineral resources; flood-risk issues associated with land-use decisions; the effect of water shortages and drought; sources and amounts of sediments that flow in rivers and streams; rates at which selected lakes are being filled by sediments; amounts of pesticides and other chemicals that are reaching water supplies; and the extent of ground-water flow systems and the effects of those systems on pollutant migration and Indiana water supplies.

National Water-Quality Assessment Program

In 1991, the USGS began a study of the White River Basin in Indiana as part of the National Water-Quality Assessment (NAWQA) Program (fig. 1). The goal of the study is to determine water-quality conditions and trends in the surface and ground waters of the 11,349-square-mile Basin and to understand the factors that affect water quality. In particular, a wide variety of pesticides used in agriculture and urban areas is being monitored in surface and ground waters to determine concentrations and the frequency of their occurrence. Nitrogen and phosphorous also are being studied to determine if the major sources of these nutrients are agricultural or are discharges from sewage-treatment plants or combined-sewer overflows. The NAWQA Program is producing a wealth of water-quality information that is useful to policymakers and water managers at local, State, and national levels.

Topographic Mapping

Cooperative mapping programs between the USGS and the State of Indiana began in the 1920's. Among the most popular products are the topographic maps at the scale of 1:24,000 (1 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 the terrain. Indiana, which is covered by 710 maps at this scale, was the first State under the program to have complete coverage. The maps are used not only by engineers, scientists, and resource managers, but also by the general public who enjoy hiking, exploring, and other outdoor activities.

The current program emphasis is on converting the Indiana primary map series to a digital format for the growing number of computer applications, which include the State's digital data base. Digital map products have been developed by the USGS for Indiana at a scale of 1:100,000. These digital files are available by computer and are used by local, State, Federal, and private entities in resource assessments, technical investigations, and planning.

Figure 1. The White River Basin study area for the National Water-Quality Assessment Program.

Index of Subjects

Indiana Ground-Water Atlas

In Indiana, about 200 billion gallons of ground water are withdrawn each year for drinking water, energy production, and industrial, agricultural, and commercial uses. To address the need for a comprehensive publication that details information on water-bearing units in the State, the USGS published an atlas of aquifers in 1994. The atlas was a cooperative effort by the USGS, the Indiana Department of Environmental Management (IDEM), and the Indiana Department of Natural Resources (IDNR), Division of Water.

Ground-Water Studies

The St. Joseph aquifer system, which is the only sole-source aquifer in Indiana, was the focus of a cooperative study by the USGS and the IDNR. A sole-source aquifer is one that supplies 50 percent or more of the drinking water for an area and for which there are no reasonably available alternative sources should it become contaminated. In addition to collecting data to define the geology of the system, the investigation included development of a computer model to determine ground-water flow paths and to predict changes in water levels that result from

theoretical increased withdrawals. A ground-water-quality investigation includes comparisons of samples from the deep and shallow parts of the aquifer.

The disposal of refuse and treated waste is an issue that confronts citizens of Indiana and the Nation. The USGS, in cooperation with the Indianapolis Department of Public Works, investigated ground-water flows at landfills in Marion County. In one study, ground-water flow models were calibrated with data collected at the sites to determine the amount of water that flows through the landfills and if the leachate was reaching shallow aquifers and nearby streams. Another study focused on ground-water flow and water quality beneath sewage-sludge lagoons.

The USGS has conducted extensive studies on ground-water availability throughout the State, as well as studies that define regional ground-water flow systems. In a cooperative study, the USGS, the city of Elkhart, and the U.S. Environmental Protection Agency (USEPA) used a computer model to investigate the ground-water flow system that is accessed for Elkhart's public water supply. Results of the study indicated the extent to which adjacent commercial and industrial sites affect the ground-water flow system. In another study, the USGS, in cooperation with the IDNR, used a three-dimensional digital computer model to investigate the ground-water flow systems of a heavily irrigated area in Newton and Jasper Counties. Results of the study indicated that a clay confining unit is the most important component that controls the rate of recharge to the bedrock aquifer. Results also indicated that irrigation pumpage did not exceed recharge, even during dry years such as 1988, but may cause drawdowns that lead to conflict among ground-water users. The information gained from these types of studies was useful to water-resource planners and managers in the development of regional water-management policies.

Ecology of Aquatic and Terrestrial Ecosystems

The USGS's Biological Resources Division (formerly the National Biological Service) provides scientific data on Indiana's parks, beaches, and savannas to those Federal and State agencies responsible for managing these areas. The Lake Michigan Ecological Station in Porter, which is a field station of the Great Lakes Science Center (Ann Arbor, Michigan), conducts research on the effects of contaminants in aquatic ecosystems, principally on macroinvertebrate, plant, and animal communities. Studies are being conducted in several national parks, which include the Cuyahoga and the St. Croix National Scenic Riverways and the Grand Calumet Lagoons.

