WATER RESOURCE AVAILABILITY IN THE MAUMEE RIVER BASIN, INDIANA





STATE OF INDIANA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER

1996

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MAJOR ACRONYMS AND ABBREVIATIONS

DOW	Division of Water
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
IGS	Indiana Geological Survey
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
USACE	U.S. Army Corps of Engineers
BG	billion gallons
cfs	cubic feet per second
^{o}F	degrees Fahrenheit
I.C.	Indiana Code
m.s.l.	mean sea level
gpd	gallons per day
gpm	gallons per minute
MCL	maximum contaminant level
MG	million gallons
MGD	million gallons per day
mg/L	milligrams per liter
ml	milliliter
SMCL	secondary maximum contaminant level
sq. mi.	square miles

SELECTED CONVERSION FACTORS

Multiply	By	To obtain
	AREA	
Acres	43,560	Square feet
	0.001562	Square miles
	VOLUME	
Acre-feet	0.3259	Million gallons
	43,560	Cubic feet
	FLOW	
Cubic feet per second	0.646317	Million gallons per day
Gallons per minute	0.002228	Cubic feet per second
Gallons per minute	0.0014	Million gallons per day

WATER RESOURCE AVAILABILITY IN THE MAUMEE RIVER BASIN, INDIANA

INTRODUCTION

Water is a vital resource which greatly influences Indiana's socioeconomic development. Ground-water and surface-water supplies serve a diversity of human needs, ranging from non-withdrawal uses such as instream recreation to large water withdrawals for public supply, industry, power generation and agriculture. Demands on the water resource are expected to increase as Indiana's economy and population continue to grow. Effective management of the water resource is possible only through a continuing assessment of the interactions between water availability and use.

BACKGROUND AND APPROACH

Issues concerning water supply and use in Indiana historically have been addressed on a case-by-case basis. The need for a comprehensive approach to conservation and management of Indiana's water resource led to the 1983 enactment of the Water Resource Management Act (I.C. 14-25-7, previously I.C. 13-2-6).

Under this legislative mandate, the Natural Resources Commission must 1) conduct a continuing assessment of water resource availability, 2) conduct and maintain an inventory of significant withdrawals of surface water and ground water, and 3) plan for the development and conservation of the water resource for beneficial uses.

The legislation further mandates the continuing investigation of 1) low stream-flow characteristics, 2) water use projections, 3) the capabilities of streams and aquifers to support various uses, and 4) the potential for alternative water supply development.

The Indiana Department of Natural Resources, Division of Water, serving as the commission's technical staff, is achieving these legislative directives through ongoing investigations of water resource availability, water use, and conflicts involving limited water supply or competing uses.

Although conflicts between supply and demand typically are of a local nature, ongoing assessments of water availability and use are being conducted on a regional basis using the 12 water management basins designated by the Natural Resources Commission (figure 1).

A drainage basin, or watershed, is defined by the land surface divide that separates surface-water runoff between two adjoining regions (figure 2). A basin encompasses all of the land that eventually drains to a common river.

One disadvantage of using a drainage divide as the boundary of a water management unit is the potential oversight of factors that influence water resource issues but are located geographically outside of the basin. On the other hand, the basin approach allows local conditions or problems to be evaluated as parts of a unified hydrologic system. This integrated approach to a basin's water resource stems primarily from a recognition of the interrelated elements of the hydrologic cycle (figure 2), a continual exchange of water between the atmosphere and earth.

A comprehensive assessment of a basin's water resource requires an understanding of the socioeconomic setting, physical environment and hydrologic regime (figure 3). The complex interactions among these natural and manmade factors define the availability of a suitable water supply, which subsequently influences urban and industrial expansion, economic and agricultural development, and population growth. The water availability reports prepared by the Division of Water address these interactions in an attempt to comprehensively assess the water resource and its potential for further development.

