CURRENT WATER-RESOURCES ACTIVITIES IN OHIO, 1987

Compiled by Charlene C. Vince

U.S. GEOLOGICAL SURVEY

Open-File Report 87-102

Columbus, Ohio

1987

DEPARTMENT OF THE INTERIOR

DONALD PAUL HODEL, Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information write to:

District Chief
Water Resources Division
U.S. Geological Survey
975 W. Third Avenue
Columbus, Ohio 43212

Copies of this report can be purchased from:

U.S. Geological Survey
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Box 25425, Federal Center
Denver, Colorado 80225

FOREWORD

The U.S. Geological Survey, Water Resources Division, has been active in water-resource investigations in Ohio for more than 70 years. During that time, volumes of data have been collected, numerous investigations completed, and more than 150 reports published on various aspects of Ohio's water resources. Many changes have taken place in the Geological Survey and the Water Resources Division since its formation in 1879, but our mission remains firm--"to provide the hydrologic information and understanding needed for the optimum utilization and management of the Nation's water resources for the overall benefit of the people of the United States." As the water resources of Ohio become increasingly important to its economy and quality of life, the Ohio District's role as an unbiased water resource investigation and data-collection agency also becomes increasingly important.

Over the years the District's programs have reflected the needs of the people and priority issues of the times. We have evolved from the early days of ground- and surface-water reconnaissance studies into flood and low-flow studies, projects associated with energy production, and finally, into studies relating to toxic- and hazardous-waste disposal. Through all of this, the district has continued to expend a considerable amount of its resources in collecting and disseminating basic data on surface water, ground water, water quality, and sediment.

Our present program centers on four areas: Basic hydrologic data collection, surface-water modeling, coal-mine reclamation, and ground-water assessment. In all of the above areas, chemical quality of the resource is an important factor. In fact, I feel that water quality will become the overriding concern in all water-resource investigations through the remainder of the 1980's and into the 1990's. The use of computers and digital modeling will continue to be an integral part of all investigations.

The next few years promise a growth of new projects directed toward contamination of ground and surface waters and associated effects on hydrologic systems. To meet this need, the district will correspondingly increase its technical expertise in the fields of geohydrology and organic geochemistry. I look forward to the U.S. Geological Survey's active role in these activities and a continuing relationship with State, county, local, and other Federal agencies in studying the water-resource issues of Ohio.

Steven M. Hindall,
District Chief

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ABSTRACT

The mission of the U.S. Geological Survey's Water Resources Division is to provide the hydrologic information and understanding needed for the optimum utilization and management of the Nation's water resources for the overall benefit of the United States. This report summarizes the Division's program in Ohio in 1987.

The work of the Ohio District is carried out through the District office in Columbus and a field office in New Philadelphia. Collection of basic data needed for continuing determination and evaluation of the quantity, quality, and use of Ohio's water resources is the responsibility of the District's Hydrologic Surveillance Section. The Hydrologic Investigations Section conducts analytical and interpretive water-resource appraisals describing the occurrence, availability, and the physical, chemical, and biological characteristics of surface and ground water.

In addition to introductory material describing the structure of the Ohio District, information is presented on current projects, sites at which basic surface- and ground-water data are collected, and reports on Ohio's water resources published by the U.S. Geological Survey and cooperating agencies.

INTRODUCTION

Origin of the U.S. Geological Survey

The U.S. Geological Survey was established by an act of Congress on March 3, 1879, to provide a permanent Federal agency to conduct the systematic and scientific "classification of the public lands, and examination of the geological structure, mineral resources, and products of national domain." An integral part of that original mission includes publishing and disseminating the earth-science information needed to understand, to plan the use of, and to manage the Nation's energy, land, mineral, and water resources.

Since 1879, the research and fact-finding role of the Survey has grown and been modified to meet the changing needs of the Nation it serves. As part of that evolution, the Survey has become the Federal Government's largest earth-science research

agency, the Nation's largest civilian mapmaking agency, the primary source of data on the Nation's surface- and ground-water resources, and the employer of the largest number of professional earth scientists. Today's programs serve a diversity of needs and users. Programs include:

- Conducting detailed assessments of the energy and mineral potential of the Nation's land and offshore areas.
- Investigating and issuing warnings of earthquakes, volcanic eruptions, landslides, and other geologic and hydrologic hazards.
- Conducting research on the geologic structure of the Nation.
- Studying the geologic features, structure, processes, and history of the other planets of our solar system.
- Conducting topographic surveys of the Nation and preparing topographic and thematic maps and related cartographic products.
- Developing and producing digital cartographic data bases and products.
- Collecting data on a routine basis to determine the quantity, quality, and use of surface and ground water.
- Conducting water-resource appraisals in order to describe the consequences of alternative plans for developing land and water resources.
- Conducting research in hydraulics and hydrology, and coordinating all Federal water-data acquisition.
- Using remotely sensed data to develop new cartographic, geologic, and hydrologic research techniques for natural resources planning and management.
- Providing earth-science information through an extensive publications program and a network of public access points.

Along with its continuing commitment to meet the growing and changing earth-science needs of the Nation, the Survey remains dedicated to its original mission to collect, analyze, interpret, publish, and disseminate information about the natural resources of the Nation--providing "Earth Science in the Public Service."

Basic Mission and Program of the Water Resources Division

The mission of the Water Resources Division is to provide the hydrologic information and understanding needed for the optimum utilization and management of the Nation's water resources for the overall benefit of the people of the United States.

This is accomplished, in large part, through cooperation with other Federal and non-Federal agencies, by:

- Collecting, on a systematic basis, data needed for the continuing determination and evaluation of the quantity, quality, and use of the Nation's water resources.

- Conducting analytical and interpretive water-resource appraisals describing the occurrence, availability, and the physical, chemical, and biological characteristics of surface and ground water.

- Conducting supportive basic and problem-oriented research in hydraulics, hydrology, and related fields of science to improve the scientific basis for investigations and measurement techniques and to understand hydrologic systems sufficiently well to quantitatively predict their response to stress, either natural or manmade.

- Disseminating the water data and the results of these investigations and research through reports, maps, computerized information services, and other forms of public releases.

- Coordinating the activities of Federal agencies in the acquisition of water data for streams, lakes, reservoirs, estuaries, and ground waters.

- Providing scientific and technical assistance in hydrologic fields to other Federal, State, and local agencies, to licensees of the Federal Power Commission, and to international agencies on behalf of the Department of State.

- Administering the provisions of the Water Resources Research Act of 1984, which include the State Water Resources Research Institutes and the Research Grants and Contracts Programs.

- Supporting the provisions of the National Environmental Policy Act of 1969 and managing the Geological Survey conduct of natural resources surveys in response to the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund Act) of 1980.

Organization and Activities of the Ohio District

Organization

The Ohio District is part of the U.S. Department of the Interior, Geological Survey, Water Resources Division. There are a total of 42 districts throughout the country located in each individual state, with the exception of four districts encompassing two or more states.

The Ohio District is comprised of the district office in Columbus and a field office in New Philadelphia. There are two major sections in the district office--Hydrologic Investigations and Hydrologic Surveillance. The New Philadelphia field office is part of the Hydrologic Surveillance section.

Steven M. Hindall, District Chief, is responsible for the overall operation and management of the district, and is assisted by Section Chiefs Richard V. Swisshelm, Jr., and Harold L. Shindel. To carry out the diversity of tasks in support of its varied program, the Ohio District's additional 45-member staff consists of hydrologists, hydrologic technicians, and other administrative, clerical, and support personnel.

The chart on page 6 depicts the organization of the Ohio District and explains the functions of the individual sections and units within those sections.

Types of Funding and Cooperating Agencies

Funds to support the work performed by the Ohio District, Water Resources Division, are derived from three principal sources:

- Federal Program--Funds for the Federal Program are appropriated by the Congress, and are specifically identified in the annual Geological Survey budget. These funds are used to support research, data collection, high-priority topical programs including energy-related programs, the coordination of all Federal programs related to collection of water data, and internal support services.

- Federal-State Cooperative Program--Federal funds are appropriated by the Congress and used to match those furnished by State and other tax-supported agencies on a 50-50 basis. These funds funds are used for a variety of hydrologic data-collection activities and water-resources investigations in which the Water Resources Division represents the national responsibilities and the cooperating agencies represent State and local interests.

- Other Federal Agencies (OFA) Program--In this program, the funds are transferred to the Geological Survey as reimbursement for work performed at the request of another Federal agency.