Current studies include investigations of the sources, extent, and fate of bacterial contamination, which has caused occasioal closures of some beaches in Indiana, and associated health-related problems. Oak savannas, which were once an extensive vegetation zone between prairie and forest across the Midwest, have been affected by human activity and altered by fire suppression. Studies are focusing on gathering information needed to determine the influence of fire on the savannas and to restore them on Lake Michigan dunes. The results of these research activities will provide information to enable managers of natural areas to understand better the relation between various factors within complex biological systems.

Southern Shore of Lake Michigan

In northwestern Indiana on the southern shore of Lake Michigan is a complex area of dunes, beaches, and wetlands. This area is adjacent to a highly industrialized zone. Because of the environmental stress created by the industrial activities, the zone is recognized by the International Joint Commission and the USEPA as one of the principal areas of concern in the Great Lakes Basin. For environmental managers and community planners to make knowledgeable decisions related to industrial, urban, and environmental issues, there is a need for an increased understanding of the hydrological, geological, and biological processes that occur in the lake shore area. To fulfill this need, cooperative studies have been conducted by many local, State, and Federal agencies. For example, in one cooperative study, the National Park Service (NPS) and the USGS investigated the hydrogeology and hydrochemistry of the dunes and wetlands.

The USGS and the IDEM cooperated on a number of studies in the industrial lakeshore area to address contamination issues and to define the complex interaction between ground and surface waters. In cooperation with the USEPA, ground-water-level and water-quality data have been collected to evaluate those interactions in areas of extensive industrial and waste-disposal activities.

The USGS operates acoustical velocity meters to monitor the flows at Burns Ditch at Portage, the Indiana Harbor Canal at East Chicago, and Trail Creek Harbor at Michigan City. By using acoustical technology, flow data can be collected even during periods of complex backwater conditions. Regulators and industrial site managers need the data to determine possible contaminant loads into the lake.

The quality and quantity of rain, snow, sleet, dew, or hail, in the Grand Calumet River watershed in northwestern Indiana was the focus of another study by the USGS and the IDEM. Selected major ions and trace metals were monitored by collecting weekly precipitation samples at the Gary Regional Airport from June 1992 through August 1993. Additional samples were collected from October 1995 through December 1996.

Coastal wetlands of Lake Michigan aid in protecting the drinking water and the shoreline communities of Indiana. Many physical, chemical, and man-made processes have interacted to cause the deterioration of these wetlands ever since the glaciers melted. A geographic information system (GIS) is being used to prepare maps that describe the development and history of wetlands. In addition to helping scientists understand geological limits on biodiversity, these maps are used to monitor the changes over time and to provide a predictive tool for the land-use planners, resource managers, and political representatives who are responsible for determining best-management practices. These investigations have required close cooperation between the USGS, the Indiana Geological Survey, the NPS, and the U.S. Fish and Wildlife Service.

Collection of Continuous Hydrologic Data

In response to the water-information needs of the individuals and agencies required to make important economic, environmental, and regulatory decisions, the USGS has been developing a long-term base of water-resources data in Indiana since the early part of the 20th century. In 1996, continuous-record data were collected at 166 streamflow-gaging stations (fig. 2), 6 stage-only stations, 80 lakes, and 94 ground-water observation wells. The IDNR, Division of Water, is the principal State agency that cooperates in USGS data-collection programs. Currently, more than 80 percent of the continuous hydrologic data-collection activity is maintained through efforts cooperatively funded by the IDNR and the USGS. Other cooperators in the data program include the U.S. Army Corps of Engineers (USACE), the IDEM, the Indiana Department of Transportation, and the Indianapolis Department of Public Works.

Effects of Wastewater Treatment on the White River

The USGS and the Indianapolis Department of Public Works have cooperated in numerous water-quality investigations of the White River and its major tributaries near Indianapolis. In the 1970's and 1980's, data collected before and after the construction of

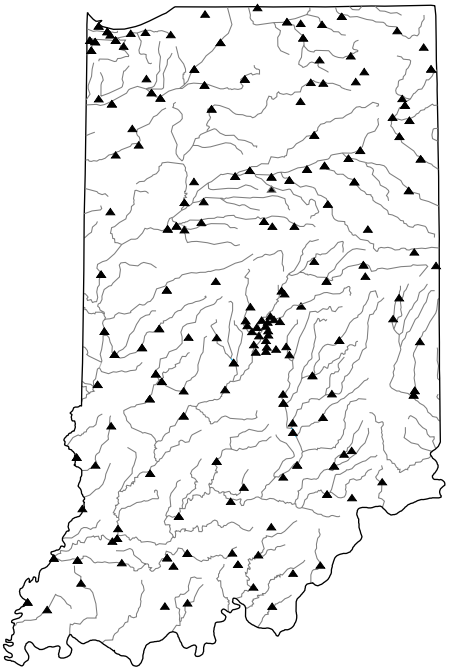


Figure 2. Locations of streamflow-gaging stations in Indiana in 1996.

advanced wastewater-treatment systems were analyzed to determine the effects of the improved treatment on the quality of the White River. In the late 1980's, the effects of storm runoff on water quality were investigated; one study focused on the effects of combined-sewer overflows on the water quality of the Fall Creek, which is a tributary to the White River. Current studies focus on examining the populations of selected aquatic organisms. Results of the studies complement earlier efforts to examine trends in water quality and aquatic ecosystem health of the White River.