PURPOSE AND SCOPE

This report describes the availability, distribution, quality and use of surface water and ground water in the Maumee River basin, Indiana, (figure 4). The fifth

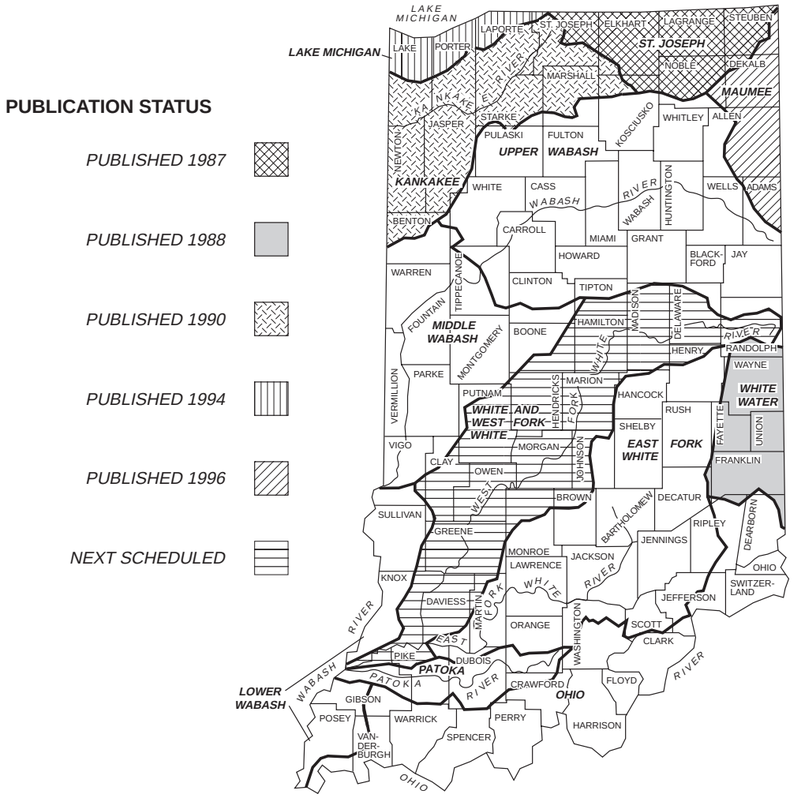


Figure 1. Location of Indiana water management basins and status of water availability reports

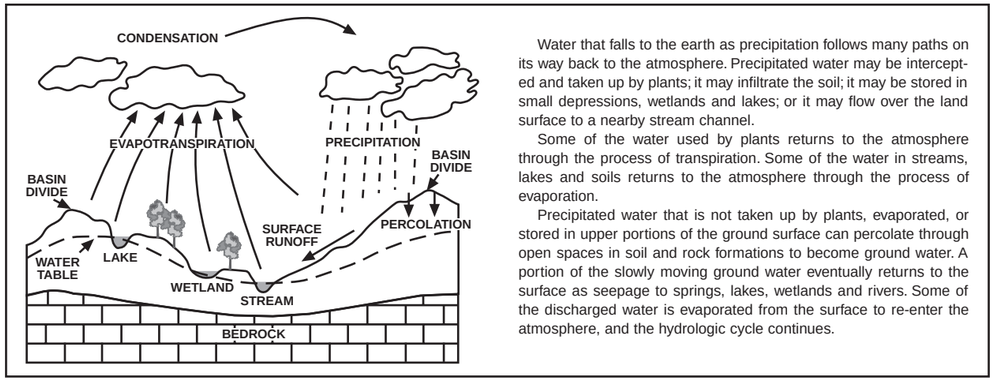
in a series of 12 regional investigations (figure 1), the report is intended to provide background hydrologic information for persons interested in managing or developing the basin's water resource.

The Maumee River basin in northeastern Indiana is dominated by its major population center, Fort Wayne and its surroundings. The city is located at the junction where the St. Marys and St. Joseph Rivers join to form the Maumee River. The location of Fort Wayne along the "three rivers" has made it a focus of commerce and trade, and has caused the city to experience major flooding when high flows occur in the St. Marys and St. Joseph Rivers simultaneously.

The basin's flat to gently rolling landscape is comprised of a nearly featureless plain in its midsection and surrounding arcuate uplands with intervening streams. The topography of the uplands that define the basin's boundary is pronounced in the north, subdued in the south, and nearly indistinct in the west.

Six counties lie partly within the Maumee River basin (table 1). The largest city within the basin is Fort Wayne, in Allen County. Other major population centers include Decatur, Auburn, and New Haven.