The Ohio District's 1987 Fiscal Year programs; agencies that had signed cooperative agreements as of January 1, 1987; funds allocated; and percentages of total budget are listed by category below:

Federal Program.....	$ 196,000	(8%)
Federal-State Cooperative Program.....	1,796,000	(71%)
Ohio Department of Natural Resources Division of Water Division of Reclamation Division of Natural Areas & Preserves		
Ohio Department of Transportation		
Ohio Environmental Protection Agency		
Miami Conservancy District		
Williams County		
City of Columbus		
City of Northwood		
City of Akron		
Geauga County		
Lucas County		
Sandusky County		
Wood County		
Ross County		
Seneca Soil & Water District (Heidelberg College) (Heidelberg College)		
City of Canton		
City of Toledo		
City of Fremont		
Other Federal Agencies Program.....	540,000	(21%)
U.S. Army Corps of Engineers Federal Emergency Management Agency U.S. Department of Interior (OSM)		
TOTAL.....	$2,532,000	

U.S. Geological Survey
Water Resources Division
Ohio District

March 11, 1987

OFFICE OF THE DISTRICT CHIEF

S.M. Hindall — **District Chief GM-14**
J.E. Hinterschied — Secretary — GS-6

Administrative Services Unit

H.K. Fugitt	**AdminOff**	**GS-11**
S.J. Beck	Clk(Typ)	GS-5
J.A. Sturtz	AdminClk	GS-5
T.L. Arebalo	StuTra (AcctMaintClk)	GS-2 **(JP)**

HYDROLOGIC SURVEILLANCE SECTION

H.L. Shindel	**SectionChfHydr**	**GM-13** a/
M.S. Katzenbach	HydrolTech	GS-12
J.A. McClure	HydrolDataAsst	GS-6

Area 1: Scioto and Muskingum Basins

J.H. Klingler	HydrolTech	GS-11
D.F. MacFadden	HydrolTech	GS-9
D.J. Shifflet	HydrolTech	GS-8

Area 2: Maumee, Miami and Sandusky Basins

J.P. Mangus	HydrolTech	GS-11
S.A. Vivian	HydrolTech	GS-9
S.W. Hatch	HydrolTech	GS-8 d/

****

NEW PHILADELPHIA FIELD OFFICE *

Area: Cuyahoga, Tuscarawas, Mahoning, Conneaut, Muskingum Basins

L.E. Trimble	**SupvHydrolTech**	**GS-11**
L.M. Hicks	HydrolTech	GS-9
C.A. Hawkins	HydrolTech	GS-8

Computer Services Unit *

V.E. Nichols	Hydrologist	GS-11
A.E. Arnett	InfoMgmtAsst	GS-7 e,f/
J.J. Welday	CompProg	GS-7
G.F. Ward	CompAsst	GS-6

Laboratory Services Unit *

B.B. Palcsak	HydrolTech	GS-7
J.C. Boyle	PhySciAid	GS-1 **(PT)**

*** Reports to Hydrologic Surveillance Section**

****

- KEY -

a/Training Officer
b/Reports Specialist
c/FWP Coordinator
d/Safety Officer
e/NAWDEX LAC Officer
f/Information Officer
g/EEO Officer
h/SW Specialist (Vacant)
i/GW Specialist
j/QW Specialist

Reports Processing Unit

C.M. Eberle	TechPub/Ed	GS-11b/
R.P. Frehs	SciIllus	GS-9
C.C. Vince	EdAsst	GS-6
L.D. Camp	RptProClk	GS-5c/

HYDROLOGIC INVESTIGATION SECTION

R.V. Swissheim, Jr., SectionChfHydr GM-13

E.S. Bair	Hydrologist	GS-13(WAE)
Vacancy	Hydrologist	GS-12h/
C.J. Childress	Hydrologist	GS-12j/
J.T. de Roche	Hydrologist	GS-12i/
J.Hren	Hydrologist	GS-12
K.J. Breen	Hydrologist	GS-11
D.D. Brooks	HydrolTech	GS-11
G.F. Koltun	Hydrologist	GS-11(PT)
D.N. Myers	Hydrologist	GS-11(WAE)
J.W. Roberts	Hydrologist	GS-11
A.C. Sedam	Hydrologist	GS-11
J.M. Sherwood	Hydrologist	GS-11
A.W. Coen, III	Hydrologist	GS-9
S.M. Eberts	Hydrologist	GS-9
K.S. Jackson	Engineer	GS-9
C.N. Owens	HydrolTech	GS-9g/
K.S. Wilson	Hydrologist	GS-9
R.L. Jones	HydrolTech	GS-8
A.L. Jones	Hydrologist	GS-7
Vacancy	Hydrologist	GS-7

Public-Information and Public-Service Activities

The activities of the Ohio district staff are not confined to project work. Much of the daily activity of the staff is devoted to answering requests from landowners, public officials, and business concerns on a wide range of hydrologic and geologic topics. For example, the Ohio district spent approximately 350 hours answering nearly 700 telephone and mail inquiries during 1986.

District personnel also are involved in education. Staff hydrologists and hydrologic technicians have served as instructors and guest lecturers for water-resources courses at Ohio State University, Ohio University, and Central State University. The district also has sponsored seminars and information-exchange meetings with themes ranging from well design to political and social water-resources issues in Ohio.

Equally important is the involvement of district staff in work groups, committees, and task forces of professional societies and other government agencies. Among these groups are:

- Technical Committee and Toxic Strategy Subcommittee of the Ohio River Valley Water Sanitation Commission (ORSANCO).
- Public Advisory Groups and the Phosphorus-Reduction Task Force of the Ohio Environmental Protection Agency.
- Program Review Panel for the Ohio State University Water Resources Center.
- Steering Committee for the Ohio Water Seminar Luncheon Series.
- Board of Directors of the Ohio Lake Management Society.
- The Ohio State University Student Chapter of the American Society of Civil Engineers (advisory role as Student Contact Member).

Summary of Water Conditions in Ohio

The availability of water has been an important factor in Ohio's development. Ohio's principal streams (fig. 1) were the settlers' first avenues of transportation and their first sources of power for manufacturing. Shallow, hand-dug wells provided water to a growing farm population. The construction of canals beginning in 1825 continued to encourage the growth of cities and industries and stimulate agricultural production. Today, Ohio is still characterized by a diverse economy in which water resources play a vital part.

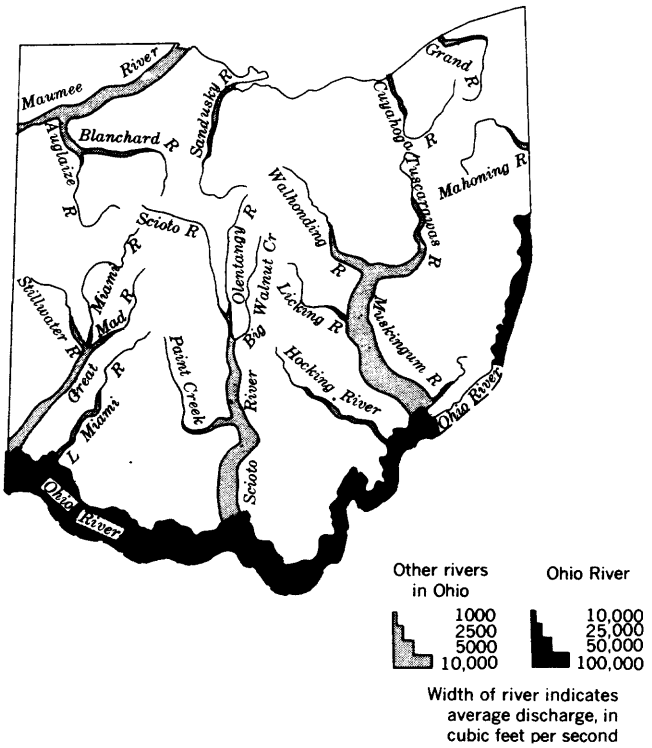


Figure 1.--Average discharge of principal streams in Ohio.

Ohio receives about 38 inches of precipitation annually. About 10 inches runs off immediately, 2 inches is retained at or near the surface and evaporates or transpires, and 26 inches enters the ground. Of the 26 inches that enters the ground, 20 inches is retained in the unsaturated zone and is later lost by evapotranspiration. The remaining 6 inches reaches the water table. Of this 6 inches, 2 inches is eventually discharged to streams, and and the rest is lost by evapotranspiration or consumptive use.

Ohio's water problems tend to be localized. Generally, these problems involve excess water (flooding or poor drainage) or water quality.

Ohio has serious local flooding nearly every year. Most Ohio floods are either flash floods resulting from intense summer thunderstorms or large-stream floods resulting from a combination of rain and snowmelt. Accelerated erosion of bare ground and streambanks and deposition of sediment in stream channels, culverts, and drainage ditches are negative side effects of flooding. Nine projects are active in the Ohio District in 1987 that directly or indirectly contribute to our knowledge of flooding and (or) related sedimentation problems in the State.

The focus of concern about Ohio's water quality in recent years has been on waste disposal and its effects on ground-water quality. Despite the predominance of surface water in terms of total withdrawal, the importance of ground water to Ohio cannot be overlooked. Nearly 80 percent of the public water-supply systems in the State depend to some extent on ground water as a source. Of the ten ground-water projects active in the Ohio District in 1987, two deal specifically with waste-disposal sites. Both are scientific studies to describe local ground-water levels and flow and to provide baseline water-quality data near the sites. (The other eight ground-water projects are resource appraisals.)