Environmental and Industrial Uses of Mineral Resources

Economic growth and development in Indiana depend on continued availability of industrial minerals for use in construction, industry, manufacturing, and the maintenance and upgrading of the State's infrastructure.

Limestone and dolomite, which are the leading mineral commodities produced in the State, are rich sources of calcium and magnesium, respectively. In raw and unrefined form, these products have many environmental uses, particularly in cleaning smokestack emissions of coal-fired power stations. In addition, they are vital to medicine, agriculture, and residential consumption. Indiana is one of the Nation's leading producers of masonry cement from limestone. The USGS has begun an assessment of the undiscovered limestone and dolomite resources in Indiana and other States.

Oil and Gas Resources

Part of Indiana is underlain by the petroleum-producing Illinois Basin. Because the production history is well documented in this Basin, the amount of petroleum that has been produced can be compared with the potential total amount contained in source rocks. This information helps in estimating how much more petroleum can be produced. The USGS works closely with State agencies throughout the country in acquiring the data necessary to make such determinations. The USGS Energy Resources Program has published a National Assessment of Undiscovered Oil and Gas Resources in a series of three CD–ROM's in a Digital Data Series. In this series, information on Indiana oil and gas resources can be downloaded for use in a spreadsheet or a GIS.

Coal Mining

The Nation depends on coal as a major source of energy. Coal usage accounts for one-third of the total energy and more than one-half of the electricity generated in the United States. The use of coal is expected to increase during the next century to offset dependence on foreign oil and to sustain environmentally sound economic growth. Coal mining has an important role in the economy of southern Indiana.

The effects of coal mining on water quality and storm runoff have been studied in cooperative efforts between the USGS and the IDNR, Division of Water. The results of these studies have assisted resource managers in identifying and instituting responsible mining practices.

As part of a cooperative geological mapping program, the USGS is assisting the Indiana Geological Survey in mapping minable low-sulfur coal resources in the State. As part of the mapping program, the USGS also is assisting in the identification of coal beds and associated horizons by means of analyses of their microfossil content.

State Cooperatives in Coal-Resources Data

Resource managers, scientists, industry, and other government agencies require current standardized information on the location, quantity, and quality of coal resources. A joint venture between the USGS and the State Geological Surveys was initiated in 1975 to develop the National Coal Resources Data System (NCRDS). Currently, cooperative projects are ongoing with the 22 States that represent 98 percent of U.S. coal production.

A cooperative project between the USGS and the Indiana Geological Survey began in 1982 to collect, evaluate, and correlate drillhole, mine, and outcrop data; to encode and enter geologic and geochemical data into the NCRDS; and to access the NCRDS data bases and software to generate new maps, reports, and resource assessments. Continued data collection and support of the NCRDS data bases provide baseline information that can be accessed for annual State resource updates and to meet data needs as they arise.

Earthquake Hazards

In the past decade, there has been increasing awareness that the seismic hazard in the Eastern United States could be greater than the historic earthquake record suggests. Since 1875, this region has experienced at least 40 earthquakes that could be felt by residents. Recent discoveries have shown evidence of at least seven strong prehistoric earthquakes. An earthquake that had a magnitude of more than 7-1/2 struck about 6,000 years ago in the Wabash River Valley near the Indiana–Illinois border. Numerous prehistoric earthquakes of magnitude 6 to 7 have struck southern Indiana and Illinois. Geologic evidence of these earthquakes in the form of liquefaction-induced intrusions of sand and gravel in river sediments has been discovered at more than 100 widespread sites in the Wabash River Valley and along the River's tributaries. These intrusions permit the use of geologic, archaeological, and engineering techniques to determine when the earthquakes occurred, as well as their epicenters and approximate magnitudes. This work has been carried out in cooperation with the Indiana Geological Survey and archeologists from Indiana University.

Information about today's earthquake activity also is important to the citizens of Indiana. The National Earthquake Information Center, which is located in Golden, Colorado, collects, processes, and distributes information from more than 20,000 seismic events each year. This information is distributed in the form of alerts, bulletins, and routine catalogs to emergency-management officials at Federal and State levels, operators of critical facilities, the news media, the general public, and the earthquake-research community.