The study region is bounded on the northwest by the crest of the Packerton Moraine, on the north by the Michigan state line, and on the east by the Ohio state line. A low ridge in the south, the Wabash Moraine, separates the Maumee basin from the Wabash; and



Water that falls to the earth as precipitation follows many paths on its way back to the atmosphere. Precipitated water may be intercepted and taken up by plants; it may infiltrate the soil; it may be stored in small depressions, wetlands and lakes; or it may flow over the land surface to a nearby stream channel.

Some of the water used by plants returns to the atmosphere through the process of transpiration. Some of the water in streams, lakes and soils returns to the atmosphere through the process of evaporation.

Precipitated water that is not taken up by plants, evaporated, or stored in upper portions of the ground surface can percolate through open spaces in soil and rock formations to become ground water. A portion of the slowly moving ground water eventually returns to the surface as seepage to springs, lakes, wetlands and rivers. Some of the discharged water is evaporated from the surface to re-enter the atmosphere, and the hydrologic cycle continues.

Figure 2. Major components of Hydrologic cycle

the basin's western boundary is topographically indistinct. Approximately 4 percent of Indiana's land area lies within the Maumee River basin.

The Maumee River basin, as defined in this study, encompasses a total of approximately 1283 sq. mi. (square miles) of land in northeast Indiana. Streamflow leaving the basin enters the state of Ohio and eventually reaches Lake Erie.

Streams of the basin include the Maumee, St. Marys, St. Joseph Rivers, Cedar Creek, and an extensive network of smaller tributary streams and ditches. The natural hydrology has been altered considerably by removal of native forest and drainage of swampland for agriculture.

Although the Maumee River Basin drainage system covers parts of three states, this report examines only the Indiana portion unless otherwise indicated. In general, discussions apply to in-basin portions of Adams, Allen, DeKalb, Noble, Steuben, and Wells Counties.

Unless otherwise noted, data in this report are compiled only for areas lying within the study boundary. However, some economic, land use and agricultural information are for entire counties.

The information presented in this report should be suitable as a comprehensive reference source for public and private interests including governmental, agricultural, commercial, industrial, and recreational. However, the report is not intended for evaluating site-specific water-resource development projects. Persons involved in such projects should contact the Division of Water for further information.

The contents of this report follow the generalized scheme shown in figure 3. An overview of the population, economy, land use, and categories of water use is followed by a discussion of climate, geology, and soils. The report then describes the basin's surface-water and ground-water hydrology, including water quality. The final section of the report summarizes current and potential water use, and examines areas of past or potential conflicts between water demand and available water supply.