INFORMATION CONTAINED IN THIS REPORT

Information is presented in the remainder of this report in four parts: (1) A listing and brief description of current projects, (2) a listing of surface-water hydrologic data stations, (3) a listing of ground-water hydrologic data stations, and (4) selected references on Ohio hydrology. The first part contains information on the status of all projects in which there has been activity during 1987. Further information concerning project activities is available from the project leader or from Richard V. Swisshelm, Jr., Chief, Hydrologic Investigations Section. The second and third parts contain tables showing station numbers, station names, and types of data collected. Further information on statewide station activities, unpublished records, or provisional data prior to publication is available from Harold L. Shindel, Chief, Hydrologic Surveillance Section. The fourth part is a selected list of reports issued by the U.S. Geological Survey and its cooperating agencies concerning hydrologic investigations in Ohio. Further information on these reports is available from Ann E. Arnett, Information Officer for the Ohio district.

These contact people can be reached at:

District Office
Water Resources Division
U.S. Geological Survey
975 W. Third Avenue
Columbus, OH 43212
(614) 469-5553

Information about data-collection activities in northeastern Ohio also can be obtained by contacting:

Lowell Trimble
New Philadelphia Field Office
Water Resources Division
U.S. Geological Survey
551 Wabash Avenue, P.O. Box 272
New Philadelphia, OH 44663
(216) 343-2343

OTHER INFORMATION AVAILABLE

The U.S. Geological Survey publishes an annual series of reports titled "Water Resources Data--Ohio," in which the hydrologic data collected during each water year are presented. Information about these reports and how to obtain them is available from the district office at the address and phone number given above.

Flood-prone-area maps for selected parts of Ohio also are available from the district office. These maps were prepared in cooperation with the U.S. Department of Housing and Urban Development, Federal Insurance Administration, to serve as guides for public agencies and private citizens concerned with present and future land development. The maps were prepared on standard 7-1/2 minute topographic quadrangles, and show the approximate area subject to inundation by a 100-year flood.

CURRENT PROJECTS

The project descriptions that follow show the project number, title, period of the project, cooperating agencies, project leader, purpose of the project, and progress and significant results.

SURFACE-WATER STATIONS
(OH001)

Period of Project:
Continuous since October 1915

Project Leader:
Harold L. Shindel

Cooperators:
Ohio Department of Natural Resources
City of Columbus
Miami Conservancy District
Ohio Environmental Protection Agency
City of Canton
U.S. Army Corps of Engineers
Seneca Soil and Water District
Ross County
City of Fremont

Purpose: To provide a surface-water data base through collection, analysis, and publication of records for gaging stations and selected sites along streams, lakes, and reservoirs throughout Ohio. The gaging-station network is operated in cooperation with other Federal, State, and local agencies. The surface-water data base provides information for research purposes of surveillance, planning, design, hazards warning, accounting systems, operation, and management in various water-related fields.

Progress and significant results: Field data were collected on schedule and prepared for publication (1986 water year). Network maintenance was continued, including modernization equipment in places to improve record quality. Modifications to the network, such as additions or deletions of stations or data-collecting activity, were made in response to program's needs.

GROUND-WATER STATIONS
(OH002)

Period of Project:
Continuous since January 1938

Project Leader:
Stephen A. Vivian

Cooperator:
Ohio Department of Natural Resources

Purpose: To observe the effects on ground-water quantity and quality exerted by such factors as climatic variations and withdrawal patterns. Water-level data are collected to provide a data base against which short- and long-term fluctuations can be compared for proper planning and management.

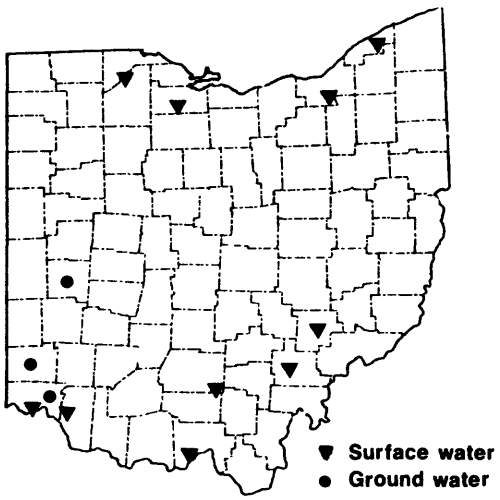
Progress and significant results: Field data were collected and processed on schedule. Network currently consists of 10 sites with continuous recorders, 13 sites with periodic measurements, and 89 state-operated sites with continuous recorders.

WATER-QUALITY STATIONS
(OH003)

Period of Project:
Continuous since January 1946

Project Leader:
Betty B. Palcsak

Cooperators:
Miami Conservancy District
Ohio Environmental Protection Agency



Purpose: To collect, analyze, and publish water-quality records for selected sites in Ohio in cooperation with State and local agencies. The records contribute to a national water-quality data base requisite to nationwide and regional planning and action programs.

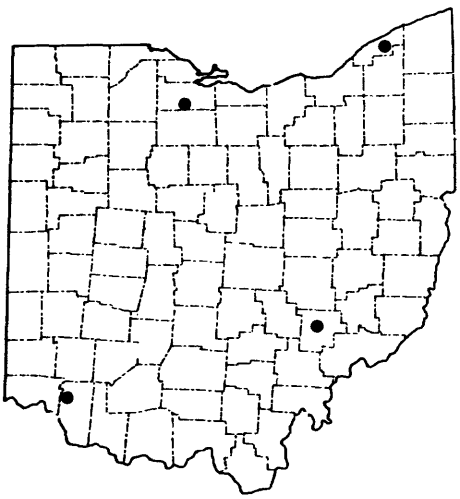
Progress and significant results: Stations operated by the U.S. Geological Survey consisted of nine NASQAN stations and one Benchmark station in the water-quality network in the 1986 water year. Four Miami Conservancy District ground-water sites also were sampled. The Geological Survey collects a water sample at the NASQAN sites for the Ohio Environmental Protection Agency for the determination of chemical oxygen demand.

SEDIMENT STATIONS
(OH004)

Period of Project:
Continuous since July 1970

Project Leader:
Jesse H. Klingler

Cooperator:
Ohio Department of Natural Resources



Purpose: To provide a data base needed to assess sedimentation characteristics of drainage areas required for planning and management of State and Federal programs. The data also are needed to evaluate effectiveness of Ohio House Bill 513, which concerns the abatement of sediment pollution in agricultural and urban situations.

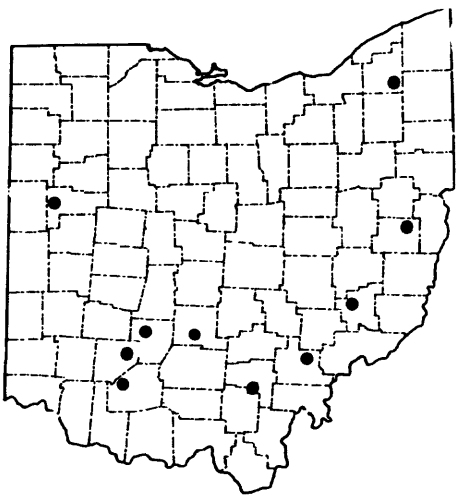
Progress and significant results: A network of four daily sediment stations representative of Ohio's major physiographic provinces is being operated to provide spatial and temporal averages of concentration, discharge, and particle-size distribution of suspended sediment carried by major streams. Suspended-sediment data also were collected from finite-duration studies in selected aricultural, mined, and urban areas. All 1986 data were collected on schedule.

FLOOD INVESTIGATIONS
(OH006)

Period of Project:
March 1984 (reestablished)
through October 1987.

Project Leader:
K. Scott Jackson

Cooperator:
Federal Emergency Management
Agency (FEMA)



Purpose: The National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973 provide for the operation of a flood insurance program. The Federal Emergency Management Agency (FEMA) needs flood studies in selected areas to determine applicable flood insurance premium rates.

The purpose of this project is to conduct the necessary hydrologic and hydraulic evaluations and studies of areas assigned by FEMA and to present the results in an appropriate format.

Progress and significant results: Work has been completed on FEMA-FIA Type 15 flood-insurance studies at Crooksville, Perry County, and London, Madison County, Ohio. Meetings were held with FEMA, State, and community officials to determine time required and costs of 10 Limited Detail Studies. FEMA has funded these 10 Limited Detail Studies, and they are now in progress. The areas to be studied are: St. Marys, Auglaize County; Darbyville, Pickaway County; Jewett, Harrison County; Amesville, Athens County; Middlefield, Geauga County; Jeffersonville, Fayette County; Belle Valley, Noble County; Sabina, Clinton County; Lynchburg, Highland County; and Hamden, Vinton County.

WATER USE IN OHIO
(OH007)

Period of Project:
Continuous since October 1977

Project Leader:
Vance E. Nichols

Cooperator:
Ohio Department of Natural Resources

Purpose: To establish an effective and coordinated program for collecting, storing, accessing, and disseminating water-use data. The data are organized to be compatible with a national data base for water use. In Ohio, there is a demonstrated need for local and statewide water-use information that is consistent with regard to definitions, standards, and methods of presentation.

Progress and significant results: A U.S. Geological Survey Fact Sheet, "Water Withdrawals by Thermoelectric Power Plants and Public Water Suppliers in Ohio, 1982," was published. Public-water-supply and commercial data were entered into the preliminary version of a State Water-Use data base.