Earth Science Information Center

The Earth Science Information Centers (ESIC's) provide information to the public about USGS programs and products. The ESIC in West Lafayette was established under a cooperative agreement between the USGS and the Laboratory for Applications of Remote Sensing at Purdue University. As part of the national ESIC network, this office provides information on cartography, geography,

digital data, remote sensing, and land use. These types of information are useful to citizens throughout Indiana who are involved in land planning, resource management, and environmental monitoring and analysis.

Juday Creek Sediment Study

Juday Creek is a tributary of the St. Joseph River in St. Joseph County. With its low water temperatures, sand and gravel beds, and clear water, it is one of the few streams in Indiana that can support a brown trout population. Since the early 1980's, however, a decline in indicator insect species has caused concern about changes in the stream-water quality. In 1993 and 1994, the USGS, in cooperation with the IDNR and the St. Joseph County Drainage Board, conducted a study of these changes. Results indicated that although the observed amounts of suspended sediments would have no direct adverse effects on the trout, the movement of sand and gravel, which commonly are called bed-load materials, along the river bed, could be a threat to spawning and food supplies.

Lost River Investigation

The Lost River is one of the most fascinating hydrologic systems in the State (fig. 3). Above the Orangeville Rise, the River drains 163 square miles of scenic hills. The Lost River is characterized by sinkholes and streambed swallow holes into which most of the headwaters "disappear" near the central part of the watershed. The water that leaves the surface through these natural openings travels underground through fractures and joints of the limestone. Most of the water returns to the surface at the Orangeville Rise. The remaining water resurfaces at Twin Caves, Hamer Cave, Rise of Lost River, and other springs.

The Lost River Basin has been the subject of numerous studies for many decades. In 1993 and 1994, the USGS and the USACE conducted an investigation to define the ground-water drainage boundaries of the Basin better and to increase the understanding of the hydrogeology near the town of Orleans, which is subject to frequent flooding. Nontoxic fluorescent dyes were injected into the ground-water system at selected locations, and their reappearance was observed. On the basis of these observations, drainage boundaries were delineated, and the directions of underground flows were determined. In addition, hydrologic factors that contribute to flooding at Orleans were determined. This information can be useful to water-resource managers and planners in future flood-control designs.

Cooperative Programs

The USGS cooperates with numerous local, State, and Federal agencies to conduct a wide range of scientific investigations. When local and State agencies are involved, activities typically are funded on a matching-funds basis. In addition to agencies already mentioned, the USGS has conducted cooperative studies with the town of Carmel, the cities of Indianapolis, Muncie, and Seymour; the St. Joseph River Basin Commission; the Indiana Department of Highways; the U.S. Department of Defense; and others.

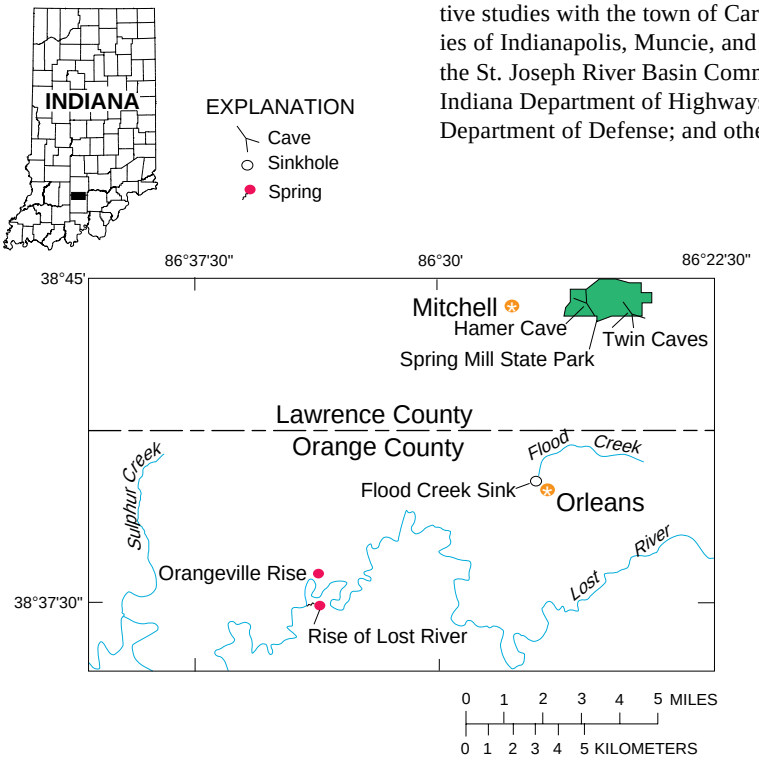


Figure 3. The Lost River study area.

For More Information

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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**

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

U.S. Geological Survey
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