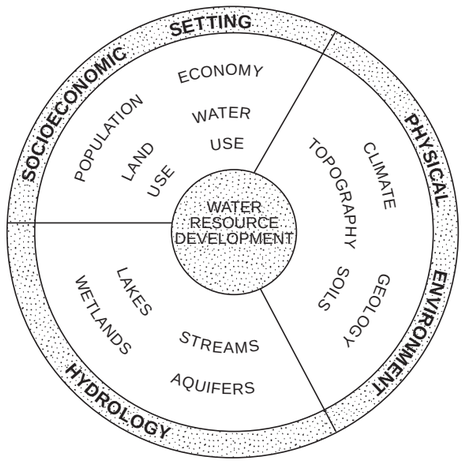


Figure 3. Factors influencing water availability

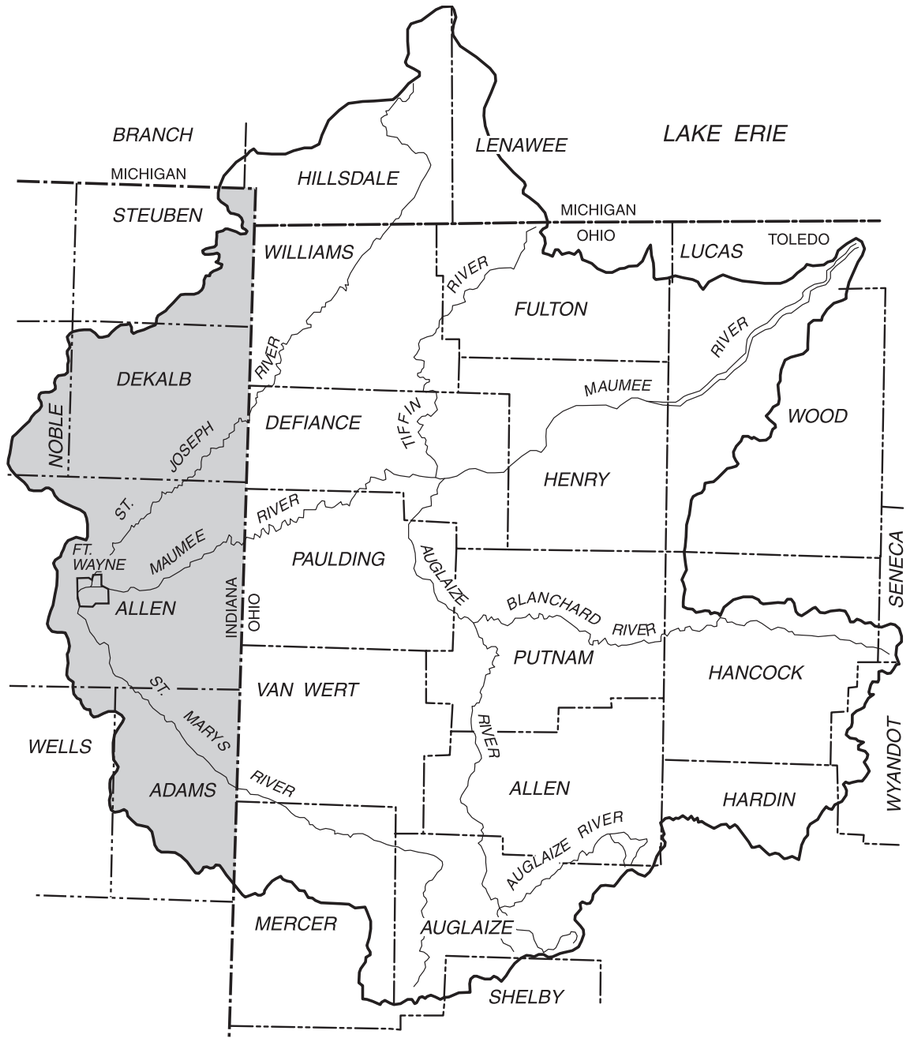


Figure 4. Location of Maumee River Basin

Because the report is written for a wide spectrum of readers, key technical words within the text are italicized the first time they appear, and where appropriate thereafter. Brief definitions are given in the glossary. An appendix includes data tabulations and illustrations which supplement the information found within the body of the report.

Water-use information presented in this report was derived from data compiled by the Division of Water on a continuing basis. Water-well records and other data on file at the division were used to define the hydrogeologic conditions of the basin.

Field investigations conducted by the Division of Water and the Indiana Geological Survey between 1988 and 1989 provided additional data on the geology and ground-water quality of the basin. In areas of sparse geologic data, down-hole geophysical information (natural gamma) was collected to better define the basin's geology and hydraulic characteristics of surficial materials. Collection and analysis of 100 water-well samples yielded information on ambient ground-water quality throughout the study region.

The remainder of the information in this report was derived, summarized, or interpreted from data, maps and technical reports developed by various state and federal agencies. Specific sources of data are referenced within the report, and a list of selected references is included at the end of the report.

Table 1. Area of Indiana counties within the Maumee River basin

County	Total area (sq mi)	In-basin area (sq mi)	Percent of total basin area
Adams	340	265	21
Allen	658	500	39
DeKalb	364	355	27
Noble	413	62	5
Steuben	308	74	6
Wells	370	27	2
Total	2453	1283	100

PREVIOUS INVESTIGATIONS

Because published and unpublished documents relating to the Maumee River basin in Indiana are numerous, only the primary sources used to prepare this report are discussed below. These primary documents and other major references are cited at the end of the report. Additional sources of information are listed within these cited references.