HYDRAULICS OF RIVER VALLEYS AND BRIDGE SITES
(OH010)

Period of Project:
Continuous since June 1963

Project Leader:
G. F. Koltun

Cooperator:
Ohio Department of Transportation

Purpose: To evaluate the hydraulic effects of proposed or existing bridges and highway fills at selected locations. Such structures decrease the capacity of river valleys for conveying floodwaters, and in turn may cause backwater and excessive upstream flooding. This project also provides information to highway engineers on miscellaneous hydrologic topics related to the design or maintenance of highway properties.

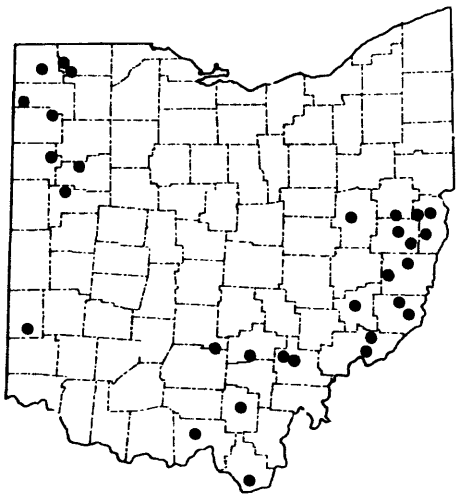
Progress and significant results: Equipment was installed to monitor the relative effectiveness of a conventional sand and gravel fill highway drainage system and a drainage mat highway drainage system. The drainage mat system responded quicker after rain events and with more peaked discharges than the conventional sand and gravel fill early in the monitoring period; however, recent results suggest that conventional drain now provides quicker, more peaked response. Bucket surveys were performed in extreme northeastern and southern Ohio as a result of heavy rains that damaged major highways.

INVESTIGATION AND ANALYSIS OF FLOODS FROM SMALL NORTHWESTERN, STRIP-MINED, AND FORESTED DRAINAGE BASINS IN OHIO (OH034)

Period of Project:
July 1977 to June 1988

Project Leader:
John W. Roberts

Cooperator:
Ohio Department of Transportation



Purpose: To determine flood characteristics for 30 small basins in reclaimed strip-mined areas, forested areas, and northwestern Ohio. Information is needed for engineering design purposes concerning the degree to which flood flows from small basins are influenced by strip-mine reclamation techniques and by forest cover. Flow models to predict peak discharge, along with an updated flood frequency report, are to be prepared which are applicable to a wider range of land-use types than previously available.

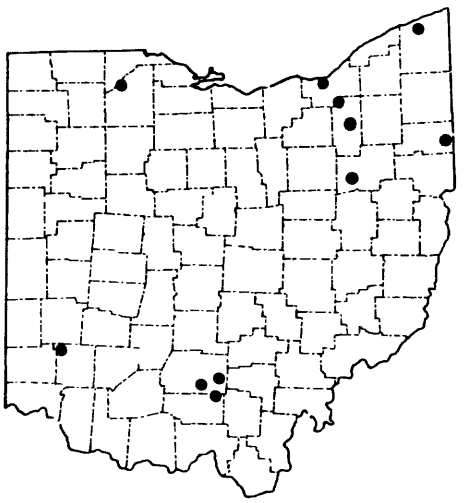
Progress and significant results: Peak-stage data and discharges for the 1986 water year were obtained for 30 crest-stage stations. Basin characteristics--predominantly percent strip-mine and percent forest--have been determined from U.S. Geological Survey 7.5-minute topographic maps for 296 stream-gaging stations. Forty-nine of these gaged basins have been disturbed by surface mining. The percentages of basin area disturbed by mining range from 0.1 to 82.9 percent.

AUTOMATIC MEASUREMENT OF TEMPERATURE, SPECIFIC CONDUCTANCE, DISSOLVED OXYGEN AND pH IN SELECTED STREAMS IN OHIO
(OH042)

Period of Project:
Continuous (re-established October 1985)

Project Leader:
Max S. Katzenbach

Cooperator:
Ohio Environmental Protection Agency



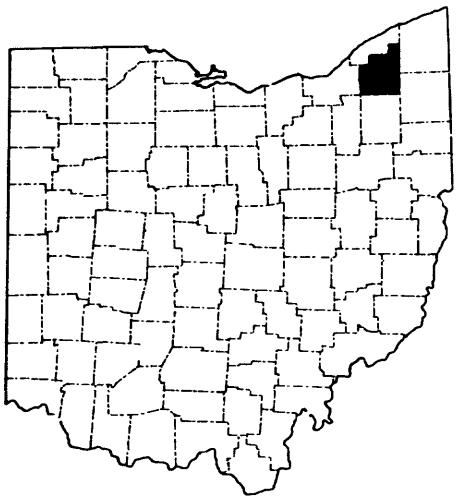
Purpose: (1) To continuously collect stream-temperature, dissolved-oxygen, specific-conductance and pH data, which will serve (either as direct or surrogate) indicators of water quality conditions in analyses conducted by the U.S. Geological Survey and State agencies to determine the impact and severity of man's influence on surface waters; and (2) provide relevant standardized data collected continously for comprehensive study by the U.S. Geological Survey and other agencies.

Progress and significant results: Data collection and processing continued at all 10 stations. This ten-station network, formerly considered part of the water-quality stations network, is now a separate project.

HYDROGEOLOGIC CONDITIONS AND AQUIFER SYSTEM RESPONSE TO INCREASED GROUND-WATER DEVELOPMENT, GEAUGA COUNTY, OHIO (OH048)

Period of Project:
July 1985 to December 1987

Project Leader:
Jeffrey T. de Roche



Purpose: Ground-water development for domestic and industrial water supplies is increasing in Geauga County. Many businesses and residences are being built in areas where the primary aquifer may not be able to produce sustained usable quantities of water. There are indications in the central and eastern parts of the county that several heavily utilized aquifers may be contaminated by brines generated by increased oil and gas production.

The objectives of the study are to: (1) Define the hydrogeology of the major aquifers; (2) determine if water levels and water quality have changed significantly since a study in 1978; (3) using computer simulation, predict what changes are likely to occur within the major aquifers; and (4) investigate possible ground-water contamination by brines from oil and gas production.

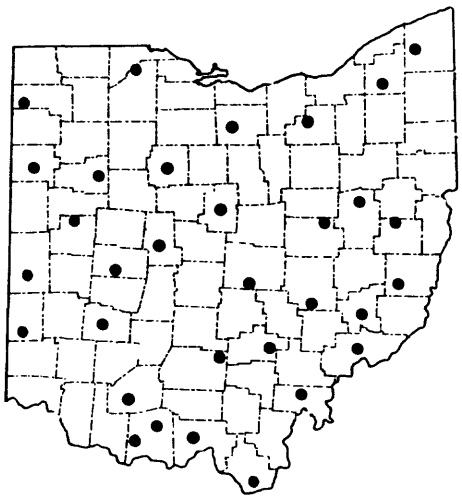
Progress and significant results: Additional geologic sections of the county have been prepared. Three rounds of routine water-level measurements were completed. Forty wells were sampled for ambient water quality. A three-dimensional ground-water flow model has been constructed.

FLOOD-VOLUME FREQUENCY FROM SMALL DRAINAGE BASINS IN OHIO (OH056)

Period of Project:
February 1981 to December 1987

Project Leader:
James M. Sherwood

Cooperator:
Ohio Department of Transportation



Purpose: To define the magnitude and frequency of flood volumes and to develop a method for deriving a design-flow hydrograph from small rural basins in Ohio. The information would be used by planners to design safe and economical hydraulic structures to convey floodflows. Complete hydrograph records for rural Ohio basins generally are lacking.

Progress and significant results: Data collection and processing continued at all 32 sites. Thirty-seven discharge measurements were made at 27 sites for theoretical rating verification. An average of 8.4 storm events per site were stored in computer files for water years 1982 and 1983. Annual peak discharges for the 1984 water year were published in the annual water-resources data report. An interim report was prepared and approved.

GLACIAL VALLEY AQUIFERS IN NORTHEASTERN OHIO
(OH066)

Period of Project:
March 1982 to September 1987

Project Leader:
Kevin J. Breen

Purpose: To obtain a better understanding and definition of the flow characteristics of a glacial aquifer west of Wooster, Ohio, as part of the Northeast Glacial Aquifers Regional Aquifer System Analysis study. Emphasis is placed on determining the contribution to pumping wells from stream infiltration and surrounding bedrock. Use will be made of stream and aquifer head relationships in combination with computer simulations of flow. Isotopic and inorganic-chemical characteristics of water also will be analyzed.

Progress and significant results: Thirteen observation wells have been installed in shallow (30 feet) and deep (60+ feet) glacial aquifers. Eleven well points driven into the channel of Killbuck Creek and Clear Creek have been added to this existing observation-well network. Stream-channel well points show groundwater heads consistently below water levels in the stream. Shallow and deep paired well points show lower heads in wells screened at deeper zones. Stream gain/loss studies show two tributary streams to Killbuck are losing 50 to 95 percent of flow during base-flow periods. Chemical characteristics of the ground water differ both areally and with respect to occurrence in shallow and deep water-yielding zones. Chemical-quality data indicate that water of the type observed in shale and sandstone bedrock is an important component in selected wells completed in the glacial aquifer.

SEDIMENTATION IN WHEELING CREEK BASIN, BELMONT COUNTY, OHIO (OH068)

Period of Project:
Continuous since July 1982

Project Leader:
G. F. Koltun

Cooperator:
Ohio Department of Natural Resources

Purpose: To assess post-dredging trends in gross channel fill or scour in and around selected reaches of Wheeling Creek.

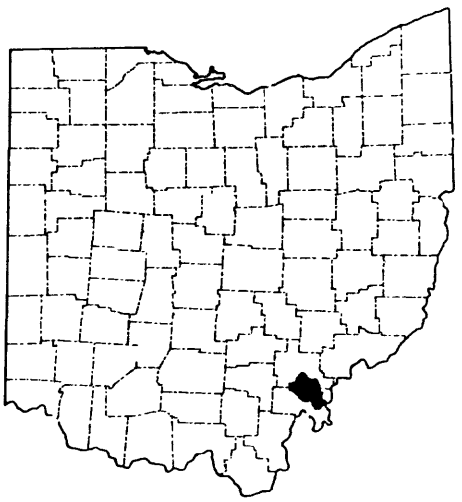
Progress and significant results: Cross-section surveys continue on Wheeling Creek. Data collected to date show some localized evidence of scour and fill, however, no generalized gross trends are evident. Daily discharge and suspended-sediment data continue to be collected at the gaging station (Wheeling Creek below Blaine, Ohio; station number 03111548).

EFFECTS OF SURFACE-MINE RECLAMATION WITHIN WEST BRANCH SHADE RIVER BASIN (OH073)

Period of Project:
February 1983 through
December 1986

Project Leader:
Carolyn J. Oblinger Childress

Cooperator:
Ohio Department of Natural Resources



Purpose: Residents and local and State officials are concerned about sedimentation and flooding in the West Branch Shade River basin in Meigs and Athens Counties. The flooding may be due in part to a loss of conveyance of the channels caused by heavy sediment deposition from abandoned surface mines. The Ohio Department of Natural Resources is reclaiming some of these mines, and data are needed to measure the effectiveness of reclamation.

The objectives of this study are to: (1) Measure changes in stream discharge and sediment concentrations at two points in the basin; (2) measure changes in water chemistry at three points in the basin; (3) measure sediment deposition and scour rates at nine typical stream cross-sections on West Branch Shade River and Kingsbury Creek; and (4) correlate discharge and sediment data from West Branch Shade River with data from part of the nearby East Branch Shade River basin, which is unaffected by mining.

Progress and significant results: Cross sections were surveyed, quarterly water-quality samples were collected, and daily sediment load and daily mean discharge were computed. From October 1984 through September 1986, suspended-sediment yield was 2 times higher in West Branch (0.51 tons/acre-foot of runoff) than East Branch (0.28 tons/acre-foot of runoff) Shade River. Preliminary analysis indicates that suspended-sediment yield from the headwaters of West Branch Shade River decreased significantly following reclamation (from 8.5 tons/acre-foot of runoff in the 1984 water year to 0.14 ton/acre-foot of runoff in the 1985 water year). In addition, acidity is higher, pH is lower, and concentrations of dissolved sulfate and metals are higher in the West Branch Shade River basin than in the East Branch Shade River basin. The first two preliminary reports have been published and a final report is in preparation.

SUMMARY OF WATER-QUALITY MONITORING ACTIVITIES IN OHIO
(OH081)

Period of Project:
September 1984 through March 1987

Project Leader:
Janet Hren

Purpose: The purpose of this study is to determine the extent to which existing water data, collected by different groups for various purposes and using different procedures, can be aggregated into a consistent data base for use in addressing selected water-quality questions of regional and national scope. Examples of such questions are:

1. What are (were) near-natural water-quality conditions?
2. What are existing water-quality conditions?
3. How has water quality changed, and how do the changes relate to human activity?

A three-phase approach was used. The objectives of these phases are:

Phase I. Identify and inventory water-quality data-collection programs, including costs, and identify those programs that meet a set of criteria for conducting broad-scope water-quality assessments.

Phase II. Evaluate the quality assurance of sampling techniques and laboratory methods used in collecting the data that meet the broad criteria of Phase I.

Phase III. Evaluate the applicability of these qualifying data for addressing selected water-quality questions of regional and national scope.

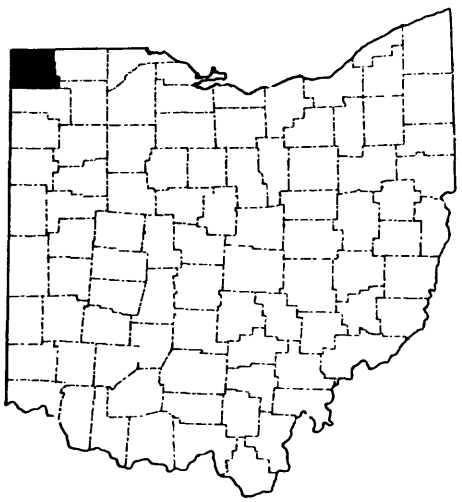
Progress and significant results: Phase I report completed and published as U.S. Geological Survey Open File Report 85-574, and also has been approved for publication as Water-Supply Paper 2295-A. The Phase II and Phase III reports are in preparation.

GROUND-WATER RESOURCES OF SHALLOW GLACIAL AQUIFERS IN WILLIAMS COUNTY, OHIO (OH082)

Period of Project:
September 1984 through
September 1987

Project Leader:
Alban W. Coen, III

Cooperator:
City of Bryan, Ohio



Purpose: Water for domestic, municipal, and industrial uses in Williams County is totally derived from ground water. A better understanding of the hydrogeologic setting is needed to protect the resource and to manage potential problems. For example, municipal ground-water pumpage has significantly lowered the water table near Bryan.

The objectives of this project are to define the availability and quality of ground water in the shallow glacial aquifers in Williams County, Ohio, by: (1) Literature and data search, (2) collecting ground-water level and quality data, (3) constructing and calibrating a quasi three-dimensional ground-water flow model, (4) using surface geophysics and well logs to define the hydrogeologic system, and (5) measuring stream gains and losses.

Progress and significant results: Water levels in 80 wells have been measured quarterly for 18 months. Most areas in the county showed 2 or 3 feet of annual fluctuation in water level. Regional ground-water flow is to the southeast, with local flow towards streams.

Water samples from 48 wells and 4 streams, including domestic, commercial, and municipal water supplies, were collected and analyzed for common dissolved constituents in April, August, and November, 1985. Preliminary results show generally good water quality.

SURFACE-WATER QUALITY OF COAL-MINE LANDS IN RACCOON CREEK BASIN, OHIO (OH083)

Period of Project:
October 1984 through June 1987

Project Leader:
Karen S. Wilson

Cooperator:
Ohio Department of Natural Resources

Purpose: The Ohio Department of Natural Resources, Division of Reclamation, is planning to reclaim many of the abandoned surface mines that are producing acid mine drainage in the Raccoon Creek basin. Water-quality conditions before reclamation needs to be defined.

The objectives of this study are to: (1) Document water quality throughout the basin, (2) determine macroinvertebrate abundance and diversity at selected points representing the entire basin, and (3) measure rates of deposition and scour in the basin as a whole.

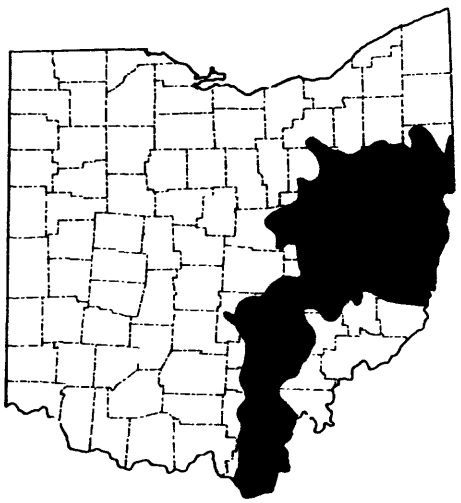
Progress and significant results: During water-year 1986, the project was suspended for a short period due to funding difficulties. Because significant reclamation was not scheduled to begin in the basin until after data collection was completed, several changes in purpose and approach were made when the project was reinstated. This project is now scheduled to be suspended in June 1987 and restarted in July 1988. All five gaging stations were discontinued and removed. Water-quality data collection was completed quarterly at 17 sites, and macroinvertebrate data were collected twice at the same 17 sites.

QUALITY OF SURFACE WATER AND GROUND WATER IN ACTIVE COAL MINING AREAS OF OHIO
(OH084)

Period of Project:
July 1985 to October 1992

Project Leader:
Allison Jones

Cooperator:
Ohio Department of Natural Resources-Division of Reclamation



Purpose: The Ohio Department of Natural Resources needs baseline ground-water and surface-water quality data in the active coal mining areas of Ohio. This data will be used for surface mining permit application and compliance as well as to assess the impact of present and future mining and reclamation. Twenty basins in southeastern Ohio will be investigated and monitored during a 7-year period.