In 1960, the Ohio Department of Natural Resources developed a water inventory of the Maumee River Basin which focuses primarily on the portion of the basin within Ohio but includes information for Indiana. The inventory includes analyses of streamflow characteristics, ground water, and water use. The Great Lakes Basin Commission (GLBC) in 1975 and 1976 published a Great Lakes Framework Study which encompassed the Maumee River Basin. The GLBC study includes a framework study report, 25 appendix volumes, and an environmental impact statement. The framework study was developed to provide an information base, identify problems, and determine future needs for the Great Lakes Basin; it includes surveys of the physical, biological, social and political resources which make up the Great Lakes Basin.

As a result of the framework study, the Great Lakes Basin Commission, in 1976 and 1977 published "Level B" studies for the Maumee River Basin including the portion in Indiana. The Level B studies are a reconnaissance-level evaluation of water and land resources, more detailed in scope and more limited in area than framework studies (Level A). The Maumee River Basin Level B study includes status reports, a series of baseline reference papers, and technical papers.

A report by the Indiana Department of Natural Resources (1980) assesses various aspects of water availability and use for 18 planning and development regions in the state of Indiana. The Maumee River basin lies primarily in two of these regions. Topics addressed in the 1980 report include flood hazard mitigation, land use, soil erosion, sedimentation, water supply, water quality, drainage irrigation, fish and wildlife habitat, and outdoor recreation.

Various aspects of the geology and hydrology of several Indiana counties, lying wholly or partly within the Maumee River basin, are addressed in numerous reports by the Indiana Department of Natural Resources (IDNR) and the U.S. Geological Survey (USGS).

Maps and reports by the Indiana Geological Survey (formerly part of the Department of Natural Resources) describe the surficial and bedrock geology of northeastern Indiana (Wayne, 1956, 1958, 1963; Pinsak and Shaver, 1964; Burger and others, 1971; Johnson and Keller, 1972; Ault and others, 1973; Becker, 1974; Bleuer and Moore 1972 and 1975; Bleuer, 1974, 1989, 1991; Doheny and others, 1975; Gray, 1982, 1983, 1989; Droste and Shaver, 1982, 1983; Shaver and others 1986; Gray and others 1987; and Rupp, 1991. Cooperative efforts within the IDNR between the Geological Survey and the Division of Water produced reports linking the geology and

ground water of the basin. Foley and others (1973) report on strontium and other notable ground-water chemistry constituents in Allen County. Various aspects of geology important to environmental planning in Allen County are presented by Bleuer and Moore, 1978. Fleming (1994) reports on the hydrogeology of Allen County. In an unpublished 1994 paper, Fleming interprets the glacial geology of the Maumee River basin in Indiana as part of a cooperative data collection effort between the Geological Survey and the Division of Water.

Primary references from the IDNR Division of Water include Herring (1969) and Bruns and others, 1985. Herring identifies principal aquifers, transmissivity values, average annual recharge, potential yields, and ground-water quality in the Maumee River basin in Indiana. Bruns and others map the bedrock topography of the Teays Valley and its major tributaries.

The U.S. Geological Survey (USGS), in cooperation with the Division of Water, IDNR (formerly Department of Conservation), produced ground-water resource studies for two of the counties within the basin: Stallman and Klaer, 1950, for Noble County, and Watkins and Ward, 1962, for Adams County. The Adams County report includes information on ground-water quality.

Other U.S. Geological Survey publications which address ground water resources in the basin include: Pettijohn and Davis, 1973, which provides a hydrologic atlas of ground-water and surface-water resources of the Maumee River basin in Indiana; Planert, 1980, which models ground water and streamflow for a 700 square mile area in northwestern Allen County; and Greeman (1994) which describes and delineates aquifers in the Maumee River basin in Indiana at a scale of 1:500,000 as part of a hydrogeologic atlas of aquifers in Indiana.

In addition to agency reports, investigations published by Ferguson (1992) and Ferguson and others (1991 and 1992) provide insight into the hydrogeology, hydrogeochemistry, and recharge characteristics of fine-grained glacial till deposits in northeastern Indiana.

Streamflow characteristics of the Maumee River basin in Indiana are defined primarily in U.S. Geological Survey (USGS) publications: Stewart and others, 1994, provide water-resources data for Indiana, water year 1993; and Fowler and Wilson, 1996, provide low-flow characteristics of Indiana streams.