Progress and significant results: The following basins have been intensely investigated:

Stillwater Creek
Symmes/Ice/Indian Guyan Creeks
Moxahala Creek
Little Beaver Creek
McMahon/Captina/Sunfish Creeks.

A basin which has been intensely investigated includes the collection of ten additional surface-water samples, four ground-water samples, and the definition of the approximate location and extent of a productive shallow aquifer in the basin.

A network of 40 long-term surface-water sites (sampled twice yearly) is also distributed throughout the study area.

NORTHWESTERN OHIO GROUND WATER
(OH085)

Period of Project:
October 1985 through July 1988

Project Leader:
Kevin J. Breen

Cooperators:
Wood County
Lucas County
Sandusky County

Purpose: The County planners and health officials of Lucas, Sandusky, and Wood Counties, in northwestern Ohio, are faced with increasing concerns relating to contamination and use of their ground-water resources. A regional ground-water network needs to be established to inventory in detail the location of wells and to provide geohydrologic data, aquifer-head data, and ground-water-quality baseline information.

The objective of this study is to assess the ground-water resources of Lucas, Wood, and Sandusky counties, and to (1) describe the hydrogeologic framework of the regional Silurian- and Devonian-age bedrock carbonate aquifer; (2) describe the hydrogeologic framework of selected Pleistocene-age surficial aquifers; (3) define the direction of ground-water movement; (4) develop a regional ground-water-quality baseline, using historic data and proposed data collection; and (5) compare the quality of water from selected springs and quarry seeps with ground water from wells near these sites.

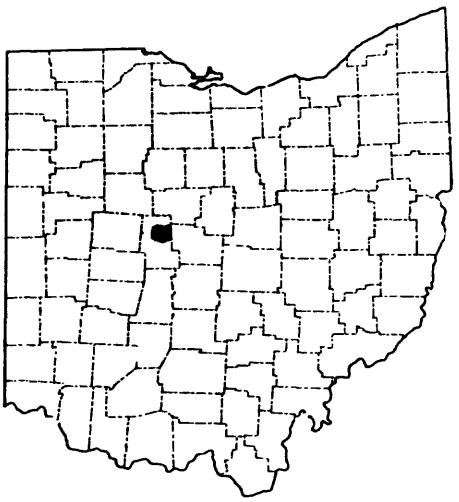
Progress and significant results: A network of 350 wells has been established to monitor water levels in the Silurian-Devonian carbonate (dolomite) aquifer. Seventeen wells have been located or installed as part of the water-level and water-quality network in the sandhills region of Lucas County.

GROUND-WATER MOVEMENT AND QUALITY IN NORTHEAST UNION COUNTY, OHIO
UNION COUNTY
(OH086)

Period of Project:
July 1985 through December 1986

Project Leader:
Karen S. Wilson

Cooperators: City of Richwood



Purpose: The people of northeastern Union County and the City of Richwood are concerned about the quality of their water supply, which has had elevated ammonia and nitrite concentrations for several years. A description and definition of the ground-water hydrology and water quality would provide backgrouond information needed to evaluate the susceptibility of present and future water supplies to ground-water contamination.

The objective of this study is to describe the ground-water hydrology and water quality of northeastern Union County by determining (1) the flow directions and seasonal ground-water fluctuations, and (2) time and areal variations in the quality of the ground water.

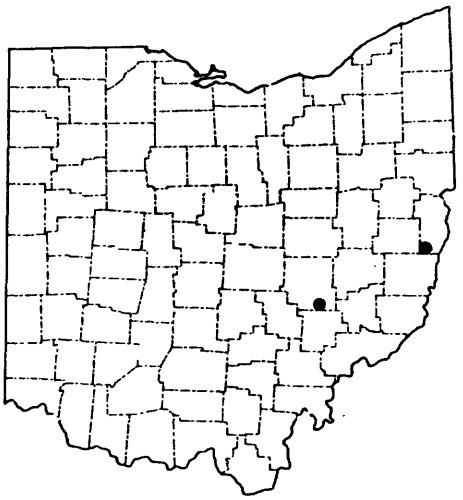
Progress and significant results: Quarterly water-level measurements were completed, and groundwater was determined to be in an easterly direction. Fourteen wells and Richwood Lake were sampled twice for chemical quality. No presence of organic chemicals or pesticides were found. Several well elevations were surveyed and a seepage measurement on Fulton Creek was conducted. All data-collection tasks were completed.

GROUND WATER AND SURFACE-MINE RECLAMATION (OH087)

Period of Project:
September 1985 through
September 1989

Project Leader:
Rick L. Jones

Cooperators:
U.S. Office of Surface Mining



Problem: Long term impacts of surface coal mining on groundwater quality and quantity are poorly defined. Resaturation rates, recharge capacity, conductivity, storage, quality, and movement are a few of the hydrologic conditions not completely understood.

The objectives of this study are to (1) describe occurrence of ground water in and beneath the overburden soils of the reclaimed area, (2) describe rates of resaturation, and (3) evaluate chemical changes in the water quality.

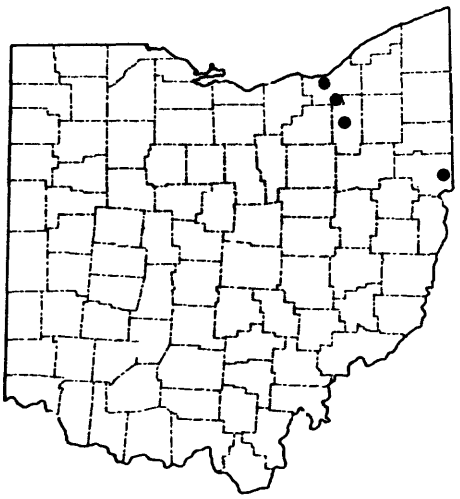
Watersheds will be visited bimonthly for water-level measurements. Water quality samples will be taken from four wells semiannually and from stream and seeps annually. Variations of chemical composition will be identified by the use of Stiff and Piper diagrams.

Progress and significant results: Water levels and water-quality samples have been completed for 1986. No significant results have been noted to date.

TECHNIQUES FOR OPERATING IN SITU WATER-QUALITY MONITOR STATIONS (OH089)

Period of Project:
October 1985 through March 1987

Project Leader:
Max S. Katzenbach



Problem: There are questions to be answered regarding the use of a "packaged-sensor" type of in situ water-quality monitor as opposed to the U.S. Geological Survey's minimonitor: (1) How reliable is each system under field conditions; (2) what is the cost of operation and maintenance of each system; and (3) how do the data from each system compare with the standard flow-through monitors.

The objective of this study is to evaluate the technicalities and economics of operating these two monitor systems. In situ monitors with packaged sensors and minimonitors have been installed at four flow-through monitor sites to analyze (1) the possible reduction in costly field time required to service monitor stations and (2) increased reliability of monitor stations and their records.

Progress and significant results: Data were collected for one year and stored in computer files. Sites were visited every 2 weeks and data verified by making field measurements. Preliminary indications are that packaged-sensor systems would be cheaper to operate and just as reliable as the minimonitors.

SURFACE-WATER STATIONS FOR WHICH RECORDS ARE PUBLISHED

The tables in this section list hydrologic data stations for which daily records have been published by the U.S. Geological Survey in 1986. Surface-water stations are numbered and listed in downstream order along the main stem. A station on a tributary entering between two main-stem stations is listed between them. A similar order is followed in listing stations on first rank, second rank, and other ranks of tributaries. This downstream order numbering system is a permanent system of numerical designations adopted by the Survey in 1950.

Surface-water stations for which daily data are collected are classified as: Discharge, stage only, sediment, continuous-record water quality, and reservoir or lake contents and (or) elevation. Daily discharge and stage-only stations are sites instrumented to provide a continuous stage record. For daily discharge stations, calculations of mean daily discharge, peak flows during floods, and total monthly and yearly runoff are made by applying stage data to a stage-discharge rating curve derived from actual discharge measurements.

Pool-elevation data collected at reservoir or lake stations are used to determine periodic changes in the amount of water held in storage. Continuous-record water-quality stations are sites equipped to record one or more physical or chemical characteristics. The record is used to determine maximum and minimum daily values. For daily sediment stations, samples collected daily are analyzed for their suspended-sediment concentrations to develop a curve from which daily mean concentrations are determined. Suspended-sediment discharges are computed by multiplying water discharge times concentration times a conversion factor.

In addition to the daily stations listed, data are collected at many sites where daily stations are not feasible. At these "partial-record stations," data are collected at regular intervals ranging from once to several times annually. Types of data collected include peak discharge, low-flow discharge, chemical quality, sediment, and biologic. Information about locations of partial-record stations and types of data collected is available upon request.