Flooding, a major concern in the basin, has been addressed from several perspectives by numerous authors. The U.S. Army Corps of Engineers (USACE) has been extensively involved in investigations of flooding on various reaches of the Maumee River and its tributaries in the basin, including: (1959,1967, 1968, 1974, 1976, and 1987). The U.S. Geological Survey has also analyzed specific floods: Hoggatt (1981) reports on floods of March 1978 in the Maumee River basin, northeastern Indiana; and Glatfelter and others (1984 and 1988) examines the floods of March 1982 in Indiana, Ohio, Michigan, and Illinois.

Other federal agencies studying flooding in the basin include: U.S. Department of Agriculture (USDA) and the Federal Emergency Management Agency (FEMA). The USDA, Soil Conservation Service (now, Natural Resources Conservation Service) prepared flood hazard analysis reports for Fairfield Ditch and Spy Run Creek in 1972. The Federal Emergency Management Agency (FEMA) has prepared flood insurance studies for several streams in the basin (1981a, 1981b, 1987, 1989a, 1989b, and 1990).

In addition to federal agency involvement in basin flooding issues, Allen County and Fort Wayne have prepared a flood protection plan (1982). Private consultants have also addressed flood-related issues in the basin: Turnbell (1986); Snell Environmental Group, Inc. (1993 and 1994); and Christopher B. Burke (1994 and 1995).

A Maumee River flood control feasibility study (1986) was prepared for the Allen County Commissioners by Turnbell Engineering. Snell Environmental Group, Inc. prepared a draft-hydraulic report for Cedar Creek, Little Cedar Creek and Black Creek (1993) and a Maumee River Basin hydraulic report, phase 2, for the St. Marys River, Yellow Creek and Blue Creek (1994).

A series of six interrelated reports were generated in connection with the Maumee River Basin Flood Control Master Plan. The first report, published by the Maumee River Basin Commission in 1993, is an introduction for flood control and resource management in northeast Indiana. The report includes information on: the history of flooding in the area, resources and economy of the basin, development and environmental trends, water quality and use, flooding, erosion and sedimentation problems, and a summary of the master planning process. The second through the sixth volumes of the series, prepared by Christopher B. Burke Engineering, Ltd., 1994 and 1995, provide a detailed account of the nature and severity of flood damages in the basin; the Maumee River Basin Flood Control Master Plan main report; appendices; and a public comment response document.

ACKNOWLEDGEMENTS

The following divisions of the Indiana Department of Natural Resources (IDNR) provided valuable data and assistance during the preparation of this report: Fish and Wildlife, Forestry, Nature Preserves, Soil Conservation, Outdoor Recreation, and Geological Survey (now part of Indiana University). The following organizations also made significant contributions: Indiana Department of Environmental Management; Indiana State Department of Health; Indiana State Library (Indiana Division, Government Documents, Data Center); Indiana Business Research Center; U.S. Department of Interior (Fish and Wildlife; Geological Survey, Water Division); U.S. Environmental Protection Agency (Region 5); and U.S. Department of Agriculture (Resource Conservation Service). Ken Scheeringa, the State Climatologist, provided climatic data for the Maumee River basin.

The authors of this report thank residents of the Maumee River basin for their cooperation during a 1988 ground-water sampling project. In addition, well-drilling contractors contributed water-well records and cooperated with a gamma-ray logging project.

The project manager extends special appreciation to former staff members of the Basin Studies Section: Michael A. Smith, Rajindra Gosine, Kimberly A. Wade, and Cynthia J. Clendenon for the invaluable contributions they made to the study. Temporary employees Ann Kroll and Stacy Bellavia also contributed to the production of this report. Ann Kroll developed tables and text for various parts of the report, and Stacy Bellavia generated several geographic information system (GIS) maps for the publication.

The Ground Water Section within the Division of Water developed the Aquifer Systems and Potentiometric Surface maps in addition to portions of the text in the Ground-Water Hydrology chapter of the report.

Draftsman Jeffrey S. Foreman prepared most of the drafted figures in the report, and Information Specialist Ed Reynolds prepared the layout and camera-ready copy.