SURFACE-WATER STATIONS FOR WHICH RECORDS ARE PUBLISHED

[Letter after station name designates type of data: (B) biological, (C) chemical, (D) discharge, (E) contents and (or) elevation, (M) microbiological, (NASQAN) National stream-quality accounting network, (R) radiochemical, (S) sediment, and (T) temperature]

Station number	Station	Type of data
	OHIO RIVER BASIN	
	Ohio River:	
	BEAVER RIVER BASIN	
03086500	Mahoning R (head of Beaver R) at Alliance	D
03090500	Mahoning R bl Berlin Dam, nr Berlin Center	D
03091500	Mahoning R at Pricetown	D
03092000	Kale C nr Pricetown	D
03092090	W B Mahoning R nr Ravenna	D
03092460	W B Mahoning R bl M. J. Kirwan Dam, at Wayland	D
03093000	Eagle C at Phalanx Station	D
03094000	Mahoning R at Leavittsburg	D
	Mosquito Creek:	
03095500	Mosquito C bl Mosquito C Dam, nr Cortland	D
03099500	Mahoning R at Lowellville	D
03099510	Mahoning R at Oh-Pa State line bl Lowellville	CT
	Shenago River:	
03102950	Pymatuning C at Kinsman	D
	LITTLE BEAVER CREEK BASIN	
	North Fork L Beaver Creek:	
03109500	L Beaver C nr East Liverpool	D
	YELLOW CREEK BASIN	
03110000	Yellow C nr Hammondsville	D
	SHORT CREEK BASIN	
	Short Creek:	
03111500	Short C nr Dillonvale	D
	WHEELING CREEK BASIN	
	Wheeling Creek:	
03111548	Wheeling C bl Blaine	DS
	CAPTINA CREEK BASIN	
03114000	Captina C at Armstrong Mills	D
	MUSKINGUM RIVER BASIN	
	Tuscarawas R (head of Muskingum R):	
03117000	Tuscarawas R at Massillon	D
03117100	Tuscarawas R at Navarre	CT
03117500	Sandy C at Waynesburg	D
03118000	M B Nimishillen C (head of Nimishillen Creek) at Canton	D
03118500	Nimishillen C at North Industry	D

SURFACE-WATER STATIONS--Continued

Station number	Station	Type of data
	McGuire Creek:	
03120500	McGuire C bl Leesville Dam, nr Leesville	D
03122500	Tuscarawas R bl Dover Dam, nr Dover	D
03124000	Sugar Creek bl Beach City Dam, nr Beach City	D
03124500	Sugar Creek at Strasburg	D
	Stillwater Creek:	
03126000	Stillwater C at Piedmont	D
03127000	Stillwater C at Tippecanoe	D
03127500	Stillwater C at Uhrichsville	D
	Clear Fork (head of L Stillwater Creek):	
03128500	L Stillwater C bl Tappan Dam, at Tappan	D
03129000	Tuscarawas R at Newcomerstown	D
03130000	Black F (head of Walhonding River) bl Charles Mill Dam, nr Mifflin	D
03131500	Black F at Loudonville	D
03133500	Clear F bl Pleasant Hill Dam nr Perrysville	D
	Mohican R (continuation of Black Fork):	
	Lake Fork:	
03135000	L F bl Mohicanville Dam, nr Mohicanville	D
03136500	Kokosing R nr Mount Vernon	D
03138500	Walhonding R (continuation of Mohican R) bl Mohawk Dam, at Nellie	D
03139000	Killbuck C at Killbuck	D
03140000	Mill C nr Coshocton	D
03140500	Muskingum R (continuation of Tuscarawas R) nr Coshocton	D
	Wills Creek:	
	Seneca Fork:	
03141500	Seneca F bl Senecaville Dam, nr Senecaville	D
03142000	Wills C at Cambridge	D
03143500	Wills C bl Wills C Dam, at Wills Creek	D
03144000	Wakatomika C nr Frazeysburg	D
	Licking River	
03145000	S F Licking R (head of Licking River) nr Hebron	D
03146500	Licking R nr Newark	D
03147500	Licking R bl Dillon Dam, nr Dillon Falls	D
03150000	Muskingum R at McConnelsville (NASQAN)	DCBMS
03142290	Muskingum River basin, Salt Fork Re	E
	HOCKING RIVER BASIN	
	Hocking River:	
03157000	Clear C nr Rockbridge	D
03157500	Hocking River at Enterprise	D
03159510	Hocking River bl Athens (NASQAN)	DCBS

SURFACE-WATER STATIONS--Continued

Station number	Station	Type of data
	SHADE RIVER BASIN	
03159540	Shade R nr Chester	D
	RACCOON CREEK BASIN	
	Raccoon Creek:	
	SCIOTO RIVER BASIN	
03219500	Scioto R nr Prospect	D
03219590	Bokes C nr Warrensburg	D
03220000	Mill C nr Bellepoint	D
03221000	Scioto R bl O'Shaughnessy Dam nr Dublin	D
	Olentangy River:	
03223000	Olentangy R at Claridon	D
03225500	Olentangy R nr Delaware	D
03227500	Scioto R at Columbus	D
03228500	Big Walnut C at Central College	D
03228805	Alum C at Africa	D
03229000	Alum C at Columbus	D
03229500	Big Walnut C at Rees	D
03230500	Big Darby C at Darbyville	D
03230900	Deer C nr Pancoastburg	D
03231000	Deer C at Williamsport	D
03231500	Scioto R at Chillicothe	DCT
	Paint Creek:	
03232470	Paint C bl Paint C Dam nr Bainbridge	D
	Rocky Fork:	
03232500	Rocky F nr Barretts Mills	D
03234000	Paint C nr Bourneville	D
03234300	Paint C at Chillicothe	DCT
03234500	Scioto R at Higby (NASQAN)	DCBMTS
	Reservoirs in Scioto R basin	E
	UPPER TWIN CREEK BASIN	
03237280	Upper Twin C at McGaw (HBM)	DCMSRT
	OHIO BRUSH CREEK BASIN	
03237500	Ohio Brush C nr West Union	D
	WHITEOAK CREEK BASIN	
03238500	Whiteoak C nr Georgetown	D
	LITTLE MIAMI RIVER BASIN	
03240000	L Miami R nr Oldtown	D
03241500	Massies C at Wilberforce	D
03245500	L Miami R at Milford (NASQAN)	DCBMTS
03247050	E F L Miami R nr Batavia	D
03247500	E F L Miami R at Perintown	D
	MIAMI CREEK BASIN	
03255500	Mill C at Reading	D
03259000	Mill C at Carthage	D

Station number	Station	Type of data
	GREAT MIAMI RIVER BASIN	
	G Miami River:	
03260700	Bokengehalas C nr De Graff	D
03261500	G Miami R at Sidney	D
03261950	Loramie C nr Newport	D
03262000	Loramie C at Lockington	D
03262700	G Miami R at Troy	D
03263000	G Miami R at Taylorsville	D
	Stillwater River:	
03264000	Greenville C nr Bradford	D
03265000	Stillwater R at Pleasant Hill	D
03266000	Stillwater R at Englewood	D
03267000	Mad R nr Urbana	D
03267900	Mad R (at St. Paris Pike) at Eagle City	D
03269500	Mad R nr Springfield	D
03270000	Mad R nr Dayton	D
03270500	G Miami R at Dayton	D
03270800	Wolf C at Trotwood	D
03271500	G Miami R at Miamisburg	D
03271510	G Miami R nr Linden Ave at Miamisburg	CT
03271800	Twin C nr Ingomar	D
03272000	Twin C nr Germantown	D
	Sevenmile Creek:	
03272700	Sevenmile C at Camden	D
03274000	G Miami at Hamilton	D
03274600	G Miami R at New Baltimore (NASQAN)	CBMTS
	ST LAWRENCE RIVER BASIN	
	(STREAMS TRIBUTARY TO LAKE ERIE)	
04177000	Ottawa R at Toledo University	D
04185000	Tiffin R at Stryker	D
04185440	Lost C nr Farmer	D
04186500	Auglaize R nr Ft Jennings	D
04189000	Blanchard R nr Findlay	D
04191500	Auglaize R nr Defiance	D
04192500	Maumee R near Defiance	D
04193490	Maumee R nr Waterville	CT
04193500	Maumee R at Waterville (NASQAN)	DCBMT
04194107	Lake Erie at Reno Beach	E
04195500	Portage R at Woodville	D
04196800	Tymochtee C at Crawford	D
04197020	Honey C nr New Washington	D
04197100	Honey C at Melmore	D

SURFACE-WATER STATIONS--Continued

Station number	Station	Type of data
04197170	Rock C at Tiffin	D
04198000	Sandusky R near Fremont (NASQAN)	DCMBTS
04199160	Old Woman's C ab U.S. 6 nr Huron	E
04199165	Old Woman's C at U.S. 6 nr Huron	E
04199170	Lake Erie at Huron	E
04200500	Black R at Elyria	D
04201500	Rocky R nr Berea	D
04202000	Cuyahoga R at Hiram Rapids	D
04206000	Cuyahoga R at Old Portage	D
04207200	Tinkers C at Bedford	D
04208000	Cuyahoga R at Independence (NASQAN)	DCBMTS
04208502	Big C at Cleveland	D
04208506	Cuyahoga R at W 3rd St bridge in Cleveland	CT
04212100	Grand R nr Painesville	DS
04212200	Grand R at Painesville (NASQAN)	CMBTS
04212680	Fields Brook at Ashtabula	CT
04213000	Conneaut C at Conneaut	D

STANDARD ABBREVIATIONS USED IN STATION NAMES

ab	above	e	east	nr	near
b	branch	f	fork	r	river
bk	brook	g	great	re	reservoir
bl	below	l	little	rn	run
c	creek	lk	lake	s	south
ca	canal	m	middle	tr	tributary
d	ditch	n	north	w	west

GROUND-WATER STATIONS FOR WHICH RECORDS ARE PUBLISHED

The following table lists the ground-water stations in Ohio for which the U.S. Geological Survey is publishing data in 1986. The first six digits of the well numbers denote degrees, minutes, and seconds of latitude, and the next seven digits denote degrees, minutes, and seconds of longitude. The last two digits are used, if needed, for sequential numbering within a 1-second grid.

In addition to the sites listed, data on water levels, yield, and chemical quality of ground water have been collected at many other locations in Ohio. Information about these miscellaneous measurements is available upon request.

GROUND-WATER STATIONS FOR WHICH RECORDS ARE PUBLISHED

[Letter after station location designates type of data:
c chemical; l, water level.]

Well number	Local number	Location
		ASHLAND COUNTY
405303082170700	AS-2	Ashland (l)
405425082173000	AS-3	Jerome Fork (l)
		ATHENS COUNTY
392004082071600	AT-2A	Athens (l)
392009082072200	AT-5	Athens (l)
		AUGLAIZE COUNTY
403233083574500	AU-3	Southwest of New Hampshire (l)
		BELMONT COUNTY
400118081082200	B-3	Mount Olivett (l)
		BUTLER COUNTY
391805084261800	BU-9	Northwest of Sharonville (l)
393202084241500	BU-15	Middletown (l)
391904084371800	BU-12	East of Ross (l)
392017084345200	BU-7	Fairfield (l)
392021084340300	BU-56	Fairfield (l)
392048084311400	BU-8	East of Hamilton (l)
392445084333000	BU-36	Hamilton (c)
392515084322000	BU-5	North of Hamilton (l)
392733084293000	BU-16	Southwest of Trenton (l)
392939084231700	BU-3	Middletown (l)
393103084240900	BU-2	Middletown (l)
		CARROLL COUNTY
403709081052800	C-1	North of Carrollton (l)
		CHAMPAIGN COUNTY
400638083453900	CH-3	Urbana (l)
		CLARK COUNTY
395639084012200	CL-9	New Carlisle (l)
395840083495200	CL-7	Northwest of Springfield (l)

GROUND-WATER STATIONS--Continued

Well number	Local number	Location
		COSHOCTON COUNTY
401256081525100	CS-3	North of Conesville (1)
		CRAWFORD COUNTY
404838082563100	CR-1	Bucyrus (1)
		DARKE COUNTY
400514084345700	D-2	East of Greenville (1)
		DELAWARE COUNTY
402126083040400	DL-3	Delaware (1)
		FAIRFIELD COUNTY
394257082362900	F-6	Lancaster (1)
394544082271000	F-1	West Rushville (1)
395053082361900	F-5	Baltimore (1)
		FAYETTE COUNTY
393153083322000	FA-1	West of Washington Court House (1)
		FRANKLIN COUNTY
394956083002700	FR-18	Shadeville (1)
395118083573300	FR-3	Southwest of Rees (1)
395157083003500	FR-109	Columbus (1)
400101083021800	FR-10	Columbus (1)
		GALLIA COUNTY
383638082103300	G-2	East of Crown City (1)
		GEAUGA COUNTY
412518081221500	GE-3A	Southeast of Chagrin Falls (1)
		GREENE COUNTY
394411083561300	GR-1	North of Xenia (1)
394425083551100	GR-10	North of Xenia (1)

GROUND-WATER STATIONS--Continued

Well number	Local number	Location
		HAMILTON COUNTY
391039084291500	H-11	Cincinnati (1)
391101084172100	H-3	Southeast of Miamiville (1)
391201084281600	H-10	Cincinnati (1)
391214084470100	H-1	Southeast of Harrison (1)
391324084272500	H-9	Cincinnati (1)
391341084275300	H-8	Wyoming (1)
391442084262900	H-7	Evendale (1)
391608084254400	H-6	Glendale (1)
391733084392400	H-2	South of Ross (1)
391748084393800	H-19	Southwest of Venice (c)
391817084393300	H-4	Southwest of Ross (1)
		HARDIN COUNTY
404218083503700	HN-1	Alger (1)
404648083412600	HN-2A	Southeast of Dola (1)
		HENRY COUNTY
412123083574000	HY-2	Southwest of McClure (1)
		HOCKING COUNTY
393200082235300	HK-1	Logan (1)
		KNOX COUNTY
402344082300700	K-1	Mt. Vernon (1)
		LUCAS COUNTY
413704083362200	LU-1	Toledo (1)
		MADISON COUNTY
395301083272200	M-2	London (1)
395357083304400	M-4	Northwest of London (1)
395740083255700	M-3	North of London (1)
		MAHONING COUNTY
410042080453800	MA-1	Canfield (1)
		MARION COUNTY
403413083170500	MN-4	Southeast of New Bloomington (1)
403443083230400	MN-1	LaRue (1)
403601083110400	MN-2	West of Marion (1)

GROUND-WATER STATIONS--Continued

Well number	Local number	Location
		MEDINA COUNTY
410120081431800	MD-3	Wadsworth (1)
410142082005900	MD-1	Lodi (1)
		MERCER COUNTY
402833084375200	MR-2	Coldwater (1)
		MIAMI COUNTY
395848084085500	MI-3	Northeast of Tipp City (1)
400208084112900	MI-44	Troy (c)
		MONTGOMERY COUNTY
393757084173600	MT-928	Miamisburg (c)
394012084151700	MT-55	West Carrollton (1)
394025084162800	MT-49	West Carrollton (1)
394425084113200	MT-3	Dayton (1c)
394533084113800	MT-6	Dayton (1)
		MUSKINGUM COUNTY
395804081593200	MU-1A	Zanesville (1)
		PICKAWAY COUNTY
393327082571600	PK-7	South of Circleville (1)
393402082572500	PK-4	South of Circleville (1)
393638082572300	PK-6	Northwest of Circleville (1)
393438083072200	PK-8	Williamsport (1)
		PIKE COUNTY
390359083015100	PI-2	West of Piketon (1)
		PORTAGE COUNTY
411401081025000	PO-1	Windham (1)
410540081213600	PO-7	Brimfield (1)
410920081192000	PO-6	East of Kent (1)
		PREBLE COUNTY
394438084335900	PR-2	East of Eaton (1)

GROUND-WATER STATIONS--Continued

Well number	Local number	Location
		PUTNAM COUNTY
405505084032900	PU-1	Columbus Grove (1)
		RICHLAND COUNTY
404625082305100	R-4	Mansfield (1)
405753082360800	R-3	Shiloh (1)
		ROSS COUNTY
391341083172200	RO-7	West of Bainbridge (1)
391913082580500	RO-8	Chillicothe (1)
		SANDUSKY COUNTY
411914083045300	S-3	Fremont (1)
412703083213600	S-2	Woodville (1)
		SENECA COUNTY
410802083093900	SE-2	Tiffin (1)
		SHELBY COUNTY
401712084103500	SH-4	Sidney (1)
		STARK COUNTY
404939081203800	ST-5A	Canton (1)
405051081244200	ST-28	Northwest of Canton (1)
405211081253500	ST-27	North Canton (1)
		SUMMIT COUNTY
410141081315200	SU-4A	Akron (1)
410330081282000	SU-6	Akron (1)
410846081271600	SU-7	Cuyahoga Falls (1)
		TRUMBULL COUNTY
411604080505600	T-3	Near Warren (1)
		TUSCARAWAS COUNTY
403207081293800	TU-3	Dover (1)
403557081313600	TU-4	Strasburg (1)
403653081321800	TU-1	North of Strasburg (1)
403823081324200	TU-5	Near Strasburg (1)

GROUND-WATER STATIONS--Continued

Well number	Local number	Location
		UNION COUNTY
401826083255200	U-4	Southeast of Raymond (1)
		VAN WERT COUNTY
405215084335400	VW-1	Van Wert (1)
		VINTON COUNTY
391452082282900	V-1	McArthur (1)
		WARREN COUNTY
392712084191700	W-5	East of Monroe (1)
		WASHINGTON COUNTY
392553081281600	WA-2	Marietta (1)
		WAYNE COUNTY
404655081553200	WN-3	Near Wooster (1)
404802081583100	WN-2A	Near Wooster (1)
405745081510200	WN-7	Near Sterling (1)
405805081462300	WN-6	Rittman (1)
		WILLIAMS COUNTY
412821084313600	WM-1	Near Bryan (1)
412930084320900	WM-3	Bryan (1)
413108084415300	WM-12	East of Blakeslee (1)
		WYANDOT COUNTY
405009083172600	WY-1	Upper Sandusky (1)

SELECTED REFERENCES ON OHIO HYDROLOGY

Selected references on water resources in Ohio are listed below; many of them are available for inspection at the Ohio District office and at large public and university libraries. The publications are grouped as follows: (1) U.S. Geological Survey publications; (2) reports prepared by the Geological Survey in cooperation with specific agencies and which can be obtained from the cooperating agencies; and (3) other publications, such as contributions to technical journals.

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